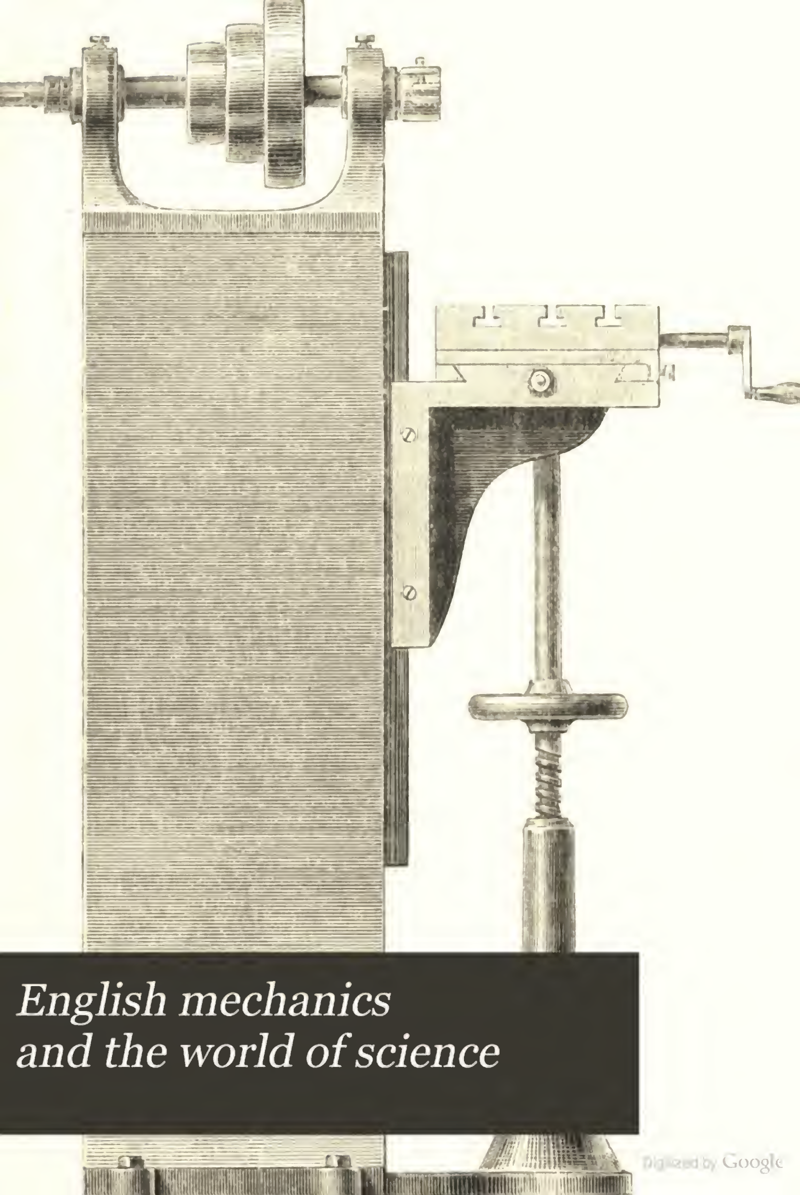

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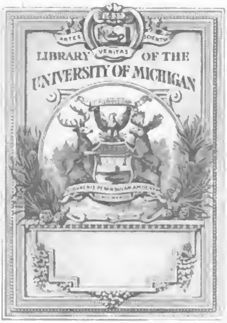

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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

THE COMING TRANSIT OF VENUS.

By "A Fellow of the Royal Astronomical Society."

IN compliance with a request which has been made in these columns, I propose to attempt such an explanation of the approaching Transit of Venus, as may enable any moderately well-educated person to read intelligently the accounts and notices of it which have appeared, and will continue to appear, from time to time in the public press. In doing this, however, I am sensible that I have not a very easy task before me. The determination of what is technically called the Solar parallax (whence the distance of the Earth from the Sun is found in statute miles) is essentially a mathematical problem, and one, moreover, of very considerable complexity. I trust, however, that by proceeding step by step, and passing gradually from the most elementary considerations to others of a less rudimentary character, I may succeed in rendering the principles, at all events, upon which the observations will be made and utilised intelligible to every reader who will give me his careful attention. Into the minutiæ of reductions and corrections it would be wholly foreign to my purpose to enter here. I shall have quite fulfilled my self-imposed task if the student rises from the perusal of this Essay with a clear notion of the way in which it is hoped to determine our exact distance from the Sun by observing the passage of Venus across his face on the 6th of next December, and generally of the nature of the method by which the observations will be utilised. In what follows I shall make no reference to what is called the method of durations—or that of Halley—for three reasons. The first is that it is the one described in nearly all popular books on Astronomy; the next, that I myself wrote an article on it, in anticipation of the Transit of 1874, on pp. 316, *et seq.* of your Xth Volume; and the third (and, as far as we are concerned, by far the most important) that Halley's method will be inapplicable, and, as a matter of fact, will not be employed at all, in the observation of the coming Transit. What, then, I propose to describe is the method suggested at the beginning of the last century by Delisle, the French astronomer, in anticipation of the Transit of 1761, inasmuch as it is on the principle devised by him that the approaching eye observations will all be made. I say "eye observations," because there will possibly also be photographs taken on the system employed in 1874 by the American observers and the present Earl of Crawford. It is a very stale story that the British Photographing results were utterly worthless; and therefore, the method of photographing the Transit forced upon our own Government on that occasion will assuredly never be used again, and, in fact, scarcely even deserves the passing mention I have given it.

FIG. 1.

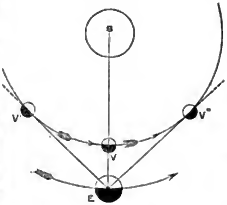
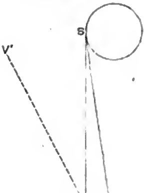
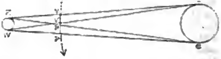


FIG. 2.



First and foremost, what do we mean by Parallax? Well, simply the angular displacement of any object, as viewed from two stations separated by an appreciable interval. If the reader will look out of window at a house, or tree, and note what part of it is cut by one of the vertical window-bars; and will then move his head a foot or two to the right, he will note that the bar will seem to be shifted to the left on the landscape by a corresponding quantity. Such shifting is the parallactic displacement of the window-bar. Now, what we want to find out is, the exact angle by which the planet Venus is displaced upon the Sun's disc, on the very rare occasions when she crosses it, by being viewed from stations widely separated upon the Earth's surface, because, knowing as we do, with very great accuracy, the precise figure and dimensions of the Earth, we can calculate, with the greatest nicety, the distance between any two given points on its surface; and so, in a way to be explained further on, turn our angular measurements into linear ones. Let us see what data we have to aid us in this research. In limine, we know, and have known for some hundreds of years, the *proportional* distance of the various bodies in the Solar System from the Sun. In the case of Venus, revolving as she does in an orbit between us and the Sun, her relative distance may be determined at once in one of two ways. Of course, travelling round the Sun in the same direction that we are doing, she must move across the heavens from right to left in that part of her orbit which is behind the Sun, and from left to right as she passes between us and him. If, then, we measure accurately her angular distance from the Sun when she is at her greatest elongations east and west of him, we may describe a circle, having the Sun for its centre, with its circumference touching the line drawn from the Earth to Venus at such points, and this circle will represent the orbit of Venus to scale. To simplify this, I here reproduce a figure from my article in Vol. X, previously referred to.

FIG. 3.



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A glance at this will show that if we measure the angle V'ES, when Venus is at her greatest Eastern elongation; and, again, the angle V''ES when she attains her greatest Western elongation, and lay down the angle V'EV'' on a piece of paper, we have nothing to do but to strike a circle with a pair of compasses, just touching the lines V'E, V''E, to represent Venus's orbit accurately. We then measure the distance from E to V, and from V to the centre S of our circle, and it will be seen at once that EV will bear precisely the same proportion to VS that the distance of the Earth from Venus, when the latter is in inferior conjunction, does to the distance of Venus from the Sun's centre. In practice we should calculate instead of plotting this; but the principle is the same. Or we may avail ourselves of Kepler's well-known law: that the squares of the Planets' periodic times are as the cubes of their mean distances from the Sun. We can, of course, observe with the utmost accuracy the times occupied by Venus and the Earth respectively in going completely round the Sun; or, in other words, describing their respective orbits. So we may say, Earth's period^2: Venus' period^2 : : Earth's mean distance^3 : Venus' mean distance^3; the solution of which involves the performance of a common rule-of-three sum and the extraction of a cube root. Now, whichever of these methods we adopt, we shall find that if we divide the distance of the Earth from the Sun into 1,000 parts, the distance from Venus to the Sun will be 723 of these parts, and, of course, the distance from Venus at inferior conjunction to the Earth 277 of them. Reverting to the figure above, S V = 723 and E V = 277. Note particularly that this proportion obtains, whatever may be the length in miles, yards, feet, or inches, of the lines S V and V E. Further, as I have said above, we are in possession of the most refined and complete measures of the Earth's dimensions and knowledge of her figure; and, lastly, we know with very great accuracy, the rate of motion of Venus in her orbit: the Sun and she approaching when she is in inferior conjunction approximately at the rate of $4''$ in a minute of time. We know, too, although this only affects our solution of the problem indirectly, that the plane of Venus's orbit is inclined about $3^\circ 24'$ to the plane of the Ecliptic, so that, in the first place, it is only when the planet is in or near one of her nodes (or points where her orbit cuts the Ecliptic) that a Transit can occur at all; and, in the next place, that her path across the Sun must be a *slanting* one, sloping upwards, when the Transit happens near her ascending node, and downwards when it occurs near her descending node. She passes through her ascending node, I may here note, on or about December 7th, and through her descending node about June 6th, her days of crossing advancing something like one day in every hundred years. Very well, then, furnished with these preliminary data, let us first, in the most simple way of approaching the problem, suppose that the Sun and Venus are both apparently moving in the Celestial equator, and that observations of, let us say, ingress, are made at two widely-separated Stations on the terrestrial equator. Fig. 2 is intended to illustrate such a condition of things as I am supposing.

Let E W be the two stations on the Equator, S the Sun's disc, and V that of Venus. Now, the observer who is watching the Transit from E, will see Venus just wholly inside the Sun's disc, while to the man at W her limb (were it visible) would seem to be separated from that of the Sun by the angle V' W S. This observer at E will determine, with all the accuracy he can, the exact hour, minute, and second of local time at which this phase occurs. By-and-by, though, the observer at W will perceive internal contact; and he, as in the previous case, will note, with all possible accuracy, the local instant at his station at which it happens. The longitudes of the two stations E and W being known with certainty, these times can be at once converted into the corresponding ones at Greenwich; and hence, the time occupied by Venus in describing the angle V W S becomes known. Hence, by the most rudimentary trigonometry, sin. V W S : sin. V S W : : V S (723) : VE (277). Hence, the angle E S W is known. But E S W is the angle subtended at the Sun's distance by a straight line joining the points E W; whence the distance E S is determined at once. E is a station at which Accelerated Ingress is said technically to occur. W, one from which Retarded Ingress is observable. Mutatis mutandis, it will be seen that this applies equally to egress. Or, I may put this in another way, without the introduction of trigonometry at all.

Let S (Fig. 3) represent the Sun; E W, two points at the extremity of the Earth's equatorial diameter; and V V' Venus overtaking the Earth, and crossing the Sun's face by the excess of her motion over ours. Then, as before, when she is at V, the observer at E will see her entering on the Sun's disc at *i*; whereas the planet must arrive at V' in her orbit ere the watcher at W perceives her appulse to the Sun. Then (Euclid VI. 4) Ei : Vi : : E W : V V'. E W is, however, about 7,926 miles, so we may say 1,000 : 723 : : 7,926 : what we shall find to be 5,730·5 miles. As before, we know exactly how long Venus takes to travel this distance, and as we know perfectly the precise time she occupies in describing her entire orbit, we discover what portion of that orbit the distance V V' forms, and hence find its circumference in miles, and the radius of that circumference. Finally, we say, as 723 : 1,000 : : number of miles in the radius of the orbit of Venus : number of miles in the radius of the orbit of the Earth.

(To be concluded.)

THE TRANSMISSION OF POWER BY ELECTRICITY.

ALTHOUGH a great deal has been talked and written about the transmission of power by electricity, very little has been done beyond a few desultory experiments. There is Sir W. Armstrong's installation of the electric light at his seat in Northumberland, the Siemens, and other electric railways, M. Menier's experiment in ploughing at Sermaize, and sundry other applications on the small scale; but no one has yet come forward with any definite proposition to utilise the Falls of Niagara or to seize upon the enormous water power running to waste in the gorge of the Severn, which latter we have been assured would be sufficient to supply all the factories in England. The subject has been fairly placed before capitalists by Sir W. Thomson, Sir W. Armstrong, Prof. S. P. Thompson, and others in this country, and includes a proposal to transmit the energy of coal to the metropolis and elsewhere by wire instead of forwarding the coals themselves by railway. There seems to be no doubt in the minds of those who suggested the transmission of power by electricity that 50 per cent. of the energy expended at the source of the power could be delivered at long distances, and it will therefore follow that even in the case of coal, if it is consumed at the pit's mouth, the power can be transmitted in the shape of electricity with economy. In the cases of water and wind, sources of energy which cost nothing first hand, there is only the interest on the sum expended in machinery necessary to utilise them to reckon as the prime cost of the motive power, and if that machinery can be constructed in an inexpensive manner, it is time that some experiments on a large scale were made. If it is possible to utilise the tidal flow of the Severn, Bristol could easily find a use for a portion of the electrically transmitted power, and both Birmingham and London are not so far off that the cost of the leading wires would prevent the use of energy so cheaply obtained. At any rate, assuming that the machines worked by the water of the Severn were placed somewhere in the neighbourhood of Avonmouth, the cost of copper rods to lead the current to Bristol would not be very heavy, and there are a sufficient number of factories and workshops in that city and its environs to fairly test the question on the large scale. It is not impossible that capitalists and others who might be inclined to take the matter in hand are waiting to see how Mr. Edison succeeds in his attempt to supply a whole district in New York with current for both power and light. His main leads are stout copper rods of about half-moon section, carefully cemented into iron tubes with an insulating material, and it is obvious that much of the success of the installation will depend upon the behaviour of the latter, for leakage of current would very seriously increase the cost, and if excessive would practically render the system inefficient. If any difficulty is experienced in keeping up the insulation where the leads are laid beneath the footwalks of cities, it is tolerably obvious that it will not be easy to keep the "wires" in proper electrical condition when they stretch over many miles of country. In his recent address, as President of the British Association, Dr. Siemens took 50 per cent. as a safe estimate of the amount of energy that could be transmitted by electrical means, and he pointed out that as large steam-engines work on a consumption of 2lb. of coal per horse-power, whereas small ones use 5lb., there is an economy which, with other advantages, balances the loss of energy in the electric system. As a matter of fact, calculations show that between producing the current in one machine and reconverting it into mechanical effect by means of another, the loss should not be more than 20 per cent., and some carefully-conducted experiments made at the Stevens Institute of Technology, Hoboken, N.J., give a smaller loss than that. These experiments were made by G. and W. E. Gibbs, and form a thesis, an abstract of which we find in *Van Nostrand's Magazine*. The machines used were of Weston's latest pattern, the generator being a "fifty light incandescent machine," and the motor a "forty light" of the same construction—viz., the "derived field" type, the field-magnets being wound with comparatively fine wire, so that their resistance was about 800 times the resistance of the armature. The dynamometer used for measuring the power transmitted by the engine to the generating dynamo was one of the Kent type, built at the Stevens Institute, and was carefully standardised for the purpose of these experiments. The bearings of the armature were "assumed" to absorb 2·5 per cent. in friction, as no suitable apparatus were available for determining it experimentally; but there is no reason for thinking it more, while it is probable that it was less. In testing the efficiency of the generator, the current was carried by iron wire resistances running across the room from side to side in the open air, so that the heat was rapidly conducted away. A switch was so arranged that the generator could be instantly thrown out of circuit, and the resistance of the line measured within five seconds by a Thomson high-resistance galvanometer. In determining the electrical energy developed by this method a calorimeter was used in circuit with the iron wire resistance. The actual figures show that the energy applied to revolve the armature was 112,446 foot-pounds per minute, and the total electrical energy developed in the circuit, 108,446·28 foot-pounds, so that the efficiency of the generator was ·963; that is, 96·3 per cent. of the power applied to the armature appeared in the circuit and magnet-coils. Deducting the electrical energy consumed in the field-circuit and the internal work, the machine gave a commercial efficiency of ·866, or 86·6 per cent. of the energy actually applied to the armature pulley. Tests by measurement of the E.M.F. and R. gave efficiency as ·975 and commercial efficiency as ·864. In determining the efficiency of the motor as a machine for converting electrical energy into mechanical, the two were connected by heavy copper rods so as to reduce the loss of energy in the line to a minimum. A Prony brake was applied to the pulley of the motor, and the pressure of its arm on a platform scale gave the measurements directly. The brake was kept cool by a stream of water, so that runs of any desired length of time could be made. The machines used were, however, so large that they could not be worked up to their full capacity with the appliances at hand, but the results obtained are interesting and trustworthy. A number of trials, made at various speeds, showed that the motor was well adapted to act as a machine for converting electrical energy into mechanical power; but the combination of the generator and the motor was not altogether satisfactory, the highest efficiency being ·587. The generator in this case absorbed 197,200 foot-pounds of energy, and the motor did 115,866 foot-pounds of work. The loads, and the difference of speed of the two machines, were varied by means of the brake, the generator being kept at one steady rate during thirteen experiments, but the best result was that given above. The authors of the thesis, referring to the low percentage of the efficiency when the generator and motor are coupled, point out that the cause is obvious. By one of the fundamental laws of electricity the work done in any portion of an electric circuit is directly proportional to its resistance; and in the case of the two machines upon which they experimented the resistance of each was very low and equal when coupled, while that of the line was practically *nil*. Under these conditions nearly half the work must necessarily be done in the generator; but in order to increase the efficiency of the combination, more work proportionately must be done in the motor and less in the generator. In the case of a single motor they propose to reduce the resistance of the generator armature, and raise that of the armature of the motor, so as to cause nearly all the work to be done in the motor. If several motors were supplied with current from a single generator they propose to arrange them in multiple arc, so that when coupled up the total resistance would be the same as that of a single motor doing the combined work of all. If the proper ratio of resistance is determined by experiment, the authors think there is no reason why the continued efficiency should fall short of 80 per cent. If such a result as that can be obtained at, say, 50 miles from the prime mover, there is hope for the general adoption of transmission of power by electricity; but at present nothing of the kind has been done, the extreme limit of any experimental transmission being well within 10 miles.

SOME VOLCANIC FORMATIONS ON THE MOON.

THOSE parts of the moon's surface that commonly receive the name of *craters*, the numerous circular forms inclosing a depression, in which mostly rises a group of hills, have no great similarity to the volcanoes of our earth. On the other hand, lunar formations have been described in recent times which, in the opinion of selenographers, are the analogues of terrestrial volcanoes. In this class Herr Klein (in a recent paper, of which an abstract appears in *Der Naturforscher*), reckons in the first place the so-called *crater cones* of Mr. Neison, to belong. These are steep or conical hills, or mountain summits, varying in diameter from ½ to 2 or 3 miles, with steep, funnel-like, central depressions, scarcely half as large, which, with a high sun, appear in strong telescopes as very small white spots; they occur sometimes on the top of a mountain, but not unfrequently also on the inner surface of a circular range, or a walled plain.

Another class of formations of the moon's surface, which seem to Herr Klein in a still higher degree to resemble our volcanic formations, have previously been observed only by Herr Schmidt in Athens, who described small dark spots as imperfect half-shaded craters, and in them a white central part, which appears at times as a crater. These forms are so rare that Herr Klein can only count five which present this type with certainty, and two in which it is probably present.

Herr Klein, without knowing of Herr Schmidt's observations, has himself found two of these formations in the neighbourhood of Theophilus, and regarded them as craters with bright white crater cavities, which are surrounded to a great distance with a ring of grey matter. The larger of the two craters appeared on further observations as a flat cone, on the outer portion of which (extending several miles) the steep eruption-cone stands at the highest point; the dark grey mass was only in the neighbourhood of the white main crater, bedded round about its steep cone (on the slope Herr Klein observed some small secondary craters). The second crater showed similar features; but since last autumn it has not been so distinct as before, and one sees now only a grey spot within a dark ring. A similar object was discovered 50 years ago by Gruithuisen, south from Hyginus; he saw a small, bright, white crater in the middle of a grey broad spot. This small crater is still present; but Herr Klein has never seen it as a bright spot, nor has Herr Schmidt. Now, since Gruithuisen's observations are beyond question, it is to be inferred (Herr Klein says) that that small crater has darkened in the course of years. "From the agreement in the cases mentioned, but especially also from very careful examinations of the large crater in the south-west of Theophilus, it may be concluded that the dark matter which surrounds the brightly shining crater was thrown out from this. We may regard it as a kind of lava, which, in time, fades." That the formation of the ring of dark matter, or the "eruption" south-west of Theophilus, belongs to recent time, Herr Klein infers from the circumstance that this dark spot, which is very obvious, and even appears on one of Rutherford's lunar photographs, was seen neither by Lohrmann, Mädler, nor Gruithuisen.

The intimate connection between the dark matter and the bright crater at its middle, as also the inference that this mass was thrown out, lava-like, from the crater at a time long after its formation, Herr Klein has been able to establish by several years' study of such a lunar crater observed by no one previously. The object in question lies in the interior of the great walled plain Alphonsus, where Mädler has described a triangular dark spot, remarkable in full moon for its darkness and regularity. Within this spot Herr Klein has discovered the bright crater cone, and he has closely studied it. He gives a small map showing the position of this cone and its surroundings. From observation with different solar altitudes it appears, that in the neighbourhood of the crater-cone small hill ranges and undulations are present, and as one can still at the same time perceive the double triangle in them, a distinct conviction is reached that the dark material has everywhere spread to the lower positions, and has thereby acquired the characteristic form of the triangle. This material, however, can only have accumulated in a comparatively thin layer, which could not cover even small elevations, for even the small hillocks appear, with a certain solar altitude, as fine light points projecting from the dark triangular surface. Thereby is also proved that the dark material did not fall from above like volcanic ashes, and cover everything; but that it was liquid, as it spread outwards.

"In my opinion," says Herr Klein, "the relations here depicted prove the existence of phenomena on the moon's surface which present the greatest similarity to the lava-floor of our terrestrial volcanoes, so that the occurrence of true volcanic phenomena on the moon is no longer to be doubted. These phenomena belong, in the case of the crater described, to an epoch when the hill-ranges of the surrounding surface were already present, so that the outflowing material had to follow the inclines presented by the ground.

"While in the example just given, all the phenomena point to lava-like flows, we may in another case, though with less certainty, infer the covering of the ground with stone or ashy masses. The region in question lies at 1° N. lat., and 47° W. long. There the grey bottom of the shallow sea, studded only with very low hills, is traversed with bright streaks of light. One observes, however, even with a low sun, that on a surface of several square miles, an egg-shaped spot, as of dark gauze, covers the ground, and below it the brighter and darker parts of the ground glimmer out. This spot gives an observer the impression of its being transparent, or of a fine mist covering the ground. The latter, however, cannot be accepted, for the spot is a quite persistent phenomenon, a modification of the colour of the moon's ground. But such would necessarily arise, if the ground, both where it is bright grey and where it is crossed with white streaks, were covered with ashy or stony masses in very thin layers. Similar indications are found in other places on the moon's surface; but they have mostly escaped moon-observers hitherto, because these considered the more general and large features of the lunar surface, and the investigation of details has properly only begun. Thereby, already, a much greater similarity of the moon's surface to that of our earth than was formerly supposed, has been made out. Still the investigation is only beginning, and is in presence of quite infinite detail; besides this, it is much more difficult and trying than many other observations."

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.[*]

By John Watson Warman,

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r. *No. 5 Treatment.*—We have, in the preceding scheme, brought the reader to the best practicable of the existing Treatments for the Key-boards and their involved Action in the Two-Manual Organ, as itself arranged at its Normal best.

But even this, that is to say, the Treatment No. 4½ just concluded, contains the Defect of not comprehending the device of the *Clear Coupler*. Such Coupler has been already once or twice mentioned (having been first introduced at 10, *k*), and will of course be fully described and considered in *Departments* Couplers, Coupling-Actions, and Schedules: a few words, however, are here requisite as well.

First it is to be understood that both in the present Treatment No. 5, and in that of No. 5½ following it, and also generally at other times when the Clear Coupler is spoken of, it is assumed that the Organ possesses only *two* Manual Sections, and that these are respectively —as usual—a *Great* and a *Swell* Organ. With any other number or kind of Sections the Clear Coupler will lose its especial value. Here see what is said in the *Summary* (at *u*, next, 2nd and 3rd parags.) with regard to these two said Sections being *always* the best for any 2-Manual Instrument, and as to the very large proportion of Organs made with such number of Manuals.

As concerns the Arrangement for the provision of such Clear Coupler, it will be sufficient here to refer the reader to that which was given at 89, *q*. The actual treatment of the Mechanism consists, as will have been seen, simply in (1) causing the Coupling Swell-to-Great to take one of those Forms (preferably the *Drumstick*) which are located between the two sets of [Manual]

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Key-tails; and (2) constructing the Coupler Great-to-Pedals so that it acts not upon the the Key-Tail itself of such Great-Org., but upon the Backfall, Lever, or Square, which is most nearly connected with such Tail. See here again in the Remarks at end (ref. *u*, next, 2nd and 3rd parags.), regarding the advantages gained by this Device.

In the present Treatment the following points must also be understood in respect of the *General* Arrangement of the involved portions of the Instrument. The Manual Windchests may be placed either the one *behind* the other—on one same level—, as in the preceding Treatment, or with one such Windchest mounted *over* the other. The latter arrangement will in the present case prevent a Crossing of the two Manual Actions (see *r*, ante, 8th parag.), but the setting of such two Windchests at one same level is, as has been already seen or implied (at *qqq*, ante), to be decidedly preferred. The posit of the Pallett Pulls may also be determined at discretion (see *m*, ante, 6th parag.). The Claviers may be placed anywhere, and in or with any direction or Projection; and they have now a further license—secured by the adoption of the Coupler between Manuals—with reference to a Buffet which is Detached from the Body of the Instrument (see again *r*, ante, 14th parag.): also there may exist any desired distance between the Levels of the two Manuals (see 92, *t* and on), though 2½in. favours the Drumstick form of their Coupler (see preceding parag.). Concerning the planting of the Pipes remember:—(1) That the Semitonal Order is especially to be discountenanced in the present Treatment, because the impracticability of Fanning either the Great or the Swell Pallett Action prevents such Semitonal Order from being made available for the simplification of such Action. (2) That there exists no real reason why one same Pipe-Order should be employed for both the [Manual] Sections, for the Skewing of the Great-Org. Backfalls (see next parag. but two) will in *any* case prevent the two [Manual] Roller-Boards from being Set-out exactly alike. It is true that such Skewing *could* be rendered unnecessary, either by the already indicated method of placing the Swell Windchest *over* that of the Great, or by Crank-Wiring one of the sets of *Trackers* (see part of *z*, ante) at the point of their Crossing each other: but the first of these expedients has been condemned in the same breath as that of its first mention; and the second is equally out of question, because the additional workmanship incurred with it would more than balance the gain of having but one Setting for the two said Boards.

The actual Treatment of the *Manuals* and their involved *Action* for the preceding, I have designed as follows:—

The Great-Organ Keys may be of any convenient length, so long as they are not too short (here see at 89, *r*, Bis and on; and *u*, next), and will be perfectly Straight on Plan. The Swell-Organ Keys will be of such length as that their Tails extend beyond the Great-Org. Keys by about 1½in., and will also be perfectly Straight on Plan,—so of course lying, laterally, exactly vertically over their corresponding Great-Org. Keys. The thus overhanging Tails of the Swell-Org. Keys are so *Sloped* at their under faces as to furnish a proper contact-surface for the Sticker-tops of the Coupler Swell-to-Pedals (see *r*, ante, 12th parag.), the direction of such Slope being such that the extreme end of the Key-tail is the thinnest part of latter. There is here no Side-Notching of the Swell Keys, because nothing whatever has now to pass up between them. For the treatment of the Manuals as is concerned in the Contact and Regulation of the Coupler uniting them, see with the proper Head relating thereto (at *r*, ante, 10th parag.). [It will be seen that it has been directed to provide the *whole* of the Keys of the Swell-Organ with a Tail-Slope, although it is obvious that it is only those Keys which are to be Couple-able to the Pedals that really require such an addition: the reason for this is simply to avoid any difference in the "Balancing" or Loading of the Keys of one same Manual. Of course the non Coupling Key-tails will receive no *Buffing*.]

The Great-Organ Action commences with a Set of Parallel Backfalls, having their Fore Noses resting directly on their Key-tails: and such Noses do not carry Regulating-Buttons,—for a reason to be shortly given. These Backfalls are slightly skewed, the exact angle being such that their rear Ends are brought to the true Half Semitonal Key-distance aside; thus every such rear end or Nose comes exactly beneath the space between the horizontal Trackers of the Swell-Action, and each vertical Tracker which rises from such rear Noses passes without obstruction up between said horizontal Trackers, and so goes straight to its [Whole] Roller-Board. (It will of course be understood that the said Swell-Organ Trackers are, on Plan, neither Fanned nor in any way Skewed, and that they are placed at a convenient height above the said Great-Organ Backfalls.) It should be here observed that the Skewing of these Backfalls constitutes the *only* such departure from the square which exists in the present Treatment—either as respects Keys, Key-Action, or Coupling-Action—, excepting so far as may perhaps be done in connection with the Pedal Organ. It is hardly necessary to add that the said Fore Noses of the present [Great-Org.] Backfalls must never be actually tied down to their Key-tails—as by the Forking or Clipping of the latter—, because of the requirements of the Clear-Coupler Action (see at *s*, next and on).

The Swell-Organ Action commences with a plain Non-Regulating Sticker, which is Wired at its lower end into its Key-tail, and at its upper end into the [fore] Nose of a Square which is set suitably to transmit the motion in the direction of from back to front of the Organ, —by means of the horizontal Tracker last spoken of. The length of this Sticker is such that the said Tracker, which is led as usual from the down-hanging portion of its Square, comes at such a level as to pass just clear above the Stock of the Trundel which works the Register of the Coupler Swell-to-Pedals (see next parag. but two), — which Trundel-Stock is itself placed above the said Register. The Squares themselves are of course of the ordinary, not the T, form, because the Man.-to-Man. Coupler is now obtained independently of their aid (see next parag.): they are, as has been already intimated, set perfectly square, equidistant, and parallel on Plan; their Trackers, therefore, running un-Skewed to their [Whole] Roller-board. For the reasons why the present Stickers are directed to be without either Register or Regulating-Button, see with the critical Remark (at *s*, next and on). The length indicated for such Stickers will be amply sufficient to allow of their easy Removal.

The Coupler Swell to Great is of the Drumstick Form. This is of course fully described in the future *Department* COUPLING-ACTIONS: in the meantime, however, some information has been provided at 88, *t* and on. The Lower Keys will each receive a suitable *Wedge-Block* (see 88, *z*), fixed upon the Key-tail at a point as near to the Great-Org. Backfall Nose as is admissible, and having its Slope made at the part which is farthest from such Nose. The Upper Keys will each have their Tails sawn into so as to furnish a proper *Regulating Tongue* of the kind already described (at 88, *v*), this Tongue being here cut in such a way as to leave untouched the Projecting and Sloped portion of the Tail: to secure this the Saw will pass a little way vertically into the under face of the Key at a point sufficiently removed from the extreme tail end of such Key, and will then turn and run towards the Playing end of the Key, for a proper distance and in such a way as to form the flexible Tongue desired. A suitable Screw-Eye (see 88, *u*), for Regulating such Tongue, will be inserted into the Key at a point in front of, and as *near* as possible to, the just described Sticker on the same Key-tail (such Screw-Eye being thus placed slightly nearer the Playing end of the Key than is the said Sticker): each Screw-Eye will enter at the upper face of the Key; but should not be so entered at the *middle* of such face, but at a little on one *side*, and be set at such an *angle* that the lower or pushing end of the Screw-stem itself comes at such middle. By this last treatment the Screw-eye Hole will not be liable to *split* into the Sticker-wire Hole.

The Coupler Great to Pedals has its connection made by means of a simple Wired and Non Regulating Sticker, rising from the usual rear end of the Coupling Backfall, and—in order to obtain the CLEAR Coupler—entering into the fore end of the Great-Organ *Backfall*,—instead of into the *Key-tail*. It is essential that the said Coupling-Backfall (un-Skewed, remember) do extend far enough back to bring the said Sticker beneath a point which is itself sufficiently far back from the rear end of the Great-Org. Key to allow a certain *space* between latter and said Sticker,—such space having to be occupied by the Sticker of the Coupler *Swell* Manual to Pedals. The present Coupling Backfall for the Great Organ is set below the similar Backfall for the Swell Organ, and is brought into and out of Action by the raising and lowering of the Beam which carries such Backfalls.

The Coupler Swell to Pedals will have been partly understood from what has been already said. Its Backfall—also un-Skewed—is placed next beneath the Great-Organ Keys, and its carrying Beam is a fixture: the Backfall extends backwards to a point a little beyond the extreme end of the Great-Org. Key Tail, and just short of the [Great-to-Ped.] Coupling Sticker last described. From such rear Nose of the present Backfall, and thus occupying the space already mentioned, uses the Sticker, to a point in contact with the bottom or foot of the Under-Slope of the Swell Key-tail (see at *r*, ante, 7th parag.) The lower portion of this Sticker is Wire-Cranked (see fully at *z*, ante), in order to enable it to pass between the [fore] Noses of the Great-Organ regular Backfalls; and its upper portion is four-sided (of an elongated square on plan-section), so as to properly enter through and be guided and worked by a suitable *Register*. The moving of such Register backwards and forwards constitutes the throwing out of and into Action of this Coupler. The object of employing such a Register, instead of Wiring the Sticker-top into the Key Tail, is of course the facilitation of the Removal of such Key; and the having the throwing out of and into Action to be by means of such Register is as obviously for the purpose of utilising the latter, and so avoiding extra workmanship. The said Wire of the Swell-to-Ped. Sticker furnishes the only case of Cranking, of any kind whatever, existent in the present *Treatment*.

The *Clear* Coupler secured by the foregoing Design is of so advantageous a character that there does not really exist that necessity for such analysis as was given in the cases of the earlier *Treatments*. A criticism will, however, be added—notwithstanding this—, for the sake of a fuller comprehension of the construction.

(*To be continued.*)

BAILLIE-HAMILTON'S IMPROVEMENTS IN HARMONIUM REEDS.

WE mentioned some little time ago the improved harmonium built on the plan suggested by Mr. J. Baillie-Hamilton, of Greenwich, and we are now able to illustrate some of the methods of controlling reeds which have been patented by that gentleman. Technically, the reeds are of the kind known as free, but the special term "constrained" distinguishes them from the ordinary type. The invention consists in so combining together two, three, or more reed tongues that their movement is so governed that differences of pitch and variations of quality are obtained. According to one mode of carrying the invention into effect, the patentee employs three reeds in a group and side by side—namely, two outer ones termed "motor reeds," and a central one (termed a governing reed). The individual reeds are termed "tongues," and the combined tongues "reeds." The two outer or motor tongues are connected together by a bridge piece (called the unison bar) extending over and above or under and beneath the middle or governing tongue, and this bridge piece is attached to the governing tongue. In the Figs. annexed are several views of reeds having tongues connected or combined in different manners; but they give only an indication of the plan, as the modifications possible are very numerous. Fig. 1 represents in plan and side and end elevation a reed wherein the motor tongues are connected by a bridge piece attached to them at about the centre of their length. The governing tongue is connected to the bridge piece by a wire or strip of metal fastened at one end to the bridge-piece, and at the other end to the tongue near the tip or free end thereof. The motor tongues and the governing tongues may be all of the same length, or the governing tongue may be longer or shorter, as shown in Fig. 1, and they may be all in one plane or not, as may be convenient—for example, the governing tongue may be arranged above the motor tongues. The wire or strip which forms the connection between the bridge and the governing tongue instead of being attached in two places may be attached at one end only, the other end being extended beyond the bridge piece to project to any required distance so as to admit of variations of quality being regulated to great nicety by filing away or removing portions of the projecting end of the wire or strip.

Fig. 2 is a longitudinal and transverse section and plan of a combined reed wherein the motor and governing tongues are connected by the bridge piece and wire being fixed to the underside instead of the upper side of the tongues. Fig. 3 illustrates compound reeds, wherein the governing tongue is connected to the motor tongues by one piece of metal formed with legs, one of which is fixed to each tongue. This piece of metal is larger in proportion to the nearness of its point of attachment to the root or fixed end of the tongue, as shown.

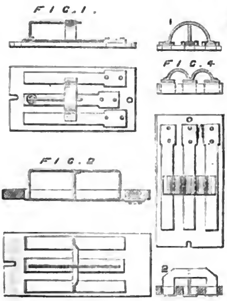


FIG. 1.

FIG. 4.

FIG. 2.

Fig. 4 shows in end view and plan the tongues as being connected by a strip bent into a double arch form, and connected at each end to the motor tongues, and at the centre part to the governing tongue. A modification, employed in order to bring into unison two reed tongues, which would otherwise be discrepant consists in placing the two tongues side by side and connecting them together by a bridge piece, which may be of wire and rivetted out of its own substance, or be formed out of a wider strip or band. The two tongues may be both of the same length, or they may be of different lengths, and may be arranged either in the same plane or in different planes, the bridge-piece being connected to the under or upper side of the tongues. The connection of the bridge pieces, strips, and tongues may be effected by soldering, but preferably by riveting, which may be effected either by separate rivets or the substance of the bridge piece or strip may form the rivets.

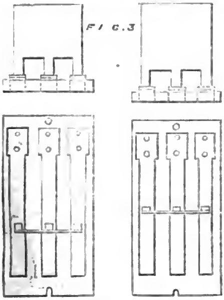


FIG. 3

In applying the improved reeds, the patentee prefers to employ stop-movements and operating parts of the organ type, making the chambers or channels both preceding and following the reed of the fullest length practicable for the necessary reinforcement, as he finds that by this means, in conjunction with the use of the improved reeds the best conditions of quality and voicing are obtained. In some cases he inverts the position usual to a reed in its channel; that is to say, so arranges them that the wind tends to drive the reed tongue out of the frame instead of into it.

It will be remembered that several patents based on the idea of constraining reeds have been obtained within the last few years, and according to those who have criticised the new harmonium Mr. Baillie Hamilton has been successful in producing superior tone effects.

A NEW FORM OF THE APERIODIC GALVANOMETER.

By MARCEL DEPREZ.

LAST September I described, in the *Journal Universel d'Electricité*, a rapidly indicating aperiodic galvanometer, which I had devised in connection with Mr. D'Arsonval, and which was specially designed for showing the currents due to very weak electromotive forces, such as those resulting from thermometric actions, or from the passage of a wire of a few centimetres length traversing the magnetic field of a small magnet. I am now going to make known another form of this instrument, which I devised at the beginning of the year 1881, for the purpose of rendering it applicable to cases in which it is desired to measure currents of an extremely feeble intensity traversing a circuit whose external resistance (other than that of the galvanometer itself) is very great. These two forms of the apparatus supply the same wants as ordinary galvanometers, which are of coarse or of fine wire, according to the nature of the applications for which they are designed. Fig. 1 represents this second type of galvanometer. AA' is a horseshoe magnet whose branches are held in a vertical position by fixing the back into the base of the apparatus. Between the branches there is a rectangular helix, CC', which is formed of a very fine wire wound a great number of times. This helix is connected with two silver or hard copper wires, JH and DE. The wire, JH, is attached at H to the extremity of a rod which may, at the will of the experimenter, be given two distinct motions—one of rotation in order to set the helix in position, and the other a vertical one in order to place the helix at a proper height. The second wire is attached at E to an elastic strip, EF, whose tension is regulated by the screw, G. These two wires, being tightly stretched, form in space a fixed axis around which the helix, CC', will assume a rotary motion. At the same time they serve through their extremities, H and E, which communicate respectively with the terminals, K and L, to lead the current into the helix: and finally, the elastic couple which results from their torsion under the influence of an angular motion of the helix, CC', serves to measure the intensity of the couple due to the reciprocal actions of the magnet and helix when the latter is traversed by a current. A small mirror, J, permits of reading the angles of torsion with great accuracy by applying the optical process which is employed in all apparatus of this nature. In the interior of the helix there is an iron tube, B, which is designed to strengthen the intensity of the magnetic field.

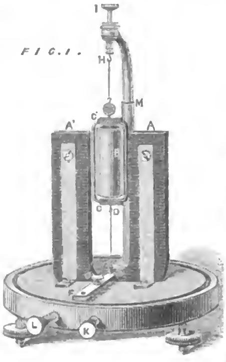


FIG. 1.

When the helix is moved by hand from its natural position of equilibrium it returns to the latter, and performs, while doing so, a series of oscillations which may last for a considerable time; but if the two terminals K and L be united by a wire, the oscillations cease at once and the helix returns to its position of equilibrium exactly as if it were moving in a fluid of great density. This phenomenon is due to the retarding mechanical action of the induction currents developed in the helix by its motion in the magnetic field. This is a very valuable feature when the instrument is applied to the measurements of resistances, and one which permits of performing them within an incomparably shorter time than can be done with the apparatus universally employed. I am anxious to state, moreover, that such a feature is in no wise obtained at the expense of sensitiveness, for the latter does not yield anything to that of the most perfect instruments employed up to the present time. In order to give some idea of this, it will be sufficient for me to say that it clearly indicates a current whose intensity is one ten-millionth of an ampère.

A description of this galvanometer naturally leads me to speak of the graduation of such instruments, in general, and I shall point out the process that I now employ, and which appears to me to be superior to all those that have hitherto been published. It is an application of the Poggendorff method of measuring electromotive forces.

Suppose G, Fig. 2, to be a galvanometer to be graduated; P, a constant current pile; and *p*, a pile whose electromotive force is taken as a type. The current of the pile, P, being closed by the wire, PBAP, and that of the type pile, *p*, by the circuit, *p*AGB*gp*, these two circuits are put in contact by the points, A and B. The result is that the three portions, AGB, AB, and A*pg*B, are traversed by three currents whose intensities may be easily calculated when the resistances of these three portions are known, as well as that of the portion, BPA, in which is located the pile, P, and when the electromotive force of the piles, P and *p*, is given. This being granted, if we obtain the resistance of the portion AGB, it is always possible to place the points of contact, A and B, of the circuit, PBAP, in such a way that the portion, B*gp*A, which contains the type pile shall not be traversed by any current. When this condition is fulfilled (a fact which may be recognised by the aid of the central galvanometer, *g*), the difference of potential of the points, A and B, is exactly equal, and of a direction contrary to the electromotive force of the type pile, *p*. The portion, AGB, whose resistance is given, is then traversed by a current whose intensity is at once given by the formula $I = \frac{ne}{r}$, in which *e* represents the electromotive force of one element of the type pile, *p*; *n*, the number of elements of such pile; and *r*, the constant resistance, AGB. It is easy, then, by causing *n* to vary (which naturally carries with it a variation in the distance of the points of contact, A and B, of the two circuits in order that

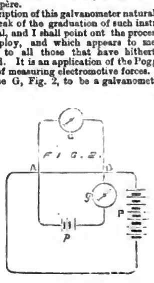


FIG. 2.

the current circulating in the portion, B$gp$A, be always brought back to zero), to carry the graduation as far as may be desired. If we take as a unit the current traversing AGB, when $n = 1$, we may obtain intensities represented by any fraction, k, whatever of such unit, on adding to the known resistance, AGB, an auxiliary resistance equal to $\left(\frac{1}{k} - 1\right) r$.

It will be seen that this absolutely accurate method permits of graduating instruments whose wires have any resistance whatever, either in volts or in ampères, without there being any need of knowing anything else than the resistance of such instruments (which can be determined with extreme precision) and the electromotive force of the type pile. This latter, moreover, operates always with open circuit, this, as is well known, being an indispensable condition in order that the electromotive force may be considered as invariable. It is scarcely necessary to remark that the auxiliary pile, P, should be composed of a number of elements dependent upon the limit to which the graduation is desired to be pushed.

PROF. MOSELEY ON PELAGIC LIFE.

THE Monday evening discourse during the meeting of the British Association was delivered by Prof. H. N. Moseley, who said:—An account of pelagic life deals with all the characteristic vital phenomena of that peculiar association of animals and plants which swim freely in the surface waters of all the oceans and seas, as distinguished from the inhabitants of their shores and bottoms; that is to say, it deals with the inhabitants of an area equal to nearly three-fourths of the surface of the globe, and in points of numbers pelagic animals probably far exceed all others existing. The existence of an abundant supply of animals in the open oceans would be impossible were there no supply of vegetable food present; but, in fact, the ocean waters in many regions teem at their surfaces with minute algæ. In the Polar regions these are principally diatoms, which often render the water thick like soup, and in the Antarctic regions are washed up in such quantities on the floating ice as to stain it brown. In the tropical regions other minute algæ (oscillatoriæ) fill the water, sometimes so abundantly as to colour it for miles, and give it a weedy smell. These pelagic plants constitute the main ultimate source of food for the pelagic animals; but as they are not very abundant everywhere in the ocean, there appears to be a certain deficit of vegetable supply to account for. It is, therefore, of great importance in the explanation of the economy of pelagic life that it has lately been discovered that a curious combination between certain animals and plants exists for purposes of mutual benefit. Certain animals have imbedded in their tissues numbers of unicellular algæ, which are not to be regarded as parasites, but which thrive on the waste products of the animal, while the animal feeds upon the compounds elaborated by the algæ. This combined condition of existence has been named by Dr. Brandt symbiosis. The animals in which it is most abundantly exhibited are the radiolarians, jelly-like protozoa, which have numerous bright yellow cells imbedded in their tissues, the unicellular algæ in question. These radiolarians are exclusively pelagic and enormously abundant, and, having been discovered to be endowed with their own vegetable supply, are self-supporting, as it were, and constitute an immense additional ultimate source of pelagic food. The yellow cells have, of course, long been known, but their import was until lately not understood. Most of the pelagic animals are perfectly crystalline and transparent, so that they are almost absolutely invisible in the water, and thus escape their enemies. Various mollusca, crustacea, annelids, and members of all other classes of the animal kingdom, have thus by natural selection had their tissues rendered glass-like in transparency to fit them for a pelagic existence. A small group of forms, again, which inhabit the very surface of the ocean water, are coloured brilliant blue, like the water itself, for protection. Some few pelagic animals are endowed with brilliant colours, and one little crustacean, Sapphirhina, gleams with tints like those of the humming-bird. Some pelagic animals have no eyes, while many others have extremely large eyes; and in this they resemble the members of the deep-sea fauna. The explanation of this fact is that most of them visit the sea surface at night, and always remain in very dim light. The great inland fresh-water possess, like the oceans, a definite shore fauna, deep-sea fauna, and what may be called a pelagic fauna. The latter consists almost exclusively of peculiar small crustacea with big eyes, representatives of which have recently been discovered in our lakes in Westmoreland. Professor Weissman, of Freiburg, has carefully watched the habits of the pelagic crustacea of Lake Constance, and he finds that during the daytime they are to be found at a depth of 25 fathoms or less, which is about the limit at which sunlight ceases to penetrate further. As the sun sets, they rise gradually to the surface, and as it rises in the morning they as gradually sink into the depths. He explains this habit by the supposition that the animals move thus up and down in order to economise the light, and be able to feed over the whole range of their possible feeding-ground. In order that they should feed at all at its deepest limits it is necessary that they should make use for that purpose of the strongest sunlight, while they can hunt the actual surface over by the faint light of night. The marine pelagic animals are probably actuated in their similar daily movements, up to the surface at night and down into the depths during the day, by the same motives. Their daily oscillations in depth are liable to be interrupted indefinitely by boisterous weather, which drives them down at once. Besides their diurnal oscillations, it is probable that at certain seasons of the year they migrate into the depths for considerable periods—at least this has been shown to occur in the case of pelagic animals inhabiting the Gulf of Naples. A most important question remaining to be settled is, to what depth do the pelagic animals descend? This is not easily answered, because an ordinary net sent down into the depths may, when pulled up again, catch animals from any intermediate depth on the way. Only a net which can be sent down securely closed, then opened and towed along, and then close again before being hauled up, can give any definite and sure information on the matter; and such a net is somewhat difficult to construct and use. Mr. Alexander Agassiz has, however, made a few experiments with such an instrument, and found, where he tried it off the American coast, that the animals extended down to about 50 fathoms deep, but not at all below 100 fathoms; and he believes from these experiments, and on other grounds, that only a narrow surface stratum of the ocean waters, and a similar stratum at the bottom, are inhabited at all, there being a vast expanse of uninhabited water between the surface and bottom. On the other hand, there are reasons for believing that there may be some few inhabitants at least of of this deep intermediate water, notwithstanding that it must be pitch-dark throughout it. Certain pelagic fish are endowed with remarkable phosphorescent organs by means of which they possibly seek their food in these dark abysses. It is also probable that the young of certain deep-sea fishes spend their early larval existence in the surface water, and if so, they must penetrate this intermediate stretch of water to reach the bottom when becoming adult. Mr. John Murray's constant researches on the subject during the voyage of H.M. ship *Challenger*, point to the existence of abundance of life at a greater depth than 100 fathoms. The question as to how far the depths of the oceans between the limit of the 100 fathom line and the bottom are inhabited is the most important with regard to deep-sea science now awaiting solution. The fact that the ultimate source of food, vegetable life, must be limited to the range of penetration of sunlight—that is to say, at the most a depth of 50 fathoms—precludes the possibility of the existence of life in great abundance in the region in question. The food supply must be too scanty. Remarkable members of the pelagic fauna are certain young fishes which, drifting away from land on the surface-waters of the ocean, become abnormally modified as a result of the abnormal exposure to the peculiar conditions of pelagic existence. They grow in size, but without developing proportionately in structure; they are absolutely transparent, some of them without a trace of red blood in them; their skeleton is gelatinous, being only little developed. They are known as leptocephali. Many of them are the young of the conger, others of allied fishes; but, according to Dr. Gunther, they perish without attaining maturity, and possibly are the offspring of eggs shed accidentally at the surface of the sea, instead of at the bottom. They are, however, of constant occurrence among the pelagic fauna. The larvæ of some other animals appear to be liable to a similar hypertrophy, without progress in development. The pelagic fauna is composed, firstly, of a number of species belonging to a series of orders and sub-classes which are absolutely peculiar to it—that is to say, which have no representatives which are littoral or terrestrial, or in any period of their existence are other than pelagic. There are about nine such groups, no one of which rises undoubtedly to the rank of a class. Secondly, the fauna contains numerous representatives of various classes and orders of animals, the majority of representatives of which are inhabitants of the sea bottom, shores, or land surfaces, but which are mostly specially modified in various ways to fit them for pelagic existence. Among these there appear to be very few infusoria; at least, very few have as yet been recorded, and none from any great distance from land. Even sea-anemones have taken to pelagic existence. Instead of their base being flattened for adherence to rocks as in common shore forms, its edge is closed in all round so as to contain a small mass of air, and, suspended by this buoy, they float at the surface with their mouth hanging downwards. There are even pelagic insects. One (halobates), belonging to the bug family, clings to the surface of the waves in the open oceans and outrides the storms. It is a close ally of the common water-bug we see jerking itself on the surfaces of our ponds. There are numerous pelagic fishes, which never frequent the coasts, and in the tropics pelagic snakes. There is one lizard at the Galepagos Islands, which, though it cannot be claimed as pelagic, swims out to sea and is interesting as a sort of representative of the gigantic extinct pelagic lizards of mesozoic times. It is very remarkable that there are no pelagic representatives of sponges, alcyonarians, sipunculids, brachiopods, lamellibranchs, or echinoderms, and that as far as geological evidence goes there never have been any. It is very easy to conceive from the analogy of other forms which have become modified for pelagic life how any one of these might have assumed a pelagic dress. The birthplace of all animal and plant life lay in the sea, and it is probable that a considerable part of the earliest life was pelagic.

REMARKABLE STEAMSHIPS.

THERE are now building in the United States two ships which, for speed and general excellence of locomotion, are expected to far transcend any vessels at present afloat. One of these, the dome steamer *Meteor*, is in course of construction at Nyack, on the Hudson. She is the invention of Mr. A. P. Bliven, of Brooklyn. The engines are capable of making 350 revolutions per minute, which gives a velocity of the wheel of over forty-five miles per hour, so that it is expected that the *Meteor* will be able to make fully twenty-five miles per hour, and thus complete the distance from New York to Queenstown or Bristol in a little over five days. The vessel is being built entirely from American materials by American mechanics, and is intended as the pioneer of a class of large steel steamers which will follow in rapid succession. A new feature of the engines is that the high-pressure cylinders are inclosed within the low-pressure cylinders, only two cylinders being visible; and this method will prevent condensation in the cylinder, thus saving all the power of the steam. The vessel will be supplied with a steam generator of the water-tube pattern—which is practically four boilers in one, having two smoke stacks, each 3ft. in diameter and 20ft. high, four steam safety valves, and four firegrates. The boilers when set up are oval in shape, having 78sq. ft. of grate-surface, 3,560sq. ft. of heating-surface, two centre cylinders of steel, 22in. in diameter and 13ft. long, and 7,850ft. of steel tubing. Every part of the boiler will be tested to 2,000lb., and inspected to 800lb., thus allowing a working pressure of 550lb. The *Meteor* will be 156ft. in length over all; length at water-line, 132ft. 6in.; length on keel, 125ft. 6in.; depth of hold, 16ft. 6in.; draught of water aft, 11ft.; tonnage, carpenter's measurement, 512,33-100. Nothing will be seen above her deck except the pilot-house and smoke-stacks. Last, but not least, no one need be exposed on a steamer of this type, for in stormy, rough weather she can be closed up perfectly watertight, and driven through and over the heaviest seas without any danger to passenger, crew, hulk, or machinery. Several companies have been formed for building *Meteor* steamers.

The second singular vessel in course of construction is the *Oceanic*, now being built at Hastings, on the Hudson. The principle of this steamship is the invention of Mr. Robert Fryer, of New York. It is stated to be a kind of marine velocipede on three wheels, the hull not being intended to touch the water. The most curious point of the invention is that the support of the ship, the float, as it were, and the propellers are one and the same. The vessel floats on three spheres, made of sheet steel, one forward and two stern; each of these is fitted with flanges, which surround nearly the whole of the circumference, and act as paddles. The spheres are so arranged that they can be worked backward and forward, or one worked backward and the others forward simultaneously, so that the vessel may be turned completely round in her own water; and with such a rapid power of turning no rudder will be necessary. The whole vessel is made water-tight, so that in the event of the wheels or spheres being broken or disabled, or the vessel capsized, it will still possess sufficient buoyancy to prevent it from sinking. The spheres are provided with a flanged keel, to adapt the vessel for use on rails in case of crossing an isthmus, or for being run upon land for repairs. The ship is designed only for passenger traffic, and it is asserted that its peculiar construction gives increased accommodation, greater safety, and a higher rate of speed than that now attained. The *Oceanic* will be 224ft. long and 130ft. wide, the spherical wheels being 24ft. in diameter, and drawing 5ft. when loaded. The trial of a small model of the steamer excited great interest recently on the Harlem river, and it travelled equally well on land. The inventor claims that as much difference exists between it and an ordinary boat as between a waggon mounted on wheels and one that should rest on the ground, and be dragged along the surface by means of wheels attached to its sides.—*Shipping Gazette.*

RECENT ADVANCES IN PHOTOGRAPHY.—VII.*

By Capt. Abney, R.E., F.R.S.

(*Concluded from page* 589.)

I NOW come to the one other destructive agent of the photographic image, and that is bromine; and while I am on the subject, I should like to show you a neat way of exposing a transparency. It is not mine, and therefore I can praise it. Through Mr. Bolas's kindness I have here a phosphorescent plate made with calcium sulphide, which I propose to expose to light, then to use it as a source of illumination for obtaining a transparency. I now expose the phosphorescent plate to the light from magnesium wire, and then placing it over a negative behind which is a sensitive plate, expose for 30 seconds. I next take a little bromine water, and brush it across the exposed sensitive plate; I rinse with water, and develop with ferrous oxalate. As I showed you in a former lecture, the ferrous oxalate is a very fair medium for cutting off the radiation which affects a bromide plate, and so I can develop it before you. The image begins to appear, and by degrees we have the image pretty perfect, except that, where the bromine has acted there the image is totally destroyed, or very nearly so. This is a very simple experiment, but I did it for the purpose of leading you to another important point with regard to gelatine plates. Most of you are aware that when you have a pure bromide plate, it is very easily reversed as they call it: that is to say, instead of a negative there is a tendency for it to become a positive. The reason of that, I think, will be found in a measure in the experiment which I have just showed you. When you expose a bromide plate to the effects of light, anybody who has at all a keen sense of smell will perfectly well know there is some substance liberated which is somewhat pungent, and it will be found that it has a smell of bromine. If, therefore, you expose a plate for a considerable period—longer than it should be, that is to say—to light, what is the first effect? The first effect is for the bromine to be decomposed at the surface, and bromine to be liberated in a gaseous state; part of it will ascend into the atmosphere, and part of it will have a tendency to go down into the film. As the light penetrates still further, the energy of the radiation will split up the bromide below into bromine and sub-bromide, and so on, and the part beneath the first part will be passed over by bromine liberated from the molecules immediately below; so that, by a continuation of this emission of bromine, you get, first, the top practically saturated, as it were, with the bromine from the lower particles, and, as we have just seen, when you have bromine applied to a plate that has been acted upon by light, it destroys its developable powers—in other words, it forms fresh bromide of silver. If such is the case, you ought to have a reversal of the image at the top of the plate, and non-reversal probably at the bottom. I think I can show you this in the lantern. I exposed to gelatine films, such as are prepared by Mr. Stebbing, behind a plate which is prepared with squares of different thicknesses of coloured gelatine; that is to say, it allows different gradations of light to pass through. On these graduated thicknesses of gelatine are painted opaque numbers. No. 1 shows the thinnest amount of gelatine, and No. 25 shows the thickest amount of gelatine. With a moderate exposure to light of a gelatine plate behind such a screen, the whole of these opaque numbers ought to appear transparent on a more or less opaque background plate, when developed and fixed.

Now I will show you an experiment demonstrating what over-exposure will do. Two of Stebbing's films were placed face to face, and exposed for a considerable time to light behind a graduated screen. The results are before you. On the film nearest the graduated screen, the whole of the numbers as far as twenty are reversed; that is, appear opaque on a transparent background. On the bottom film, except No. 1, the whole of the gradations are perfect; that is to say, there is not a reversed image at all. Thus you see that a reversal takes place in the top part of the film, and not at the bottom. That is the point I wish to bring before you. No doubt this reversing action is partly due to the bromine which passes over the molecules which lie immediately below it. Not only that, however, but, if you enter into the chemistry of the thing, you will find that gelatine will take up the bromine, as it is liberated, though slowly; and that, when bromine combines with gelatine, one of two things happens—it either replaces and liberates hydrogen, or else a molecule which has the properties of hydroxyl. Either of these will combine with bromine to form hydrobromic acid, or yet another compound of bromine, which is equally ready to destroy the photographic image as bromine itself, or as any oxidising agent such as I showed you just now.

Now, before I quit the subject of oxidising agents, I should like to introduce to your notice a very remarkable utilisation of this oxidising process of photography which was proposed, and not only proposed, but carried out—there is a great distinction between the two, for we often hear propositions made by men who perhaps never have the pluck to carry them out—by Mr. Bolas. He, first of all, took an ordinary gelatine negative with proper gradations of light and shade. Then he wanted to reproduce it, so he took a gelatine plate, and immersed it in bichromate of potash, allowed the film to dry, and then exposed it to light behind the negative to be reproduced. You will see that in this exposure to light he had an oxidising agent present in his film, and that the oxidised parts were acted upon by light, leaving the other part intact, and by that means he got a reversed image. Now, he was aided by the fact that the gelatine is rendered insoluble to a large extent by bichromate of potash, but still that is not everything.

Another use of oxidising agents is to enable us to get rid of fog. If you have a gelatine plate which has been exposed to light, and so has been fogged, you can get rid of that fog by immersing it in bichromate of potash. I have here a fogged emulsion plate of which the upper half has been immersed in bichromate of potash, the bottom half is completely veiled, but you will notice how beautifully clear the top half is, where the plate has been immersed in the bichromate.

The next subject I wish to treat of is one which has been much misunderstood by many. On this plate is pasted tin-foil, with various figures cut on it; first, there is a circle, then a line across, and so on. The image of these figures I now throw on a monster gelatine plate, the thickness of the glass being some ¾in. Now I ask you to observe what you see on it. You see every figure surrounded by a halo. Thus, the circle is surrounded by a ring. You have a halo round every part of the images (Fig. 1). If you come to analyse it, you will find that the halo surrounding the bright cross is made up of a series of rings similar to that ring which surrounds the clot of light. Now, I have here some wonderful elixir to get rid of these haloes. I touch the back of the plate where the cross falls with asphaltum, the halo vanishes. I move the plate a little, to get a fresh surface, and with red varnish I again touch the back of this plate, behind the cross, and now I have a white cross on a red background: to put the matter in words, according to the medium you place on the back of the plate, so is the reflection toned down. If I use a red varnish, this halation will have but little effect on the photographic plate, because it is red, and these red rays do not much affect the production of a change in the sensitive salt. The most perfect cure for halation is Brunswick black; there is no reflection from the back of the plate, and by that means you get rid of any tendency to fuzziness of the image, which was often a disgrace to photographers' pictures. I will now throw on the screen one or two of the absolute photographs showing different halations. One is from an ordinary plate, the other from a thick glass plate; when the thick one comes on the screen, instead of the cross remaining where it was, it spread out considerably (Fig 2). When you come to analyse it mathematically, you will find the diameters of these rings depend on the thickness of the glass, together with the critical angle of reflection for the glass employed: that the greatest intensity in the ring is fixed by the critical angle alone. That is a very important point, because there has been a good deal of controversy about it. I think what you saw on the gelatine plate, and what you see on the screen now, ought to settle that point for ever. I will show you some plates taken with an asphaltum backing; it is of no use giving improper backing; if you have anything which will reflect blue light, you get this blurring of the image. With a plate prepared with a backing of asphaltum, you can even expose it to a bright image of the sun without getting a halo round it. An astronomer in Germany has recently deluded the French Meteorological Office into believing that he has photographed the corona in full sunlight, but when you come to inquire into the matter, this corona is nothing else than the halation; not only that, but he has found the most extraordinary rays shooting out from it at certain times. When, however, you come to investigate the question, you will find that these wonderful rays which are supposed to proceed from the sun, and thus to influence our earth, are nothing more than a certain reflection which the laws of optics tell us ought to be there. Here is a simple method by which photographers can always be sure of seeing what amount of blurring they may get. If they take the trouble to place a gelatine plate, or any plate they wish to try, in contact with a slit cut in tinfoil, and then look through the back of the glass at a strong light, they will find it has more or less blurring round the slit.

FIG. 1.

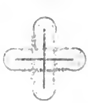
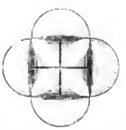


FIG. 2



Having so far digressed, I may say that the reason why you get apparently greater reversal in a photograph taken on a glass plate than you do in a paper negative, is because there is none of this halation to help it.

There is also another reason why reversal is more difficult to secure on paper, in that the bromine has two ways to escape, one through the paper and the other through the surface of the bromide.

Now I will show you how you can get rid of this reversal altogether. The film before you was exposed 60 seconds behind a negative to the full sunlight, yet there is no reversal on it. How is that? Simply because I gave it something which, instead of allowing the bromine to attack the bromide of silver, that had been altered by light, at once took it up. The substance employed was potassium nitrite. This shows that, if you want to get rid of the reversal of the image, you must give the plate something which will very rapidly absorb bromine, and I should say something, if possible, which is not organic, for the reason I have already stated to you.

I now come to a description of a most useful instrument introduced by Mr. Warnerke, which is known as a sensitometer. It consists of squares of coloured gelatine of different opacities, through which light is allowed to fall on a sensitive plate. The method of operating is very much the way in which I operated just now. First, a phosphorescent tablet is exposed to magnesium light, and then allowed to rest a minute, placed in contact with the sensitometer plate, which is in front of the plate to be tried. The exposure lasts for half a minute, and the plate is then developed. The last distinct number seen upon the plate by reflected light, before fixing, is read off. By a simple table you are able to see the comparative sensitiveness of two particular plates of the same kind. Here, owing to Mr. Warnerke's kindness, I have an enlarged apparatus, showing the way in which you read off the sensitometer. Suppose, for instance, you find the last number on one plate to be 20 in the one case, and 16 on another, if you take two such plates out in the field in the same light, and you want to know how much exposure to give in the one that registers 16, knowing that necessary for the one reading 20, how are you to do it? You take Mr. Warnerke's instrument, such as we have here (but in miniature, of course), you place this opening at 20, you then cast your eye on the ring, look at 16, and find that the one that registers 20 is three times more rapid than the one that registers 16, and expose accordingly; so, in the same way, if you had one that registered 25, which is a very high degree of sensitiveness, and another 12, you would find that you would have to give the one 36 times more exposure than the other.

This leads me on to the measurement of the intensity of light, for if we want to know anything about our plates, we must know what brightness of light we have. I again have to allude to Mr. Warnerke. He has introduced an actinometer which is dependent on phosphorescence for its value. I have here a phosphorescent tablet which has been as little illuminated as possible. Now I will throw the spectrum upon it. This bright spectrum of phosphorescent light extends into the ultra-violet, but stops short at the place in the indigo, where the phosphorescent light is emitted, that is to say, one spectrum ends where the other begins. Mr. Warnerke has shown us that by exposing such a phosphorescent tablet to the action of light, by an ingenious contrivance, he is able to tell the photographic value of the particular light. There are some bright days in summer, the light of which, when spread out in a spectrum, let us represent by a rectangle, that is to say, they are all of equal intensity. I do not say they are, but you can represent them as such. There are other days in autumn or winter in which the ultra-violets will very much decrease. If you judge the exposure by the eye, you may be entirely wrong, and if you are using a iodide plate, you may only give one-third of the exposure you ought to give: for chloride only one-fourth; for bromide about one-half. If you are using one-half iodide and one-half bromide, you would give only two-thirds of what you ought to give, so that the eye is no exact judge of the exposure you ought to give; it depends on the amount of rays which exist in the ultra-violet, and that can only be told by a photometer of some description.

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

USEFUL AND SCIENTIFIC NOTES.

Putrefaction and Antiseptics.—M. Le Bon has lately obtained results which seem to have important practical bearings. The "normal liquid" he used for putrefaction was an aqueous solution containing hashed meat to the extent of a tenth of its weight. He finds that the disinfectant power of any antiseptic is weaker the older the putrefaction (new products are given off, in time, by the putrefying liquid, that are not so easily destroyed). Measuring the power of antiseptics by their disinfectant properties on a given weight of the normal liquid, the strongest disinfectants appear to be (in order), permanganate of potash, chloride of lime, sulphate of iron acidified with acetic acid, carbolic acid, and the glyceroborates of sodium and potassium. There is no parallelism between disinfectant action and action on microbes. Thus, permanganate of potash, so strong in the former respect, has no appreciable action on microbes; alcohol, a strong preventer of microbes, is very weak as a disinfectant. Nor is the parallelism between the power of preventing putrefaction and that of stopping it when it has arisen. Alcohol and carbolic acid, preservative agents *par excellence*, have very little effect on putrefaction once commenced. With exception of a very small number of substances that are strong poisons (as bichloride of mercury), most antiseptics, and notably carbolic acid, have very little action on bacteria. M. Le Bon has at present carbolised solutions several months old, rich in bacteria; indeed he thinks, this acid one of the best liquids for preserving live bacteria a long time. There is no parallelism between the virulent power of a substance in putrefaction and the toxical power of volatile compounds given off by it—indeed these properties seem to be even in inverse ratio. A frog is placed in an inclosure with some of the liquid. When putrefaction sets in, a very fetid odour is produced and the liquid swarms with bacteria, and is known to be very virulent if injected under the skin of an animal; but the frog, merely breathing the effluvia, takes no harm? After two months, the liquid ceases to have virulent properties, but the animal breathing its volatile products is killed. The very small quantity of products of advanced putrefaction necessary to kill an animal by simple mixture with air proves those volatile alkaloids to be extremely poisonous. M. Le Bon ascertained that they are so to man. He knows only a very small number of substances, such as nicotine, prussic acid, and the new alkaloid he lately extrcted from tobacco, that are as poisonous. The experiments explain the evils arising from bodies long buried, and prove that the atmosphere of cemeteries may be very dangerous.

Electric Railways.—The development of electric railways and tramways is now considerable. Putting aside numerous lines that are merely talked of or projected, those which are working, authorised, or in course of construction, show a total length (according to the *Revue Industrielle*, July 19) of 160 kilometres—i.e., about 100 miles, and grants are becoming even more numerous. The lines actually at work are those of Lichterfelde (about 2·6 kilometres in length), and that from the Spandauer Rock to Charlottenberg, near Berlin; another line from Port Rush to Bush Mills, in the north of Ireland, has been inaugurated (length about 10 kilometres), and also in Holland, one from Zandvoort to Kostverloren (length a little over two kilometres.) Among lines authorised or in construction, the following are noted:—In Austria, the Mœdling line, near Vienna (2½ kilometres), to be constructed by the Southern Railway Company there. In Germany, the line from Wiesbaden to Nurnberg (two kilometres), and that from the Royal Mines of Saxony to Zankerode. In England, a line under the Thames, connecting Charing-cross and Waterloo Stations (1·2 kilometres); also a line in South Wales (60 kilometres), for which the force will be derived from fall of water. In Italy, Turin, and Milan will soon begin the construction of electric tramways. In America the Edison Company have arranged for the working of 80 kilometres on one of the great lines from New York. Another small line (1·8 kilometres) is to be made at St. Louis, in Missouri, by Mr. Heisler.

THE widening of the grand canal from Rotterdam to the sea, estimated to cost 43,800 florins—nearly £3,700—is to be carried out forthwith.

BRITISH ASSOCIATION.

THE ADDRESS IN BIOLOGY.

THE Address in Section D was delivered by the President, Dr. Arthur Gamgee, F.R.S., who took for his subject the growth of our knowledge of the function of secretion. In commencing, the President paid a tribute to the memory of Darwin, and reviewed the writings of the late Prof. F. M. Balfour, who was appointed in 1881 one of the two general secretaries of the Association. The subject proper of the address was of purely technical interest, but Dr. Gamgee commenced by explaining the opinions of the ancients with regard to secretion, and then passed in review the teachings of the distinguished men who have laboured to unravel the mysteries of secretion. The ancients, even Galen, held that the glands were sieves or colanders which served to strain off from the blood purely excrementitious substances; and strangely enough they did not regard the liver and kidneys as glands, but placed them among the viscera. The researches of Johannes Müller, published in 1830, seem to have been the first successful attempt to place the subject clearly before students, and of Müller Dr. Gamgee says he will probably be the last man of whom it will ever be said that he was at once the greatest comparative anatomist of his time, and the most philosophical and original of all contemporary physiological writers. With brief reference to the work of Schwann, Purkinje, and Henle, the President reviewed the labours of John Goodsir, and of Bowman, and then went on to describe the discoveries of Carl Ludwig, to whom belongs the credit of having, above all others, brought the light of experimental physiology to bear upon the subject of secretion. Ludwig discovered that during secretion heat is evolved in the glands, which is the strongest proof we have that the act of secretion is the result of the living activity of those ultimate units of the glands, the gland-cells. The work of later investigators was noticed at considerable length by Dr. Gamgee, who summed up a voluminous but valuable address with the following conclusion:—

The complicated studies, of which I have attempted to give you a brief sketch, have led to our forming certain clear general conceptions in reference to the process of secretion. They have brought into greater prominence the dignity, if I may use the expression, of the individual cell. The process of secretion appears as the result of the combined work of a large number of these units. Each, after the manner of an independent organism, uses oxygen, forms CO_2, evolves heat, and derives its nutriment from the medium in which it lives, and performs chemical operations of which the results only are imperfectly known to us, and which depend upon peculiar endowments of the cell protoplasm, of which the causes are hidden from us. So long as the protoplasm is living, the gland-cell retains its power of discharging its functions, and in many cases does so, so long as the intercellular liquid furnishes it with the materials required. In some cases, however, the gland-cells are specially sensitive to a variation in the composition of the nutrient liquid, certain constituents of which appear to stimulate the protoplasm to increased activity. In the higher animals the cells, particularly in certain glands, are in relation to nerves which, when stimulated, affect in a remarkable manner the transformations of their protoplasm, leading to an increased consumption of oxygen, an increased production of carbonic acid, an increased evolution of heat, and an increased production of those matters which the cell eliminates and which constitute its secretion. This historical survey of the growth of our knowledge of the process of secretion exhibits the characteristic features of biological advancement. Comparative anatomy has been the foundation of observation of facts and physical experiment, the road to physiological research. At various stages the value of hypotheses has been well illustrated, and whenever they have had to make way for the broader and truer interpretations suggested by the accumulation of facts and greater precision of observation, it has been demonstrated that the process of observation is not one of simple sight but of complex ratiocination.

In the

Department of Anthropology,

Professor W. Boyd Dawkins, delivered an address on the present phase of the Antiquity of Man, in which he said:—I propose to place before you the present phase of the inquiry into the antiquity of man, and to point out what we know of the conditions of life—though our knowledge of them is imperfect and fragmentary—under which man has appeared in the Old and in the New Worlds. The rudely chipped implements left by the primeval hunters in the beds of gravel of Hampshire and Wiltshire, and along the shores of Southampton Water and elsewhere, are eloquent of the presence of man in this district, at a time when there was no Southampton Water, and the elephant and the reindeer wandered over the site of this busy mart for ships; when the Isle of Wight was not an island, and the River-drift hunter could walk across from Portsmouth to Cowes, with no obstacle excepting that offered by the rivers and morasses. Professor Boyd Dawkins then gave a résumé of the discoveries made in various parts of the world, and concluded with the following summary:—

Thus in our survey of the group of animals surrounding man when he first appeared in Europe, India, and North America, we see that in all three regions, so widely removed from each other, the animal life was in the same stage of evolution, and "the old order" was yielding "place unto the new." The River-drift man is proved by his surroundings to belong to the pleistocene age in all three. The evidence of Palæolithic man in South Africa seems to me unsatisfactory, because as yet the age of the deposits in which the implements are found has not been decided

It remains now for us to sum up the results of this inquiry, in which we have been led very far afield. The identity of the implements of the River-drift hunter proves that he was in the same rude state of civilisation, if it can be called civilisation, in the Old and New Worlds, when the hand of the geological clock pointed to the same hour. It is not a little strange that his mode of life should have been the same in the forests to the north and south of the Mediterranean, in Palestine, in the tropical forests of India, and on the western shores of the Atlantic. The hunter of the reindeer in the valley of the Delaware was to all intents and purposes the same sort of savage as the hunter of the reindeer on the banks of the Wiley or of the Solent. It does not, however, follow that this identity of implements implies that the same race of men were spread over this vast tract. It points rather to a primeval condition of savagery from which mankind has emerged in the long ages which separate it from our own time. It may further be inferred, from his wide-spread range, that the River-drift man (assuming that mankind sprang from one centre) must have inhabited the earth for a long time, and that his dispersal took place before the glacial submergence and the lowering of the temperature in Northern Europe, Asia, and America. It is not reasonable to suppose that the Straits of Behring would have offered a free passage, either to the River-drift man from Asia to America, or to American animals from America to Europe, or *vice versâ*, while there was a vast barrier of ice or of sea, or of both, in the high northern latitudes. I therefore feel inclined to view the River-drift hunter as having invaded Europe in pre-glacial times along with the other living species which then appeared. The evidence, as I have already pointed out, is conclusive that he was also glacial and post-glacial. In all probability the birthplace of man was in a warm if not a tropical region of Asia, in "a garden of Eden," and from this the River-drift man found his way into those regions where his implements occur. In India he was a member of a tropical fauna, and his distribution in Europe and along the shores of the Mediterranean prove him to have belonged either to the temperate or the southern fauna in those regions. It will naturally be asked, to what race can the River-drift man be referred? The question, in my opinion, cannot be answered in the present stage of the inquiry, because the few fragments of human bones discovered along with implements are too imperfect to afford any clue. Nor can we measure the interval in terms of years which separates the River-drift man from the present day, either by assuming that the glacial period was due to astronomical causes, and then proceeding to calculate the time necessary for them to produce their result, or by an appeal to the erosion of valleys or the retrocession of waterfalls. The interval must, however, have been very great to allow of the changes in geography and climate, and the distribution of animals which has taken place—the succession of races, and the development of civilisation before history began. Standing before the rock-hewn tombs of the kings at Luxor, we may realise the impossibility of fixing the time when the River-drift hunter lived on the site of ancient Thebes, or of measuring the lapse of time between his days and the splendour of the civilisation of Egypt. In this inquiry, which is all too long, I fear, for my audience and all too short, I know, for my subject, I have purposely omitted all reference to the successor of the River-drift man in Europe—the Cave man, who was in a higher stage of the hunter civilisation.

ABSTRACTS OF REPORTS, PAPERS, &c.

The Forth Bridge.

Mr. B. Baker read a paper on the Forth Bridge, in which he stated that to Sir Thomas Bouch was due the credit of the bold proposition to cross the Forth in two spans of 1,600ft., and so avoid the necessity of intermediate piers in unprecedented depths of water. That structure, however, was abandoned after the disaster to the Tay Bridge, and Mr. Fowler had himself submitted a project for a bridge on the continuous girder principle. An Act had accordingly been obtained for constructing such a bridge having two spans of 1,700ft., two of 675ft., fourteen of 168ft., and six of 50ft., with a clear headway of 150ft. above high water spring tides. Not only would such a bridge prove stiffer than a suspension bridge, but it would also be cheaper. Steel was to be used in the construction of the bridge. No punching or shearing would be allowed, all holes being drilled through the whole thickness of plates and angles after being put together. The effect of wind pressure on the superstructure had been carefully guarded against, and he thought it might be said the bridge would withstand the strongest hurricane yet known. The total length of the great continuous girder was 5,330ft., or say a mile, and the viaduct approaches 2,754ft., or rather over half a mile. The heaviest train traversing the bridge would not deflect the 1,700ft. girder more than four inches, while a wind pressure equivalent to 30lb. per square foot over the entire 1,700ft. would bend the bridge laterally less than nine inches. About 42,000 tons of steel would be used in the superstructure of the main spans, and 3,000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations would be about 125,000 cubic yards, and the estimated cost of the bridge £1,500,000.

Migrations of Birds.

The Committee appointed at York for the purpose of obtaining observations on the migration of birds at lighthouses and lightships stated that their general report has been unavoidably delayed in printing. The wave of migration this season has been widespread upon the greater portion of our east coast line, but north of the Firth of Forth has been much more limited, more compressed and normal. The general direction has been as before, from east to west or south-east to north-west. The greatest numerical returns on the east coast of Scotland were from the Isle of May, and the next greatest from Bell Rock. North of the latter birds are reported much scarcer, while south of the former there has been a broad stream, covering the whole of our east English coast, of comparatively equal proportions, and without great throbs or "rushes." Judging from previous records by Edwards and others, Spurn Point is a great point of departure on the English coast, and we have seen that gray plover, knot and bar-tailed godwits shoot off the land there, because, while they are annually seen there and southward of it in large numbers, and in full breeding dress, nowhere to the north of it do they appear, except in isolated cases. Still the routes of spring migrants, while they are usually more direct than those of autumn migrants, are perhaps more difficult to trace, and our *data* are far from perfect yet. This is in no small measure caused by the well-known fact among ornithologists, that it is always more difficult to fix dates of departure than to fix those of arrival. Large numbers of birds which regularly arrive in the autumn, as the greenfinch, chaffinch, snow bunting, and others, and which remain for a few days only, and then pass on, have this year continued for many weeks and even months, resorting in immense flocks to the stubbles, where they found abundant supplies of food. Snow buntings have been considerably in excess of anything known for many years, the proportion of old birds being not more than one in a hundred. Hooded crows came with their usual regularity almost to a day, the great flight crossing Heligoland on the afternoon of October 17 and also on the 18th. There was a corresponding arrival along the entire length of the east coast of England on the night of the 17th or early morning of the 18th, also on the 19th. The season of 1881-82 will long be remembered by east coast ornithologists for the number of rare visitants which have appeared from time to time, driven to westward of their ordinary lines by the prevailing winds from north and north-east to south and south-east, generally strong and increasing to a severe gale. The form of a migratory movement is effected by the prevailing winds even more than than the severity or otherwise of the weather. With a dry, hot summer in northern Europe migration is always earlier than in years of rain and low temperature, birds breeding sooner in the former, and the nestlings, like all other young things, with dry weather and sunshine developing more rapidly. Nothing is more remarkable in the phenomena of migration than the punctuality with which certain species return in the autumn, one species regularly taking precedence of another.

The Electric Furnace.

A paper was read by Prof. Huntington on the electric furnace and experiments made by Dr. C. W. Siemens and himself. He said that the great advantage which the electric furnace possessed was that the temperature attainable was practically unlimited, plumbago crucibles had been used in the experiments, the clay crucibles fusing in a few minutes. Among other experiments made, was the fusing of wrought iron. Six pounds was kept under the action of the arc for 20 minutes, and was rendered quite unforgeable. It had been supposed that this result when previously obtained was due to the presence of oxygen, but in this experiment it was clear it was not due to oxygen. Steel fused in the furnace had a very spongy and crystalline fracture. White iron fused with coke remained unaltered, and they found that coke was not a satisfactory material for causing carbonization. One pound of copper was put into the furnace with a view to ascertain whether carbon could be introduced into copper at any temperature. On opening the furnace only 900 grains of copper remained, the rest having been volatilised.—Dr. Siemens was not prepared to say whether Prof. Huntington was right in saying that the temperature to be obtained by the electric furnace was unlimited, but they certainly did not know where the limit existed. They could obtain intense heats under very advantageous circumstances, inasmuch as the crucible was chemically the coolest part of the arrangement and the metal or other substance to be acted upon was subjected to the highest temperature. The experiments they had made amounted to a promise of interesting results in certain practical directions. The furnace had shown its wonderful capacity for converting substances into their natural or gaseous condition, and he believed it would be found extremely useful to chemists and metallurgists.

Compressed Air Locomotives.

A paper was read by Sir F. Bramwell, on Compressed Air as applied to Locomotion. He described an improved air tram, running from Doulon to Chantonay, at Nantes, by the side of the river Loire. A car on similar principles has been designed by Sir F. Bramwell for experimental running on the Caledonian-road, London. The novelties in this car were explained to be a contrivance called a "hot pot," for avoiding the loss of power due to condensation, and a regulating valve, which enabled the driver to insure that whatever the pressure of air left in his reservoir at any point of his journey he can maintain the same pressure in the pipes leading to his engine. The cost per mile per hour was said to compare favourably with horse traction.—Captain Galton looked forward to the displacement of steam and horse traction by compressed air, which had the special advantage of being almost noiseless.—Sir J. Hawkshaw also anticipated a time when compressed air would be extensively applied, because even if it proved a little more expensive than steam it was preferable in its working.

Report on Underground Temperature.

Prof. Everett presented the report of the committee on the Underground Temperature. In the statement of the work done during the year it was mentioned that the first time there had been obtained readings of the thermometer below the sea was at the Croft Pit, near Whitehaven. A summary was also presented of the observations made in 14 previous years. The results of these went to show that the increase of temperature varied in its rate of increase downwards from one degree Fahrenheit per 130ft. at the Bootle Waterworks, Liverpool, 1,392ft. deep, to 1deg. Fahrenheit every 34ft. At the Slitt Mine, Weardale, Northumberland, depth 660ft., the mean increase of temperature per foot is found to be ·01563, or about 1-64th of a degree per foot, or 1deg. Fahrenheit in 64ft. This was a lower ratio than had been generally assumed, but it had been fairly deduced from the evidence contained in the committee's reports. Reference was made to the experiments on the conductivity of a variety of rocks made by Sir W. Thomson and Professor Herschel to ascertain the escape of heat. The results gave for the flow of heat through a square centimetre of the earth's surface in a year 41·4 gramme degrees.

Zoological Stations.

The report of the committee appointed for the purpose of arranging for the occupation of a table at the Zoological Station at Naples, stated that the activity and prosperity of the institution continue in a course of steady development, the number of naturalists who have visited the station during the past year showing a regular increase, and the published results of the investigation undertaken by them standing in proportionate ratio. No better proof than this could be furnished of the important position held by the station in relation to the progress of zoological science generally. In the "Bericht" for 1881, issued by Prof. Dohrn, attention is very naturally drawn to this increase of working visitors, notwithstanding the fact that during the ten years which have now elapsed since the foundation of the station at Naples, nearly a dozen establishments with a similar object in view have sprung into existence elsewhere. In no instance, however, can these kindred institutions be said to rival, either in magnitude or in scope, the proportions of their Neapolitan forerunner. The Committee appointed for the purpose of aiding in the maintenance of the Scottish Zoological Station reported that, with the aid of the sum of £40 voted last year, further investigations have been made by Mr. Romanes, F.R.S., and Prof. Cossar Ewart, at Oban, where, in addition to the ordinary forms abundant on the east coast, Antedon was plentifully obtained for examination. The publication of the results obtained at Oban is reserved until the further researches now in progress are completed. During the present autumn, Mr. Romanes and Profs. Ewart and Schafer are at work on the Rosshire coast. The Committee respectfully request that a sum of £50 be voted to assist in meeting the expenses of the station.

Report on Meteoric Dust

Prof. Schuster read the report of the Committee on Meteoric Dust. M. Tissandier, he stated, had found in meteoric dust small particles of iron in a perfectly spherical form, and some dust sent to him from the Sahara desert contained similar particles, which must have been at one time in a state of fusion. The particles also contained small quantities of cobalt and nickel. The reason why these particles are unoxidised was probably accounted for by the absence of oxygen in the upper regions of the atmosphere.

Cave Explorations and the Conquest of Britain.

Prof. Boyd Dawkins read a paper on "The Light thrown by the Exploration of caves on the Conquest of Britain." Prof. Dawkins said that in the course of his explorations he had lighted upon what he thought might prove to be valuable evidence as to the character of the English conquest of Britain. In the districts of Settle and neighbourhood there were a large number of caves which contained many curious objects. The flooring was often composed of broken bones of animals used for food. In the Victoria Cave, near Settle, there had been found large quantities of Roman pottery. Spindle whorls and objects like spoons, with a hole in the middle, highly polished and finished, which on examination turned out to be brooches, and other ornaments of a similar character were also found. Articles of a similar kind had been found near the remains of Roman habitations, especially at York. Thus we were driven to the conclusion that the people who left these remains in the Victoria Cave had been driven to take refuge there from an enemy. Coins had also been found there, and the evidence pointed to a date between 400 and 500 A.D. The Victoria Cave, was, however, only one of a number in which objects of a like character had been discovered. But who was the enemy from which the Roman provincials fled? In 607 the British provincials were defeated at Chester by the invading English, who for the first time reached the Western Sea. When the English had thoroughly conquered these regions the cave ceased to be inhabited. Caves containing remains which pointed to the same period had been discovered at Kirkcudbright and other parts of Scotland. That portion of the country was conquered by the English, aided by the Picts, about 756, and Dumbarton was captured and destroyed. The same type of remains were discovered in Derbyshire, in South Wales, on the shores of the Severn, at Torquay, and elsewhere. Devon was probably conquered between 754 and 786. There was little doubt that those caves of Derbyshire and Devonshire where like those of Yorkshire, places of refuge from an invading army. The same conclusion was to be drawn from the remains of Roman villas in different parts of the country. The villa had generally been burnt, and in its neighbourhood were found articles of a like character to those which had been discovered in the caves. Thus geology added her testimony to that of history, as in her researches she lighted upon remains which appeared to belong to historic times. In this manner the real character of the English conquest was disclosed, and the statements, often discredited, of Gildas and the Anglo-Saxon Chronicle were strikingly confirmed.

Report on Electrical Standards.

Lord Rayleigh submitted the report of the committee on electrical standards. Almost the only matter in which progress has been made is in experiments upon the effect of annealing upon the electrical resistance of various wires, and particularly upon the temperature of the co-efficient—that is to say, the changes which the wire undergoes when its temperature is altered. These experiments were made by Mr. Taylor, and led to unexpected results, showing that the changes were greater than had been supposed, and that consequently the difficulty in the way of obtaining thoroughly satisfactory resistance standards was as great as with German silver wire. The result obtained was ·0296, but, after annealing, it was ·0421—a very considerable change. With steel wire the change was from ·267 to ·316. After annealing, other metals exhibited variations. Mr. Taylor and Dr. Muirhead will continue the experiments.—Dr. Siemens offered some suggestions on extending the practical system of units in electrical measurement, and referred to the units associated with the names of Weber, Ohm, Volta, Ampère, Coulomb, Joule, Watt, and Faraday.—In the discussion which followed, Sir W. Thomson, Prof. Clausius, Prof. Everett, Mr. Preece, and others took part. Mr. Preece supported the introduction of the unit of power associated with the name of Watt, and Joule's unit of heat or energy. Lord Rayleigh also supported the Watt and Joule units, and Dr. Siemens said that he attached the greatest practical importance to these.—Sir W. Thomson exhibited and described a new form of galvanometer for measuring currents and potentials in absolute units. Its advantages were its easy portability and the perfect "astronomical" steadiness of the magnetometer movable in a "V" slide.

Light of the Sky.

Captain Abney read a paper on the light of the sky at high altitudes, based upon observations made in the Alps, on the Riffel, at a height of 8,500ft. His investigations proved that in high altitudes the light of the sky diminishes very much so as to make photography difficult, and that it is only a tenth or a twentieth of that which is found on the surface of the earth. There was a remarkable absence of the rain-band spectrum. On the Riffel he only saw it once, and that was during a shower. The solar spectrum was the same on the Riffel as in London. He did not believe that aqueous vapour was present in the upper regions, at all events in the form in which it exists below. In the red part of the spectrum he found that the benzine and alcohol which had been found to exist in the atmosphere actually increased in strength in the higher regions, and he could only suppose that benzine and alcohol are not of terrestrial formation, but come to us from space.—Dr. Glaisher said had he never failed up to five miles in getting a deposition of vapour, and there was no part of the earth's atmosphere probably in which there was no aqueous vapour. At a height of seven miles in a balloon he had seen cirrus clouds still higher, and there was a great difference between the state of the atmosphere in a free balloon and on a mountain side. Prof. S. P. Langley, of Allegheny, Pennsylvania, in a paper on the distribution of energy in the solar spectrum, stated that he had investigated the infra-red spectrum at a height of 13,000ft. in a very dry region, and found that it extends very much further than had been mapped heretofore. The wave-lengths of the visible parts of the red end of the spectrum are only one-fourth of those in the infra-spectrum, so that three-fourths of the energy were invisible. His observations proved the existence of great gaps in the spectrum, and he was inclined to support Abney's conclusions on the existence of benzine and alcohol in space.

Spectra of Metals.

Prof. Liveing read a paper on the reversal of the spectral lines of metals. He said the object in investigating the reversal of the lines of terrestrial elements had been to trace the parallel between the conditions of the elements as they exist in the sun, and those in which we can place them on earth, with a view to illustrate more fully the problems of solar chemistry. A knowledge of the reversible lines might also help us to distinguish those rays which are directly due to the variations communicated to the luminiferous ether by the molecules themselves from those which are produced by superposition of waves. It was not enough to merely interpose the vapour of the metal to be examined between the slit of the spectroscope and some bright light, because the relative strength of the emissive and absorptive powers of a vapour for particular rays often varies considerably where the temperature is changed.

USEFUL AND SCIENTIFIC NOTES.

A New Milk Tester.—A novel apparatus for testing milk has been brought out by a company in Copenhagen. It consists of a round disc fixed to a vertical rotating axis such as the axis of a centrifugal machine. The disc has parts removed at intervals, and the intermediate portions are bent so as to form supports or bearings for the pivots of metal cylinders. In these are placed graduated bottles containing a certain quantity of milk to be tested. When the machine is in operation, the cylinders and their contained bottles are caused to assume a horizontal or approximately horizontal attitude, but when it is stopped they resume the normal or vertical position. The heights of the cream layers in the bottles after rotation has stopped, indicate the quality of the contents. To prevent breakage of the bottles, discs of caoutchouc are provided in the bottoms of the cylinders, and at the sides near the bottoms are holes to prevent air resisting the putting in or taking out of the bottles.—*Live Stock Journal.*

More than 1,000 deaths are recorded as having resulted last year from accidents in mines in Great Britain.

A valuable discovery has, it is said, just been made in Lehigh county, which is so rich in iron, slate, zinc, and other mineral deposits. Emery has been found in quantity, and of excellent quality.

SCIENTIFIC NEWS.

Although the British Association is to visit Montreal in 1884, according to the vote at the recent general meeting, there is much opposition to the proposal, and it is not unlikely that the visit will be postponed indefinitely.

Amongst the "grants" voted for next year, may be mentioned £50 for meteorological observations on Ben Nevis (Prof. Crum-Brown), £500 for exploring Kilimandjaro and the adjoining mountains of Eastern Equatorial Africa (Sir J. Hooker), £25 for the Scottish zoological stations (Dr. Pye-Smith), £80 for table at the Naples Zoological station (Pro. Ray Lankester), and £5 for patent legislation (Sir F. Bramwell). Provision has been made for the continuation of the records and the usual reports. The receipts amounted to £1,286.

The report of the committee on screw gauges, stated that, after comparing together a large number of screws, they had decided to adopt the Whitworth thread. They asked for reappointment to complete their labours, which was conceded, with a grant of £20.

Among the instruments described during the meeting, was one exhibited by Sir F. Bramwell, employed for ascertaining the velocity of trains and the efficiency of brakes. With this apparatus it was found that a train weighing 125 tons ran 5 miles 5 yards after steam was shut off while travelling at a speed of 45 miles an hour. The line was level and the day perfectly calm.

The number of associate tickets issued during the meeting was 516; ladies' tickets, 189. The corresponding numbers last year were 1,232 and 514.

The next meeting will be held at Southport, commencing on the 19th of September, the President being Arthur Cayley, M.A., F.R.S., Sadlerian Professor of Mathematics in Cambridge University.

In the *Astronomische Nachrichten*, Nos. 2449-50, Dr. Jedrzejewicz has published a second series of micrometrical measures of double stars, made by him at Plonsk, in Poland. The stars given in this list consist mainly of doubles with a relative movement either proved or suspected.

The mirror of the Leverrier telescope at Paris has been resilvered in a new manner. It is more than a metre in diameter, and weighs over 1,300lb., and as it will require resilvering about every two or three years it is desirable to accomplish the work with the mirror face upwards. A wall of plaster and guttapercha was built around it, the speculum forming the bottom of a sort of basin into which the solutions were poured. The form of the mirror is not quite perfect, so the telescope is to be used mostly for spectrum analysis of the light of the planets.

L'Astronomie for September contains an interesting paper entitled "Quelle heure est-il? with an illustration of the "canon solaire" at the Palais Royal. M. Ad. de Boë has a paper on the Pole-star and its companion.

News of some of the Arctic meteorological expeditions has been received. The Norwegian station at Bossekop, on the Alten Fiord, commenced operations on the 1st of August. Great magnetic perturbations were observed during the night. The gunboats have returned to Tromsö after landing the Swedish expedition at Cape Thordsen in Ice Fiord, the locality previously decided upon in the event of their being unable to reach Mossel Bay. Off the Norway Islands the gunboats encountered heavy ice, which had lain there since last winter, and which extended eastward as far as they could see. Captain Palander reports that the state of the ice was unusually bad; that the landing was accomplished with great difficulty; and that the observations would commence on the 15th of August. As the *Pola* has not been reported since she left Tromsö, it is reasonable to suppose that her second attempt to reach Jan Mayen has been successful.

The first report on a Boiler Explosion under the new Act has been issued by the Board of Trade. It refers to the explosion at Facit, Rochdale, and is as full as could be expected, being accompanied by diagrams of the boiler. "Inherent weakness in design was the cause of this explosion."

Amongst the machinery at the Bradford Technical School Exhibition is a system of 20 electric-clocks of "one minute action," all being in electrical connection with a standard regulator placed in the entrance-hall. They are so arranged that at every minute an electric-circuit is completed at the regulator, which does the duty of winding the mainspring, and giving sufficient tension to keep the clock in going order; the same electric current that winds the regulator passes through another electro-magnet, which acts as a "relay," and sets on a local battery for the purpose of actuating the synchronous dials. The system is that patented by Reid (see p. 231, Vol. XXXV.)

An exhibition of models of improved railway-waggon couplings and appliances is to be held at Darlington, on October 3rd and the four following days. The exhibition, which has the approval of the Board of Trade, is being promoted by the Amalgamated Society of Railway Servants. It is estimated that 14,000 men are regularly engaged in this kind of work, and of this number 206 have been killed and 1,614 injured in the five years ending with 1880. The risk incurred is said to arise mainly from the use of link or chain couplings, and the necessity of men placing themselves between the vehicles and passing over the rails in attaching or detaching waggons. The promoters of the exhibition desire to show that the use of improved couplings will materially reduce the risk of accidents. Inventors of improved railway couplings are invited to co-operate with the society by sending models of their inventions to the exhibition. Notice of the nature of any intended exhibits must be given before the 25th inst. to the Secretary of the Amalgamated Society of Railway Servants, or to the honorary secretaries of the local committee, and all articles sent to the exhibition must reach Darlington not later than Friday, the 29th.

In connection with the above subject and Mr. Evans's letter (p. 574), we have received a communication calling attention to the fact that Mr. James Douglass's waggon coupler is largely used on some lines. We gave a description of the appliance when it was first introduced. It is a pole with a pin or hook, which enables the shunter to lift the coupling link without going between the trucks. The coupling link is specially made so that the pin on the pole can readily catch it.

The time for making entries to the Electric Exhibition, to be held at the Westminster Aquarium during the winter, has been extended to the 14th instant. The aggregate value of the prizes will be £1,000, and they will be awarded in several branches; *e.g.*, for best system of storage and generator; for best system of street mains or leads; for best sets of fittings for use in different parts of houses; for best electric meter, &c., including a prize for the most complete apparatus for remedial appliances, especially "electric baths."

The French Government has decided to send out the following scientific missions:—M. Chapier, to study the geology and mineralogy of India; Prof. Joret, to examine the ethnology of Denmark and Norway; M. Rabot, to explore the great glacier of Swartisen, in Norway, and also Russian Lapland; M. Raffray, to form a collection of the fauna of Madagascar; and M. Munier-Chalmas, to undertake zoological researches in the neighbourhood of Cormons, north of Trieste and Slavonia.

Herr Helmerson has been appointed Director of the Geological Institute of Russia. A detailed geological map of the Russian empire is in preparation under the care of the Institute, a credit of £3,000 having been provided in the budget of 1882.

A cargo of rye received at Cologne, on examination was found to be almost a mass of living parasites. Samples of the grain have been submitted to several scientific men in Cologne, but none of them recognise the parasite as a known species. The rye came originally from South Russia, and was shipped to Rotterdam, where it lay some time in a granary.

M. J. Van der Berghe, being struck with the constant appearance of a minute quantity of copper in bread, was led to make a very cautious examination of wheat. He found in a million parts 9·24 of metallic copper, and of oats 10·8 parts.

From liquids which, in heating and vaporisation give a strong foam, which hinder the passage of vapour, the foam may be removed by contact with heated surfaces; this is the object of a recent German patent by Herr Heckman. A flat spiral tube traversed by hot-water or steam, or a tube-grating, or a hollow plate, similarly heated, is hung so that it can be let down on the foam when required.

American Indians have a very alcoholic beverage called *Chicha*, prepared by fermentation of crushed maize. This active fermentation of a mass almost wholly of starch has been found by M. Marcano to be due to reproduction of an organism of vibrion type. It is deposited in the outer pellicle of the grain of maize, and has three forms. He has found it also in the stem of maize and in the leaf tissue, and it may thus have to do with the synthetic production in plants of several substances, whose synthesis has not been possible in the laboratory. Its presence in the grain may require a modification (M. Marcano considers) of received ideas; thus there is no need for the hypothesis that makes diastase both the cause and the effect of germination; the origin of the heat developed in this process is explained; resorption of the grain is shown to be due to direct attack by the vibrion, &c.

The U.S. Government are having built in Delaware a fine new iron steamship (800 tons burden), for the special use of the Fish Commission. She will be named the *Albatross*, and one of her first important services will be the transportation to London of the collection to represent the United States at the Great Fish Exhibition next May. Among special appliances of the vessel are a deep-sea dredge, and eight miles of wire rope.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden,* W.C.

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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FOCAL IMAGES, &c. — DECLINATION CIRCLE—SCIENCE FOR THE MILLION IN A WEAKLY FORM — ANOTHER ADVERTISEMENT OF THE SOLAR PHYSICAL GENTRY — ζ HERCULIS — A PRACTICAL FORM OF STAR-GAZING—THE VICAR OF BRAY.

[20460.]—I think that "Lens" (letter 20410, Vol. XXXV., p. 571), will scarcely succeed in raising a really satisfactory disc on a star with any power less than about 35 to the inch of aperture; at least, that is my personal experience. With regard to the second question put by your correspondent, I have, after considerable trouble (in the absence of any reference), succeeded in hunting down his original query (in letter 19795, p. 9 of your last volume), and find that he is pretty obviously labouring under a total misapprehension. The image of the object-glass is formed by the eyepiece alone, which would equally form an image of a book, a candlestick, or a lead-pencil, at a similar distance from it. *It is the object-glass itself, and not any image formed by it*, which constitutes the object whereof we see the image in the eyepiece. We could measure the magnifying power of a telescope just the same if, after focussing on a star, or other celestial object, we removed the lenses of objective altogether and replaced its brass cell in the tube. Hence, to talk about "the diameter of the light-spot, as received on a card, as the focus of such lens," is to employ a mode of expression destitute of any meaning whatever. If "Lens" were to ask, What would be the diameter of the image of the Sun or Moon, at the focus of a telescope of any given focal length? I could answer him at once; but the diffused light of the sky forms no image whatever. It does not, really. And the mention of the image of the Sun suggests to me to add, that if we suppose two 3in. telescopes, one of 50in. focal length, and the other 100in. focus, each to form an image of the Sun at its focal point, it is evident that the diameter of such image will, in the telescope of longer focus, be just double that of the corresponding image in the shorter-focussed instrument. In other words (as the areas of circles vary as the squares of their diameters), the solar image in the telescope of 100in. focal length, will have an area four times that of the similar one in the 50in. telescope. Ex hypothesi, however, the areas of the object-glasses, and hence the amount of light received are identical, so that the larger image will only be one-fourth as bright as the smaller one. I make no doubt that it is my own stupidity which prevents me from seeing exactly what "Lens's" point is with reference to the Cassegrainian telescope. Doubtless, though, "Orderic Vital" will clear up his difficulty at once.

If "Brickwall" (query 47751, Vol. XXXV., p. 580) will reflect for a moment, he will see that the verniers of his declination circle being at opposite extremities of a diameter, must (if in adjustment) perforce both read the *same* declination, be it north or south. Perhaps, the most simple way out of "Brickwall's" curious difficulty would be to make his verniers read 0°, 0°. Then, of course, the telescope is pointing to the equator. If, now, he has to depress the object end to get a star into the field, the verniers will both give its south declination. If, on the other hand, the object-glass has to be raised, the verniers will, equally, of course, each read North Declination. A glance at the telescope will show him whether it is parallel to the hour circle, or which end of it inclines towards that circle.

The gifted philosopher whom I whilom quoted (letter 11529, Vol. XXIV., p. 40), as having referred to "an annular eclipse," in the columns of *All the Year Round*, "when the earth's shadow appears as a black circle in the middle of the solar disc" (!) has, pretty obviously, been at it again in this week's number of your interesting, and generally very readable, contemporary. On the present occasion he condescends to furnish some information on the subject of meteorites, concerning which he speaks of "the generally received opinion being, however, that such of these bodies as are not formed by electric fusion of the soil (!) where they are discovered—as many no doubt are—come from our own volcanoes." One would be really curious to learn among what limited association such an "opinion" is "generally received." Did this instructor of the British public, I wonder, ever hear of the numerous well-determined streams of these bodies through which the earth passes at various points of her orbit? (let us say, for example, the August and November streams). Perhaps, though, he intends to refer to what are more generally known as aërolites, or masses of meteoric matter, which not infrequently fall to the earth. If this be so, it happens a little unfortunately for "the generally-received opinion" that these bodies have by no means infrequently been seen to fall from the sky with an explosion of greater or less violence. Moreover, they have fallen in places in Germany and France, near Glasgow, in Yorkshire, in Tipperary, near Limerick, at the Cape of Good Hope, &c., &c.—localities infinitely too far removed from any volcano for their projection from it to such an impossible distance. The gentleman who "does" the Science (?) on which I am commenting has only to walk through the Mineralogical department of the British Museum to see a large collection of these bodies (including specimens from the localities of which I have spoken): some of these of a size and weight which equally set the volcanic and "the electric fusion of the soil" hypotheses at defiance. The Scotchman in the well-worn anecdote who said of Metaphysics that "whan ae mon talks aboot what he disna understand, till anither mon wha dinna understand hum, *that's* maytapheesics," furnished a definition most singularly applicable to such blind leading of the blind as the astonishing passage on which I have been commenting. Surely, its writer isn't just recovering from a severe attack of "Physiography"?

Astronomers must have read the peroration of Dr. Siemens's long-winded (not to say rather dull) Address to the British Association, with a smile. Verily, if the moribund theory of solar energy of the President of the British Association needs bolstering up by a covert advertisement of that contemptible little scientific sham, the "Committee on Solar Physics," it must be *in articulo mortis* indeed. Those behind the scenes will note how two names are dragged in by the head and shoulders, apropos of the Eclipse of May last, while men like Thollon and Trépied (whose real knowledge of solar physics probably exceeds almost indefinitely that of the two gentlemen whose names appear in Dr. Siemens's advertisement) are dismissed as "Continental observers of high standing," and Mr. Ranyard's—for reasons as obvious as they are pitiable—is ignored altogether. All this may suit the mutual admiration society whose members bask in the sunshine of each other's fulsome flattery, and doubtless the Brompton organ will go into ecstasies of admiration at the admirable oration in which its guiding spirit has been cheaply advertised; but, as I began by saying, astronomers will appreciate all this at its true worth. Even the reader without any special knowledge of the subject under discussion can scarcely fail to estimate the force of Dr. Siemens's logic, outside and irrespective of the merely private and personal part of his address altogether. My theory (he says, in effect) requires that enormous luminous equatorial extensions should perpetually emanate from the Sun. Such extensions have been visible during certain total Solar Eclipses. This shows that my hypothesis is true. They were wholly absent last May—which shows conclusively that I am right again! In watching the street drama of Punch, about Dover-street and other localities where it still lingers in that neighbourhood, I have heard a dialogue which this brings vividly to my remembrance. "About three weeks ago," says the undoubtedly legal owner of the dog Toby, "About three weeks ago, I lost this dog." "Well," replies Mr. Punch, "about three weeks ago, I found him." "That," answers his proprietor, "shows he's mine." "No!" rejoins Mr. Punch, "that shows he's mine." Surely this is no caricature of the reasoning (?) by the aid of which Dr. Siemens essays to prove the truth of his notions concerning the constitution of the Sun in connection with the phenomena observed in Egypt last May. Only this "tant pis pour les faits" style of argument is scarcely philosophical, even if it be good enough for the British Association. Professor Liveing's address (on p. 590 of your last volume) may be consulted with profit in connection with the collapse of Dr. Siemens's hypothesis.

Having now got the authoritative dictum (letter 20434, Vol. XXXV., p. 593) of the first double-star observer in the world as to the distance of the components of ζ Herculis, it would seem that Mr. Herbert Sadler and I must be content to "split the difference."

I am not much given to prophesy; but reading letter 24035 (Vol. XXXV. p. 593), and noting the earnest and practical spirit in which "Discipulus" has begun his examination of the face of the sky, I shall be surprised, and disappointed, too, if he does not in the future make valuable and enduring contributions to astronomical science.

I think that "M. R. C. S." (query 47883, Vol. XXXV.) will find that the most generally received notion is that the Vicar of Bray was named Pendleton. Bray is in Berkshire, and Isaac D'Israeli in his "Curiosities of Literature," says that the Vicar "was a Papist under the reign of Henry VIII., and a Protestant under Edward VI. He was a Papist again under Mary, and once more became a Protestant in the reign of Elizabeth." I have heard, or read somewhere, that this Pendleton was afterwards Rector of St. Stephen's, Walbrook. In the "Letters from the Bodleian," though, is one from Mr. Brome to Mr. Rawlins, in which he speaks of "Simon Alleyn or Allen, who was Vicar of Bray about 1540, and died 1588, so was Vicar of Bray nearly 50 years." The familiar old song speaks of Charles, James, William, Anne, and the Hanoverian succession; but this is doubtless a poetical license. I question extremely whether any really trustworthy information as to the identity of the original of this song is now obtainable.

A Fellow of the Royal Astronomical Society.

λ OPHIUCHI, τ OPHIUCHI, AND 4·56in. / APERTURE.—METEOR.

[20461.]—My thanks are due to "F.R.A.S." for his kind reply to my query as to measures of the above stars. I notice that the Rev. J. J. M. Perry, in his valuable communication in last week's issue, gives the distance of both λ and τ Ophiuchi as 1·34". Now, surely one, if not both, of these measures must be under the mark. I had no difficulty whatever in dividing τ last night with my 3in. Dollond achromatic, power 160; λ, however, was more difficult, and is certainly closer. I resolved it, however, as I have done before, with the single lens of the 160 eyepiece, which has a power of, I suppose, 200—considerably less than my instrument would bear. I believe my sight is good for objects of this class, as I have no difficulty in dividing ϵ^1 and ϵ^2 Lyræ with the naked eye, and can, moreover, always see nine stars in the Pleiades with attention. If Mr. Perry's measures are correct (or either of them) it is evident that the formula 4·56 / aperture needs correction for the high-class instruments of our best makers.

I noted a splendid meteor last night. I first saw it just below β Ursæ Maj. It made almost directly for the horizon; its colour seemed a very bright orange. No doubt it belonged to the Group No. 31 of Mr. Denning's catalogue, given in "Celestial Objects," the radiant point of which is fixed between β and γ Ursæ Maj., and the period July 28th to Sept. 6th.

Referring again to the two stars λ and τ Ophiuchi, I hope some of your contributors with instruments of the same aperture as my own will see what they can do with them. They are now well placed for observation. **E. S. Beaven.**

Warminster, Aug. 29th.

FEATHERY MIST ON MOON.

[20462.]—I CANNOT understand how Mr. Jackson (letter 20334, p. 497) can be sure that what he thought was a feathery mist was not, really a long hill or high ground of some kind faintly illuminated. If I understand him rightly, that it appeared at the edge of the terminator, or in the dark beyond it, how could he distinguish a just lighted hill or ridge from mist? If there were mist there, how would it differ from such a ridge? The light is very misty and transparent sometimes when it is just beginning to rest on the top of some high object. I watched the western border of the Mare Crisium at sunset, a few nights ago, and I saw a long white ridge lying parallel with the promontory Agarum on its western side, which struck me as corresponding closely with Mr. Jackson's description of the mist, on p. 499. "It lay just against the Promontory Agarum, and seemed to extend itself longitudinally, parallel with the promontory, of height apparently equal or greater than the mountain range, partly obscuring the mountains from view." I do not write with the intention of disputing Mr. Jackson's observation; I only ask for information as to his reasons for judging it to be mist, for I do not see the way clear myself to distinguish one from the other when just beyond or on the edge of the terminator. **M. A.**

THE VOSS INDUCTION MACHINE.

[20163.]—IF Mr. Frank will refer to the last volume, he will find the method of taking the discharge from the outer coatings of the small Leyden jars described, and recommended as a means of applying electricity for medical purposes. The plan of suspending the worsted thread is new to me, and I have tried it, with the result that I obtained sparks from my 10in. plate machine of 3½in., never having before obtained more than 3in. Whilst trying this I noticed what I had long suspected, that is, that the Voss machine, like the Gramme ring, is reversible, and will act as a motor, though, of course, the power is very small. When I stopped my machine it commenced to run backwards, and continued to do so for five or six revolutions of the plate. I carefully ascertained that this motion was not due to the plate merely seeking its balance, and when I discharged the jars it did not take place. The Voss machine is a most beautiful illustration of the conversion of force into electricity, and, if my experiments are verified, it will also show the conversion of electricity into force. **H. B. T. S.**

AN ELECTRICAL PROBLEM IN CONNECTION WITH AERIAL NAVIGATION.

[20464.]—I DESIRE, with your permission, to place before the readers of the "E. M." an electrical problem for discussion, viz.:—The ultimate probability of carrying on an electrical system of aerial navigation, on the basis of planetary flotation, of which the Moon is a notable illustration. I think there can be no doubt that the motion of the bodies of the solar system, and their relative position, is caused by their electrical condition. The interior of the earth, in my opinion, is charged with positive electricity, which induces an atmosphere of negative electricity on its surface. All particles of matter existing in this atmosphere are consequently charged with negative electricity, and are, therefore, attracted by the positive electricity in the earth's interior, which, if correct, explains the nature of gravitation. The Moon being in the same electrical condition as the Earth, their negative electrical atmospheres keep them asunder, and the combined action of their positive and negative electricities tend to cause them to gravitate to each other, and thus cause the Moon to float at a regulated distance from the Earth, in accordance with the principle of polarisation. The Sun also, by generating positive electricity, is surrounded with a positive atmosphere, which induces a negative electric zone outside it, and the regulated distance of the different planetary bodies from the Sun is caused by the intensity of their electrical condition. In this balanced condition of flotation, if they fluctuate towards the Sun, they are immediately repelled by its positive atmosphere, through its absorbing their negative atmosphere; or attracted by it, if they fluctuate towards the negative zone, till the equilibrium is restored.

If this theory is correct, would not an artificial globe with a gutta-percha crust if its interior was charged with a sufficiency of positive electricity, induce an atmosphere of negative electricity around it, and so float at a regulated distance from the earth. Such a globe endowed with the requisite electrical conditions, would do all in the air that a steamship can do on the ocean. It would carry passengers and cargo, be propelled in the teeth of a gale of wind, and defy the elements. It would also, by the attraction of its gravity, draw and hold an atmosphere of air around it, so that a trip to the Moon would not be prevented for want of an atmosphere to maintain respiration. By adopting the system of cometary, or solar propulsion, there would then be nothing to prevent the exploration of the universe.

Science has already endowed soft iron with artificial magnetism, which counteracts fourfold the effect of gravitation. Why should it not be able, eventually, to endow an artificial globe with the requisite electrical condition necessary to counteract terrestrial gravity, and so produce artificial planetary flotation? Are not all the forces of nature waiting to be produced and wielded by scientific skill? If so, this apparently visionary scheme may yet become a reality.

Wm. Harris.

Woodbury, near Exeter, August 29th.

SCIENCE AT SOUTH KENSINGTON.

[20465.]—YOUR correspondent, Mr. Jackson, p. 597, must be easily pleased if he is gratified to find that I "admit" what I have never denied or thought of denying. Your article, sir, was, I imagine, aimed at the system pursued at South Kensington, not at the teachers *per se*, but I note that Mr. Jackson does not yet answer the question, Who is responsible for such candidates as you exposed? If not the teachers, it must be the department, so whichever way Mr. Jackson takes it, his first letter scarcely tallies with his latest. So far, Mr. Jackson has declared that it is not the fault of the teachers that crassly stupid candidates are sent up for examination: hence it would appear that he, too, blames the department. What, then, becomes of his first letter? No one supposes that marks are given for such "answers" (save the mark!) as those you quoted, and it is really "too-too" for Mr. Jackson to explain that a man may have two occupations. It is a pity that he did not explain himself at first. When he says that he has caused me to be more just in my criticism, he implies that I have been unjust, but I regard that as a misapplication of the "scientific use of the imagination," and as no case of injustice is indicated, I leave the gratification to Mr. Jackson. The samples you gave, sir, of the answers frequently tendered at South Kensington, show clearly enough that something is radically wrong. I am one of the many who think the system is at fault, and by your leave, I shall continue to say so, whenever opportunity occurs to bring the subject before the public. **Nun. Dor.**

TRICYCLES WORKED BY GAS.

[20466.]—IT is a pity that "P. H." (p. 597) is not a mechanic as well as a chemist, for then it might have occurred to him that to work tricycles in the manner he proposes would be rather too much of a good thing. The explosive force of gas is, no doubt, a valuable property, to be utilised where possible, but has "P. H." ever thought of the weight of the cylinder and its accessories necessary to adapt the force to the tricycle? Suppose the cylinder made of thin steel, how is the power to be applied to a tricycle? It is a difficult matter with steam, supposing you could generate that in a pint pot, and it is a hundred times more difficult with gas. It seems to me that, with either steam or gas, you must have gearing, for the speed that would be necessary in the engine to give power on the tricycle would be altogether out of place if applied direct to the driving axle; and to have an engine with power enough to drive the tricycle at a permissible speed would involve weights which no tricycle could carry. I am not quite clear how the gas could be made, but that is a secondary consideration, seeing that the road is blocked by the insuperable (as I believe) difficulty of connecting the engine with the machine in a workable manner. Your correspondent should have gone into a few figures as to the size of cylinder and piston speed, and he would then have paused. **Nun. Dor.**

[20467.]—IN reply to letter 20151, of Sept. 1st, may I ask "P. H." to explain the best and safest method to obtain the vapour he speaks of? How much vapour must there be to a certain quantity of atmospheric air to cause an explosion? Also, what does "P. H." mean by "raw spirits"—is it what is commonly called "benzoline"? If he will please answer above, he shall soon know the mechanical results. **E. Thomas.**

THE PRESSURE OF WIND.

[20168.]—I AM sorry that I have again failed to understand what it was that Mr. Romanes meant (p. 596). Had he said simply that it is impossible for the wind travelling at the rate of 50 miles an hour to press upon a square foot with such a weight as 49¾lb., his meaning would have been clearer than it is in the first par. of his letter on p. 527. However, as Mr. R. "did not therefore deny that with an hourly velocity of 50 miles the pressure was 49¾lb.," am I to assume that, after all, the Greenwich anemometer was correct? It seems that I have myself been anything but perspicuous, for Mr. R. is puzzled with what I said about Mr. Simmons's balloon rate and such a "storm" not being likely on the earth. I am afraid I cannot put it plainer. I said that in the middle of one of the gusts the wind may reach even Mr. Simmons's "rate," and I cannot conceive that that is contradictory to a subsequent assertion that no one supposed such a "storm" as Mr. Simmons experienced could prevail on the earth, for that storm lasted for more than an hour.

To turn to the question of your correspondent "Khoda Bux," whom it is ever a pleasure to help, he will see that as the matter stands the engineers are at loggerheads with the meteorologists. The instruments of the latter indicate pressures which the former believe to be improbable, and by formulæ show to be "impossible." The engineers, you will observe, calculate the pressure from the velocity of the wind, and that velocity, I presume, they take from the very anemometers they abuse. Clearly, the point to be ascertained is the actual maximum pressure, and I have been endeavouring to elicit some information as to the real nature of the objection to the pressure-gauges employed, for I cannot conceive there is much mechanical difficulty in constructing an apparatus to as accurately indicate the pressure of the wind as we indicate that in a steam-boiler. There is no question that the instruments at Greenwich did in October and April last, at one time, register maxima respectively of 53lb. and 49¾lb.; the contention is that they are not to be relied upon. I hear that a "pamphlet preliminary" has been recently issued by the Institution of Civil Engineers, giving the pith of the debate which has been recently held on this very subject, in concluding which the President, Sir W. Armstrong, said he "desired to express his strong opinion of the urgent necessity for experimental investigation in connection with wind-pressure," which is just my sentiments, if I am allowed to have any, as the clown said. Personally, I believe the Tay Bridge would have been standing now if the train had not been upon it at the fatal moment of that terrible gust, and as I have a dim recollection that engineers have gravely reported that it will not pay to build bridges strong enough to resist any conceivably possible storm, I should like to elicit some opinion whether it will not be advisable for the possible future victims to help the railway companies by a public subscription in order that the bridge may be made strong enough. Smeaton's table of wind-pressures differs considerably from that of Hawkesley, but his pressures for given velocity are lower. Thus Smeaton, for what he calls a hurricane, 80 miles per hour, gives a pressure of 31·5lb., while Hawkesley gives about 34lb. "Khoda Bux," who I hope will live to see his tower weather many a gale, would, I think, do well to procure this pamphlet, for Mr. T. Stevenson let new light on the subject, by pointing out that the pressure increased with the height above ground; hence my reference to the fact that it would not be necessary to build a house at the foot of Blackheath Hill so strongly as one placed at the level of the Observatory. The difference in altitude is, I think, somewhere about 100ft., and according to Mr. Stevenson, if the pressure at 50ft. and 70 miles an hour is 27lb., that at 150ft. will be about 95 miles an hour and 45lb. I cannot ask you to burden your columns with the formulæ; but it will be seen that there is an enormous increase in pressure with altitude. In estimating the actual pressure on a lattice-girder bridge, I do not think the measurement of the real surface will correctly give the acting surface, for I think that the passages between the lattices tend to relieve the pressure on the actual surface, much on the same principle that it is impossible to blow a card off a pipe terminated by a disc. The apertures in the lattice-girder, I believe, tend to reduce the actual pressure on the surface of the bars exposed by a kind of suction, and in all I have written, I wish it to be understood that I am simply actuated by a desire to arrive at a solution of a very difficult and important problem. Probably some useful data might be obtained from the records of experiments made to ascertain the resistance to trains running at high speed; but though I remember some elaborate calculations, proving that a train could not possibly run at 70 miles an hour, owing to the resistance of the air, I know that trains, or engines at least, have accomplished it, and it is possible that the engineers may be correct, and the anemometers wrong. But I submit that the problem is, What is the actual maximum pressure of the wind on any given area? And if any of your readers can throw any light on the subject, I shall be pleased to read what they have to say. **F. M. S.**

BOOMERANGS AND OTHER PROJECTILES.

[20469.]—The reply 47346, given to "Bushranger" by "H.," respecting the boomerang, in your No. for 25th August, will not, I fear, satisfy him, as he asks for the theory of its flight, and I also should feel great pleasure in having that explained.

As I have thrown the instrument many times forty years ago, and the account given of its flight is not quite correct, I will state it as I found it to be.

Firstly, I always threw it with the concave edge forward, and the flat side downward, and generally aimed at an object about 5ft. from the ground, and 50 yards off. The flight was true to the direction in which it was thrown, but if the object was not hit the instrument would continue its flight in the same direction for 20 or 30 yards further, according to the strength of the throw, and then suddenly mount into the air almost perpendicularly to a great height, and return in its descent in the direction from whence it was thrown and pass beyond the thrower, and often very close to him. Writing about the projectile, I recall some experiments I made and a patent I took out about 1860 for an improved mode of charging and firing guns. I saw that to put a mass of metal into a very rapid motion instantly from a state of rest, was a wasteful mode of applying power, and knowing that if a tube was filled with gunpowder and fired from the open end the explosion would be gradual, like a rocket, I saw that in this way a shot could be moved slowly at first and its speed gradually increased as the powder was consumed. I saw also that as the shot moved the pressure should be increased as long as the shot was in the gun, and to effect this the powder was placed in a hollow cone, and fired from the front, and the angle of the cone proportioned to the length of the gun, so that the powder might be all burnt just before the shot left the gun.

In carrying out experiments I found that very heavy charges could be fired, and great velocity given to the shot, with very small strain on the barrel of gun. In my experiments I used the thinnest brass trumpet tubes, of the size of the No. 12 shot-gun—¾in.—soldering the tube to the pointed end of the cone, the touch-hole being close to the mouth of the cone, and the cone containing three drachms of powder. With this charge and two ounces of shot, I have repeatedly fired the thin tube, and never either burst the tube or driven it away from the end of the cone to which it was soldered, and the penetration of the shot was quite as great as that of any fowling-piece fired with a like charge. I had also a large duck-gun, in which I used to fire eight drachms of powder and four ounces of shot, at the cost of a severe blow on the shoulder. This gun I had fitted with a similar cone, holding six drachms of powder, and I could then fire it without any sensible recoil, and I believe the velocity of the shot was greater than before. I had also a rifle-barrel made to fit the same stock, and it carried a round ball of two ounces weight. The conical ball weighed five ounces, and the recoil was unfelt. These tubes, the rifle, and several flat ends of the bullets, as found in front of the iron target of the Kilburn Rifle-ground, where I repeatedly fired it, I exhibited at the exhibition of 1862, with a detailed account of the experiments, hoping that the commissioners who went round to investigate the exhibits would notice them; but they were unnoticed, and have never been further investigated, that I am aware of. My belief is that very large shot can be fired with great velocity from very light but long tubes in this manner.

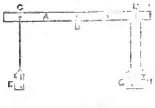
I also exhibited at the same stand a telescopic rifle-sight that I had invented and patented about the same time.

The adaptation of the telescope to the rifle had hitherto proved a failure, from the recoil of the gun deranging the telescope after a few shots. My telescope did not weigh half an ounce—allowed the original sight of the gun to be used, the object aimed at being magnified—but the sight not at all magnified, but used just as it was without the telescope. It was a small Galilean telescope without any tube, the object-glass ¾in. diameter fixed in a cell which slid into the sight protector of the Enfield rifle, close behind the sight, and the eyepiece a small concave lens fixed in a frame which slid up or down on the back sight; the magnifying-power was about six diameters, as more than that tried the holding power of the steadiest marksman, and the rifle was seen to sway in such a manner as to be useless, unless fired from a rest. With this sight, bull's-eyes after bull's-eyes might be made with care by any fair shooter. I have, in the Kilburn ground, made nine successive bull's-eyes at 400 yards, from the shoulder—fair off-hand shooting—to which the marker there could bear testimony. This invention I hoped would be used by our volunteers and soldiers, and render their shooting much more accurate; but directly this was brought before them, the order *no magnifying sights allowed*, was issued at Wimbledon, and our volunteers and soldiers prevented from shooting well by the hard pull of the trigger being raised to a 6lb. pull, that of old Brown Bess being only 3lb., which was considered quite hard enough to be safe for the most uncultivated being until after the first meeting at Wimbledon, when for our volunteers, men of education and with hands much more sensitive than those of the hard-working labourers, who formed the rank and file for using Brown Bess, a pull of 6lb. was considered necessary to prevent accidents.

In fact I believe the authorities meant the prizes to be gained by chance, and not by the best shooters, or we should see the same man get the Queen's Prize very often, instead of never. The wish of our authorities appears to be as *Punch* says—not to do it. **Philip Vallance.**

PROBLEM IN DYNAMICS.

[20470.]—The problem of the equilibrium of the monkey and the ball reminds me of a somewhat curious little experiment which I once made in the long-ago days when paradoxes and perpetual motions perplexed my brain, which may be of interest to others even now. A A is a wooden (or other) bar, pivoted at its centre B. From C, near one end, is suspended a weight of, say, 2oz.; at D, near the other end, and equidistant from B, is a pulley as shown. Over the pulley is a cord, at each end of which is suspended a weight of 1oz., as at G and H. Since the axis of pulley is at same distance from centre as the point C, and as the suspended weights are equal at both ends of the beam, the whole rests in equilibrium.



Now transfer a *part* of one of the two weights, G or H, to its fellow, then, of course, the heavier will descend and pull up the lighter; but at the same time the equilibrium of the system as a whole will be found to be disturbed, and the weight E will descend, and raise the end D of the lever. At first sight it seems strange that this should happen, since the *total* weight of the two weights G and H is not affected; but a little consideration will show that the result *must* be as described under the given conditions. **A. S. L.**

NORTHCOTT'S APPARATUS FOR TURNING IRREGULAR FORMS.

[20471.]—I was glad to see, from the letter of "Gereb Admi" (p. 596), that Northcott's clever apparatus is not quite forgotten. I have been surprised it has not been taken up; but, as I, like your correspondent, have been abroad, its defects, if it has any, may have been pointed out during our absence.

I have inquired of all the principal lathe-makers, but none of them had any experience of this apparatus, and, at last, I have come to the conclusion that the power required to move the saddle-slide must be great, and the friction must interfere with the correctness of its movements so as to prevent the use of the fixed tool for any shapes requiring more than one or two vibrations per revolution. As used for guiding drills or cutting frames, the apparatus appears to work very well.

Let "Gereb Admi" look at Figs. 204 and 205 in Northcott's book. These figures appear to have been produced by a fixed tool, making about 64 vibrations per revolution. He will see that in some places the lines of the figure are double and even treble—a defect caused, I think, by friction of slide in saddle.

The slider in Captain Dawson's rest is so much smaller, that it is, probably, much less liable to to this objection; but then it seems only suited to face work, and far less universally applicable than Northcott's.

I hope, if your correspondent perseveres in his intention to try this most ingenious apparatus, he will let us know with what result. No doubt the "one-tenth" which puzzled him is an error. The passage might read, "For every revolution of the back shaft, the worm-wheel will make one-seventh of a revolution; and, during one seventh of a revolution of the screw *e*, the slide D, will traverse one-seventieth of an inch."

I also have thought of adding this mechanism to my lathe, and herewith append my address, that your correspondent may write to me if he wishes. **F. A. M.**

32, St. James-road, Tunbridge-wells.

A BLIND MAN'S VISION.

[20472.]—Several letters, all very eulogistic, were sent me on the subject, asking for answers I can really not send. One of them, I believe, emanates from a medical man, who is surprised at the action I reported of magnetism on the organism. I, myself, am surprised that medical men have been so long without discovering it. Everybody knows that the magnet attracts iron. No doctor doubts that blood exists and circulates in the human body, and that its red colour is mostly due to the presence in it of iron. In anemic cases they prescribe iron. Is not it natural, therefore, that a magnet should act upon the blood, attract and act upon the ferrous principles therein contained. There is another thing that I do not hesitate to affirm to my correspondent. It is this: All the effects, without exception, produced upon the human body in the cure of diseases by medicinal agents, are purely electrical. The curative power they possess is due to the proportions in equivalents of electricity, either equilibriated, positive, or negative; they coerce, and they act upon diseases, in proportion to the respective electric states of both the body and the medicaments. When this is sufficiently known, diseases being classified in positive, negative, neutral, hypostrophic, atrophic, &c., electricity and electrified agents will play their real part in medicine. Electrotherapy is the medicine of the future. My electric sounds, which, by the bye, were invented in London 12 years ago, will become in great use in surgical treatments.

One of the letters is dated Charles-street, Berkeley-square, London; but it is written on a paper, and inclosed in an envelope, bearing, stamped in blue, another direction in Uxbridge, in which place the letter was posted. Which is the real address? The writer is affected with an incipient cataract, and inquires for the *modus operandi* to be used in such a case. If sent to the inquirer, my answer would only serve one person; whereas, if you can possibly spare room for it in the "E. M.," it may be useful to many. The following is the process I advise to use, submitted to the approval of the medical adviser.

A generator of electricity is, of course, necessary; then an eye-bathing cup, which can easily be procured in London. A wooden one is the best, unless it is in ivory, ebonite, or any isolating substance. It consists in a small shell or cup of proper form to fit the eye arcade, and allow the eye to freely bathe in. The handle should be perforated all through for the passage of a conducting wire, one end of which issues out at the bottom of the cup. Pure distilled water is put in the cup, and one drop (no more) of hydrochloric acid is dropped in it, the object of which is to render the water a good conductor of electricity. The cup thus filled is applied to the eye, which must be kept open in the water. The positive conductor of the pile is then put in contact with the other end of the wire, and the negative is either held in the hand or applied to any other part of the body. A circuit is then formed, and a positive electrolitic current passes from the cup through the eye and body to the negative pole. The action of this current is to carry off the substance, the accumulation of which causes the cataract. Care must be taken not to make a mistake between the two poles, as if the negative one was applied to the eye, the disease would increase. This was proved in the case I have spoken of. Should a simple current prove to be insufficiently active, a Faraday induction coil should be used with required care, to stimulate the action. **Ch. Rabache.**

P.S.—In my last communication (p. 504) there have been many misprints. Some are of little importance; others make my writing unintelligible—namely, in the equations of gunpowder explosion. Correcting them would be long; I prefer, if you please to permit, to give an explanation which may serve in other cases. The symbol $\overset{+}{E}$ means positive electricity, $\overset{-}{E}$ negative electricity; so that $\overset{+}{OE_5}$ means 5 oxygen and 5 positive electricity. $C_3\overset{-}{E}_9$ means 3 of carbon and 9 of negative electricity. φ, the first Greek letter of the word φῶς, light, means light. θ, the first letter of θερμός, means heat. I did not write ψ, but φ. **C. R.**

IRON COILS–ELECTRO-MAGNETS.

[20473.]—The improvement and the economy in the construction of dynamo-machines are important factors in the future of the electric light and motors. If iron can be used in the place of copper for coils, great economy, and also (I shall hope to show) greater efficiency will be the result. At various times, during many years past, this substitution has been tried, and in some cases reported as less efficient, and a few others as an improvement. That this should be so need not surprise us, seeing that one consequence appears to been overlooked, and that is, that besides the iron coil becoming itself a magnet, the electro-magnet itself is magnetised with an *opposite* polarity. It was natural enough that the less efficiency should be considered as arising from the inferior conducting power of the iron coil, and also that the attractive power of the coil should be attributed to the internal electro-magnet. That the iron coil should be highly magnetic we may rest assured, knowing as we do that even a copper coil is somewhat magnetic under the influence of the current.

Let us now see how we come to these conclusions. First, then, the electric current is held to be circulating in the magnet after the same fashion as it does in the coil. If the current is applied to an outer coil—which then becomes the primary—an inner coil, according to the well known law, has its induced current moving in a reverse direction. Now, if we imagine an iron bar substituted for the internal coil, the same law holds good, and hence it will be found that the polarity of the iron bar will be much neutralised by the opposite polarity of the iron coil surrounding it.

Notwithstanding this, the employment of iron coils is so far from being a failure that it will result in a great increase of magnetic power, when it is considered that the iron bar may be dispensed with, and in its place may be substituted an *inert skeleton* core of wood or brass, and thus our future electro-magnet is made up of nearly all coil, of iron wire which retains a little residual magnetism; and that the magnetism would be more intense, we may feel assured, when we reflect that in this case the current is passing through the magnet itself, instead of, as in the other case, being effected by induction, which, as is known, is influenced by distance. But not only is the intensity greater, but there is a gain in quantity, as the former—nearly *inert*—copper coil is replaced by nearly so much *magnetised* iron coil. Besides this, the opportunity occurs of using more surface in the absence of the inert *copper* coil.

Here, then (if I am correct) it is evident that an iron coil employed on the old lines defeats its own object; and it would seem that the sooner constructors begin to work on the new lines the sooner an improvement will be effected.

It will be unnecessary for me to show the application of these principles in any design for a machine, as the general principles hitherto applicable remain nearly the same, the special alteration being a substitution of iron wire for solid iron, it being part of the iron coil.

Barry-road, S.E. **J. H. Huxley.**

INDUCTION COIL—ERRATA.

[20474.]—Two errors have crept into the letter upon this subject which appeared last week. The gauge of the secondary wire should have been stated as 36 B.W.G., and its total weight as 3lb. 4oz.

Haverfordwest, Pem. **Ernest.**

LEGAL REPLIES.

[20475.]—Road Drainage (47820).—I do not see how the owner of one house in a private street can compel the other owners to make a channel in the road and put down gratings. But, on the other hand, it is clearly for the public good that this should be done, and the best thing the querist can do is to give notice of this complaint to the proper sanitary authorities of the district, who will know how to compel the proper drainage of houses which seem to have been built without the supervision now necessary.

Lease: Ground Game Act (47825).—Where the lease of a farm says nothing about the game, then, under the Ground Game Act, 1880, the occupier has an absolute right to kill and take the ground game upon the land; but only for himself, or some person in his employ, or of his family. That is to say, the occupier cannot let the right of shooting ground game, as seems to be suggested by the question; but, on the other hand, and presuming the lease says nothing about it, neither can the landlord claim any right of shooting hares and rabbits. The reduction of the rent does not affect the question, and, as far as I can see, the landlord and his son cannot legally shoot the ground game on the land let upon lease.

Married Woman's Property Act (47834.)—Any woman married since 9th August, 1870, can hold personal property to any amount coming to her as next of kin of an intestate as her separate estate, and can sell it or lease it by will as she likes, independently of her husband. But as to real estate of freehold property, the law is different, and though the rents and profits of land coming to her as heiress will form part of her separate estate, and so can be disposed of by sale or will, as she likes, yet the land itself can only be sold or mortgaged by her with her husband's consent, and by deed duly acknowledged, nor can it be willed away, but it must descend to her heir-at-law subject to her husband's life interest as tenant by courtesy. No steps need or can be taken to prevent the husband having his legal rights. By the Married Woman's Property Act, 1882, which comes into operation 1st January next, a married woman is made the absolute owner of her own property in all respects, as if she were still single, and the above law is altered.

Town Council—Bankruptcy (47837).—If the councillors in question have not actually become bankrupt, or have afterwards had their bankruptcy cancelled, they would not be disqualified. But, whether qualified or not, as long as they sit upon the council a candidate for a post under them cannot dispute their votes. He must first of all get them removed by the requisite means. This would be the rule in England, and I presume it is much the same in Ireland.

Lease—High Road (47638).—There is really nothing in this long question. In conveying a large estate, high roads which run through it may, in a foolish sense, be said to be included. Or, in speaking roughly of so many acres, the public way may be comprised. But it is absurd to talk of a tenant paying rent for a high road, over which he could have no right, and I cannot believe that any such arrangement was ever made, even in Ireland.

Misconduct of Apprentice (47652.)—The proper course is undoubtedly for the master to summon his apprentice before the magistrate of his district, by whom he can be dealt with summarily, and who has power either to stop the whole or part of his wages, or to send him to prison if his misconduct has been serious or long continued. In the case of wilful misconduct, the magistrate has power to cancel the indentures, and so rid the master of a worthless apprentice. But in these matters everything depends upon the evidence, and the magistrates have a very wide discretion.

Landlord and Tenant.—Lodgings (47866).—This querist seems to have taken the law into his own hands, and asks advice afterwards. A landlord of furnished lodgings can distrain for rent, and rent only, upon such goods of the lodger as he can find upon the premises. Until he so distrains he has no right to retain the property, as he seems to have done, any more than he had a right to take possession of the rooms without a legal order. The landlord can, however, distrain upon the goods now, and then sell them in the proper way; and he can, of course, sue his tenant for any balance owing. But I should not advise landlords in general to take the law into their own hands, as the risks they run of actions for damages are somewhat serious. **Fred. Wetherfield, Solicitor.**

2, Gresham-buildings, Guildhall.

COST OF HEATING APPARATUS.

[20476.]—"Gerer Admi" (20450, p. 597) says some of my things are dear in proportion to others. It is, I think, evident that he speaks without examination. One he specially refers to, *i.e.*, the instantaneous water-heater, contains a coil of copper pipe ¼in. bore, about 16ft. long in one spiral coil, without seam, joint, or flaw. If he will ask any maker to produce such a coil at any cost, his order would be declined with or without thanks; and yet, without a coil made in this manner, the thing would not be what it is, and would not stand one-tenth part the hard work it does. I have the greatest faith in low prices and a large demand; but when a thing cannot be finished by automatic machinery, the price must of necessity appear high, and many things which are entirely made by hand can be copied by little makers at a very low rate, simply because they have no expense in designing and in selling. If all my customers came to me without any expense or trouble, I should save some thousands of pounds every year. It is apparently the natural law of trade that one man shall experiment at a heavy cost, plan and make satisfactory apparatus, and another shall take his patterns to make a cheap copy. One ruins himself with experimenting, whilst another takes and trades on unfinished results. A man who steals his patterns can always afford to work cheaply, as his heaviest expenses are borne by other unfortunate makers who are sufficiently honest not to do this.

Thos. Fletcher.

SMALL DYNAMOS.

[20477.]—Respecting small dynamos, against which our very worthy friends, Mr. Lancaster, "Anglo Dene," and others have written, allow me to state the following. I have been in London some little time, and as I am desirous of seeing and working myself a small dynamo, I took the liberty of calling on Messrs. Patrick, who have, for some months advertised their machines in the sale column of "ours." I was shown, by an assistant, a dynamo splendidly finished that did the following:—1st, With one man driving the dynamo by lathe, light to *their full power*, four 10-candle lamps of Swan's make. Unfortunately, there were no more on the premises of this size, or else we might have tried more. 2nd, With the assistant and myself treading lathe, we lit to *their full power six 15-candle Swan lamps.*

The R of machine is, including field-magnets and armature, only 1 ohm, and through an external R of 3 ohms, total 4 ohms, gives 8 ampères current. It will be seen that this machine is better than the one described in "ours," page 591, and exhibited by Mr. W. H. Preece at British Association.

In reply to Mr. Lancaster, a friend of mine, a Mr. White, in Southport, has succeeded in making a dynamo that weighs less than 4lb., and will deposit gold, silver, and nickel. I shall write you again on this subject, and will send full particulars and measurements of its electrical properties. As near as I can judge, it will equal 2 pint Bunsen cells. This has been sent up to me in London, and I shall perhaps have an opportunity of showing it to you, sir. This, I hope, will end all doubts as to there actually being small dynamos.

J. E. Chaster.

SPRAGUE'S "ELECTRICITY: ITS THEORY, SOURCES, AND APPLICATIONS."

[20478.]—As the question is put to me (47608, p. 509) whether a new edition of this work is to be forthcoming, I take the opportunity of saying that I am engaged upon that work, which involves a great deal of time and labour in order to keep the new matter, necessitated by the rapid progress of the science in the last five years, up to the mark of the rest of the work. Of course, I have reason to regret that the work has been out of print for some months, as applications come for it continually; but various causes have prevented me from being able to do what I wanted. I may add that if there are any points on which readers desire special information, or any errors which have been observed, I shall be happy to receive any suggestions thereon, addressed to me at Green Lane, Birmingham. From the manner in which the work has been received, I conceive that it has met a want, and did a service distinct from that of the general type of electrical books, and it is my desire that the next edition should do so more fully.

J. T. Sprague.

ENGINEERING FOR CHEMISTS.

[20479.]—Will "Glatton," or some other competent engineer, fully describe the method of ascertaining the breaking strain of various metals and alloys? What would be a proper strength for a gun-metal composed of copper 40 parts, tin 5 parts, zinc 2½ parts. What would be the prime cost of a plant for pumping water from a depth of 200ft. in quantity sufficient to supply a town of 50,000 people with 30 gallons a head per diem. Also describe the various patented slide-valves, and devices of a similar nature, pointing out the advantages and faults possessed by each. While about it, perhaps "Glatton" will write a full historical and descriptive account of the steam-engine, gas-lighting, and the Suez Canal, giving such details as may enable tyros to construct engines, gas-works, and canals, in an efficient manner.

A description of all this, "I shall probably be told, would involve the writing of several articles, and cover much space. But what of that? If any correspondent is able and willing to contribute information of such practical value, I feel sure the Editor will not withhold the space so usefully employed."

In return for the information in "Glatton's" anticipated reply, I am happy to assist him by referring him to any book on qualitative analysis for a method of analysing gun-metal; the examination of white and red lead was recently very fully described in these columns; the description of the mode of examining oils is to be found in books devoted to the subject, and the quality of acids may be ascertained in the usual way. If this should meet the eyes of any readers other than "Glatton," they are earnestly requested to turn for an explanation to letter 20452, p. 597, entitled, "Chemistry for Engineers."

Alfred H. Allen.

EXAMINATION OF MALT—ANALYSIS OF PAINT—FLUX OF SOAP—CARBOLIC ACID—BISULPHITE OF LIME IN BEER—DEODORISING OIL—SILICATE OF MAGNESIA—MANGANESE—MAGNETIC SANDS.

[20480.]—It seems ungracious to criticise so full and valuable a reply as that of E. S. Beaven on page 555 in answer to the query of "Phœnix" on the "Examination of Malt" (No. 47651); but, in the interest of truth, it may be well to point out that of late years it has been conclusively shown that malt extract contains no grape-sugar whatever. The variety of sugar really present in malt infusion is *maltose*, having a composition identical with cane-sugar. If this were all it would not be worth mentioning; but the reducing power of maltose on Fehling's solution is only about two-thirds of grape-sugar, or, more correctly, ·62. Hence, the quantity of malt solution which will reduce 10cc. of Fehling's solution will contain ·05 × 100 / 62 = ·0807 gramme of maltose. This, of course, shows the percentage of sugar in the sample to be very different from that found on the assumption that it consists of grape-sugar. Again, dextrin when boiled with dilute acid yields maltose, and this is converted to grape-sugar only by very long continued boiling with acid. Six or eight hours' boiling is necessary at the ordinary pressure. As the maltose originally present is converted into grape-sugar simultaneously with the dextrin, thereby acquiring a higher reducing action on the Fehling's solution, the determination of dextrin is wholly invalidated unless this fact is taken into account; and as two hours is an insufficient time to complete the inversion under atmospheric pressure the result obtained is not even susceptible of correction in the way indicated. J. C. Belcher, p. 578, takes more care to insure complete conversion, but is similarly in error as to the formation of grape-sugar.

"Phœnix" can calculate the proportion of solid extract in his malt-infusion without the use of a table, by ascertaining the density of the 10 per cent. solution, and dividing the excess over 1,000 by the number 3·85. Thus, standard wort has a density of 1,057, and contains 14·8 per cent. of solid matter; for $\frac{1057 - 1000}{3{\cdot}85} = 14{\cdot}8$. Or, if the 10 per cent. malt-infusion have a density of 1,027, as assumed by Mr. Beaven, then it contains $\frac{1027 - 1000}{3{\cdot}85} = 7{\cdot}01$ grammes of solid extract in 100cc., or 70·1lb. in 100 gallons. This is equivalent to an extract of 70·1 per cent. from the sample.

The "Analysis of Paint" (query 47738, page 557), as far as the estimation of the oil and water is concerned, may be effected by drying a portion in the water-oven for the estimation of water, and then exhausting it with benzolene, or ether to dissolve out the oil. If there is not much water present (and this will rarely be the case) it is best to treat the original substance with benzolene, as the drying oxidises the oil and renders it insoluble.

"The Flux of Soap" (query 47752, page 580) is a term which is new to me, and I am not acquainted with its meaning. "Inquisition" addressed his query to me; but, possibly, some other contributor can give him the desired information.

"Carbolic Acid" (query 47758, p. 580) contains three chief kinds of impurity—water, neutral oily matters, and cresylic acid. The last of these is equal in antiseptic power to carbolic acid, and cannot be regarded as an impurity unless the acid is required to be readily crystallisable. The water is often present in considerable proportion. It may be detected and approximately determined by mixing the sample with two or three times its measure of carbon disulphide or chloroform, when the water will separate, and on standing, will form a layer on the surface which may be measured. Water may be wholly eliminated by boiling the sample. Neutral tar-oils may be detected and estimated by shaking 10cc. of the sample in a graduated tube with 20cc. of solution of pure caustic soda containing 9 parts of NaHO to 91 of water. The coal-oils form a separate layer either at once, or after adding a known measure of petroleum spirit. "Disinfectant" will find other and detailed methods of examining carbolic acid, disinfecting powders, &c., in Vol. I. of my "Commercial Organic Analysis."

"Bisulphite of lime in beer" (No. 47785, page 580) may be detected by treating the sample with hydrochloric acid and zinc, and noting whether the hydrogen evolved produces a black precipitate in a solution of lead acetate. An alternative test is to precipitate the beer with an excess of barium chloride, previously adding some hydrochloric acid. The filtered liquid is treated with bromine-water, when an immediate precipitate of barium sulphate will occur if a sulphite was present in the beer.

For "deodorising oil" (query 47800, p. 581), containing nitrobenzol, I should rely on the reduction of the latter to aniline. Try agitating the oil with hydrochloric acid and iron-filings, or granulated zinc, or shaking it with hot ammonium sulphide. In either case it will, of course, require a subsequent washing with water.

"Silicate of Magnesia" (No. 47816, p. 581), would be produced by precipitating a solution of sodium silicate by one of magnesium sulphate; but I expect the precipitate would be very bulky and unmanageable. All of the native silicates named by Mr. Harris on p. 603, would perhaps answer "Magnesite's" purpose.

"Manganese" (query 47757, p. 580), may be determined by the methods to be found in any work on quantitative analysis. It may be remembered that when the ore is required for producing chlorine only, the MnO_2 is of value. When used for steel-making, it is the total metallic manganese which is important, and the stage of oxidation is a matter of indifference. The various native oxides of manganese may all be regarded as mixtures or compounds of MnO_2 with more or less MnO or other oxides of similar formula. MnO_2, on heating to strong redness, loses oxygen, and is converted to Mn_3O_4. The latter body does *not* yield MnO_2 on ignition, as alleged by C. Harris. Commercial manganese ores contain quartz and silicates, barium compounds, oxides of iron, cobalt and copper, lime, magnesia, water, &c. For steel-making, sulphur and phosphorus should be absent, even in traces. In the ordinary analysis, water, silicious matter, oxide of iron, baryta, and lime are the only impurities which require determination.

Titaniferous "magnetic sands" (query 47867, page 605) are wholly useless for making steel or any similar purpose. Various companies have been formed from time to time for the purpose of smelting titanic iron ores; but they have all met with speedy failure, owing to the projected operation being simply outside the range of practical possibilities. Whole mountains of rich, pure, titanic iron ore exist in Norway, in readily-accessible localities; but iron smelters know better by this time than to meddle with them.

Sheffield, Sept. 2. **Alfred H. Allen.**

GRINDING AND POLISHING GLASS SPECULA.

[20481.]—I have now but little more to add on the testing of specula—at least, for the present. I shall have some more to say on this subject when I come to the actual figuring of specula. I would just add to my last letter (20364) that the shadings there represented in their succession are very faint indeed on the speculum, whose focus is over 9 or 10 times its diameter—so faint indeed that they may be hardly recognised at first. This shows the great difficulty of this form of test for the amateur. To be sure of being right I drew the order of the shadings as they came on from a 12in speculum of very short focus (under 7 diameter) that Mr. Calver kindly lent to me; but I first proved it to be parabolical by the zonal test, according to the rule, and that it was good up to the edge. This I took as my standard, as it gave shadings very distinct on account of its short focus. The drawing accompanying my last letter explains why the shadings come on in the order given.

There are a few more directions and precautions I would add to my letter (20154). They are the following:—Let the amateur always measure in the order from the 1st to the 5th zone, and then back from the 5th to the 1st zone, and if the readings nearly agree, say, to the 1-100in., then take the mean, which will be very near the true reading, and he may be sure the apparatus has not been moved accidentally during the measuring. I always take several measurements backwards and forwards until I am quite sure, by their general agreement, that I have them right. Always put the speculum and trough and stops in the place of testing an hour or two before testing, so that all may assume the same temperature as the surrounding atmosphere. This specially refers to the final testing. If this be not attended to, tantalising currents will show themselves on the face of the speculum, in the form of waves of light and shade floating over it. Another, and for the present, a last precaution is: Always breathe through the nose while testing. To show the amateur the necessity for this, let him gently breathe, while watching the face of the speculum, and with the shutter partly shading it, the warm air from his mouth, so that it shall be sent a foot or so under the cone of rays coming from the speculum; his mouth he will find is in a most convenient position while testing to do this. Let him watch a few seconds, and he will most likely see clouds of light and shade rise over the face of the speculum. This will teach him the importance of keeping his mouth shut while testing, that he may become a wiser man as to the figure of his speculum.

I advise the amateur to combine the shadow test with the zonal test, and with the actual observations on a star, and if he wants to see whether the foci of the outside and centre and intermediate zones are at the same points, he can take a star, though I prefer taking some very minute object on the moon, that I am well acquainted with, and that has sharp edges or markings. Now let him divide his speculum (I suppose a 6in.) into three parts by putting a circular stop on it, so as to leave about a ¾in. zone round the edge; now let him put the eyepiece out of focus by drawing it away from the speculum, then he must gradually push it in till the minute object becomes just well defined; put a mark on the outside of the tube of the eyepiece so as to know where the eyepiece has arrived at; try this over again, to be sure that he has got the exact place where the definition is first good. Now he must push the eyepiece in beyond the focus, and gradually bring it out till the minute object becomes just well defined as before. Mark this place; try again to be sure. Now, between these two lines is the exact focus of the outer zone. It will be observed that in thus bringing the eyepiece up to the point where good definition begins, the accommodating power of the eye is not a misleading element, for it is not over all the range of its power that we judge from (which is considerable in some eyes), but the extreme limit of the power of accommodation of the eye; thus, one point in the range of accommodation is always taken for both sides of the focus, and any error from the eyes' accommodating power is avoided. Now, let him put another stop on, so as to shut off the outer ¾in. zone, and a centre-stop to shut off the inner 3in., the intermediate zone will thus be left; test for its focus as for the outer zone. Now remove these stops and put one on, exposing only the centre 3in., and test for its focus as before. If the centre line of these three testings is at the same place, the speculum as a whole is properly corrected, or is parabolical. I find when a speculum is worked to the rule we have decided to be correct for centre of curvature aberration, it will give the foci of the above three zones exactly in the same place. There is one precaution which must be observed—viz., the object must be kept in all the testings in one place in the field of view, the centre preferably, because few, if any eyepieces, have perfectly flat fields, an object is in focus at the centre, when it would be out of focus half-way between the centre and edge of the field of view. Of course a high-power eyepiece must be used.

I have been trying some interesting and instructive experiments of late on the face of a speculum: some of these I shall have occasion to refer to further on; but there is one that bears on the shadow test, as showing its delicacy, and at the same time teaching some useful lessons to all possessors of specula and object-glasses; but as I could not recommend any one to try this experiment on his speculum, I will describe it and its effects, and he must take my word for the truth of it, and learn its lesson. This is the experiment. I took a speculum which had a good spherical figure, which I had produced in the process of figuring. I marked a place on its edge that I intended to be at the top in the testing. I then took a rouge-rag, wet with rouge and water, and made two dozen strokes, about 3in. long, pressing on hard—one stroke forwards and the next backwards, and so on to the end of the two dozen. This was midway between the centre and edge. I thus rubbed a second and third time on two other places, the three sets of rubs forming a triangle. I next made two dozen circular strokes, about the size of a penny-piece, on the part of the face of the speculum I intended to be top in the testings. I lastly made four dozen circular strokes the same size as before on that part of the face of the speculum I intended to be bottom in the testings. Now, in all these strokes or rubbings, I did not bear on any harder than a novice might think necessary to clean off his silver before resilvering. I now put the speculum under testing, got the artificial iris, or pinhole, as it is sometimes called, as small as possible, and put the shutter at the focus. And what did I see? Why, every place I had rubbed had a depression in the shape of shadows as follows: The three places where I had given the two dozen straight strokes appeared as irregular grooves formed of irregular lines; some far more marked than others, some hardly visible, the more distinct ones being evidently where my nail had pressed the rag harder for several strokes over the same line; these depressions were just where I had rubbed; yet, of course, no alteration of the surface was visible to the unassisted eye. Now, on the top of the face of the speculum was distinctly visible an irregular circular valley about the size of a penny-piece, with a mound in the centre, something like, and as plain as a bull's eye on a target; this was, of course, the result of the two dozen circular strokes. Then at the bottom of the face of the speculum was a very striking appearance; there stood out in very bold relief a circular valley with a mountain in its centre, all being the same diameter as the top circular valley, but being very much like one of the circular depressions on the moon with a mountain in its centre. Of course, the amateur knows this was caused by the four dozen circular rubs hollowing out a valley and leaving the centre elevated as not having been touched. Now, the face of the speculum was spoiled, and it took me two or three half-hours' polishings with the polisher to get these marks all out; the polisher, of course, did not press with the same areal pressure I used by hand with the rouge-rag. This experiment proves two things to the amateur—1st, the extreme delicacy of the shadow-test when properly used in showing the general state of the face of the speculum, and any irregularities; 2nd. The importance of the utmost care in dealing with the finished surface of the speculum: a few unwise rubs with a polishing powder may ruin a good speculum or object-glass; and yet how many amateurs, and novices especially, who have bought one, think that, so that they do not produce scratches, they may rub away at the surface to any amount and with any polishing powder, and this for year after year—perhaps for all their life; yet I would undertake, in 10 minutes, to spoil the best speculum ever made with (as the novice would say with native simplicity) "only a little rouge, a bit of rag, and a drop of water"—three little things in themselves, I grant, but capable of doing much mischief in some people's hands. Now, let all learn to be more careful with their surfaces, and never to touch them with any polishing powder. Specula ought to be cleaned by chemical means, with as few rubs of a soft rag as possible. It is better to give the chemicals plenty of time to dissolve off the silver, or grease, or dirt, if there be any, than hasten the operation by much rubbing, and in the course of years to spoil the figure.

We have now got to the end of the testing—at least so much of it that is necessary for the amateur to make a fair start. We may have to add a little more hereafter when we come to treat of my mode of figuring. I see by referring back that my first letter on testing was in the March 24th number, so that it has taken us over five months to master this subject; but then we have had to prove the rule that apparently had never been settled before. I tender my most sincere thanks to all who have contributed ever so little to this end, or helped in any way. I shall be only too pleased to help them in return.

My next letter will, I hope, commence on the machine: its principles, construction, and use.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

NEWTONIAN FLAT.—TO MR. EDWIN HOLMES.

[20482.]—The statement, wherever found, "that flats are all selected from polished plate-glass," is decidedly wrong; it is a fact that *few* can produce a better flat than polished plate-glass gives. *There are* those, however, and I know that no optician who is up to his work will say a piece of the *very best selected* plate is good enough for a telescope. As the convexity and concavity of the flats are sure to be of enormous radii if the tools are flat to start with, and the usual care of a good workman bestowed on it, I do not think this error a cause for condemnation. Perhaps our mathematical friend, "O. V." will tell us by figures what error a curve of 500ft. radius could produce, providing its sphericity is perfectly true. I do not think the colour test at all so good as testing on the penumbra of out-of-focus artificial star; to do this a very good telescope is wanted. Thus the colour-test is useful to the amateur as an approach to an optical test. I consider it only mechanical, and cannot be called a test at all, unless the plates are circular.

Prismatique.

CROWN-GLASS ACHROMATISM.

[20483.]—In answer to "Orderic Vital," (letter 20438), I may say that experience and experiment both tell me that "a long-focussed crown concave lens" cannot correct a short-focussed crown convex lens of plano or double form. What may yet be done by extraordinary meniscus and concavo-convex forms I cannot say. I hope my prediction may prove wrong, that "crown-glass achromatism" "isn't possible to be possible."

Prismatique.

RAILWAY SIGNALS.

[20484.]—According to letter 20445, I am requested to state whether "we are not to have a a limit, theoretically or otherwise, between the two signals."

What I contend is, that we must have a palpable distinction between each signal if confusion is to be avoided, and any system that does not provide this, whether it be Mr. Stooke's or my own, will be an utter failure.

Mr. Stooke has done me the honour to quote my first letter upon the subject, 20296, p. 452, and, much to my regret, has left out the very pith of my suggestion.

It is of no use endeavouring to reconcile the weakness of his own system by applying it to the division I suggested, because it does not apply.

As stated in letter 20296, the principle was to divide the quadrant into three distinct divisions of 30° each, but this was not all: here was our first step towards uniformity and simplicity; the action of the arm is subsequently explained.

If Mr. Stooke will kindly peruse my letter again he will find it reads thus:—

"The mechanism which regulates the arm ought to be so arranged that the arm will fall from zero to 15°, then from 15° to 45°, and next from 45° to 75°, thus *clearly* indicating each signal, and avoiding all confusion."

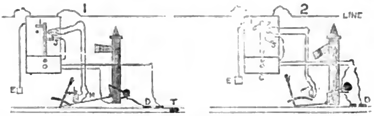
With this arrangement it is not, as Mr. Stooke has endeavoured to show, 20445, a question of distinguishing between 30° danger and 31° clear, but between 15° and 31°, which gives a margin of 16°, thus amply providing for the expansion, &c., which is contended for.

Unless the movement of the arm got out of repair, it would never be placed in the critical position of being between 30° and 31°, as we have shown that the next fall would be to 45°, and should it be, we presume that it would be instantly repaired.

A. Manock.

[20485.]—When the late Palace exhibition was in full swing, I had several opportunities of seeing the various systems of train signalling (electric), but the idea occurred to me that to install most of the inventions would make a clean sweep of all the old apparatus, and make the cost of applying them considerable—one of the most powerful objections that could be made. Some of them were impracticable, and the instruments shown by some railway companies were very ancient. Now, I wish to submit to readers of "ours" a plan suggested to me by the Vauxhall, Dalston Junction, and other accidents, which can be applied to any form of instrument without any alteration. Figs. 1 and 2 show starting signal, interlocked lever, and the instruments, with all the arms relating to one particular road. The semaphore arm (No. 3) is the only addition, and that can be placed separately. This arm is constructed so that when C (Fig. 2) draws (No. 1) arm for train from B (Fig. 1) to proceed, it likewise draws C's arm (No. 3) and B's arms (2 and 3), so unlocking the start-signal at B, and breaking the circuit between B and C. The starting signal at B can now be lowered, and the train passing over the contacts or treadle D places the semaphore arm (No. 3) at B to danger, which restores communication between A and B (A not shown). Thus, the train being in the section B C, and having placed the arms 2 and 3 of B at danger (as before stated), it relocks the starting signal at B, and thus protects the rear of train, as the starting signal must be placed at danger before the last vehicle has cleared the contacts D. C cannot telegraph line clear, or draw the arms 2 and 3 of B until the train T has passed over the contacts in advance of his starting signal. When the arm (No. 3) of his instrument is thus placed at danger, it carries with it No. 2, and thus allows C to place his arm (No. 1) up, and B's arm (No. 2) (but which has been carried up by the semaphore). To summarise the action, it needs a visible pointer, making and breaking the main circuit, according to its position; the said pointer or arm to be worked in one direction only, from the point of contact or treadle, in this case from an oblique to an horizontal, and in this position to make the circuit. The fish-tail arm (for distinction) is thrown off by accepting or being accepted, and so breaking the circuit. So that it is an impossibility for more than one train to be in a section at one time; and the signalman cannot make a mistake or forget a train; and the fact of a train starting against signals would be instantly discovered, and a train would be shunted off the main on to a siding without running past the starting signal by a treadle in the siding; and a system like this must be adopted in its entirety, and not, as a great many are, only partially. If there is anything not sufficiently clear, I should be glad to explain, and to give details of my working model.

Wall.



[20486.]—It appears to me that the exigencies of railway signalling only require three positions of the signal arm.

1. *Horizontal.*—This position naturally suggests an arm stretched out across the line to bar the way, and thus indicate danger ahead, and, when associated with a red light, presents to the imagination such danger as would cause blood to be shed, should the signal be disregarded.

2. *Vertical.*—This, or a nearly vertical position, say, between 55° and 80°, naturally indicates the bar removed or the gate opened, and consequently shows clear to the driver, and this position, associated with the white or green light, indicates freedom from obstruction such as would otherwise prevent a bright light or an open doorway from being seen.

3. *A Middle Position.*—This position seems to be required occasionally to indicate that the driver may proceed at a low speed carefully over a newly-repaired or defective part of the line. Its downward limit should be 30° from the horizontal position, and it should be associated with a violet light at night, to show that there is an element of danger (red) in the signal.

I should like to see the opinion of a few engine-drivers and signalmen on this subject, and then a summing-up letter by their friend Mr. Stretton.

G. E. Bonney.

CALCULATING SPEED OF TRAINS.

[20487.]—The following may interest some of the readers of "ours"—it is taken from one of the service time-books. Nine hundred divided by the number of seconds a train is occupied in running quarter of a mile gives the speed in miles per hour.

Iron Horse.

TRAIN INDICATING OR DESCRIBING.

[20488.]—There is a subject I desire to bring before you: it is the nuisance to the public of engine-whistles, and the frequent mistakes now made by signalmen in counting the number of whistles given by drivers at crowded junctions. Is there any kind of indicator, electric or otherwise, which could give this information to the signalman ahead, so that he might know beforehand which road a train wished to run, and thus get all his signals off without us having to whistle for them.

A Driver (Mem. A.S.R.S.)

STRING VIBRATIONS.

[20489.]—Shakespeare had an inkling of our position where he would make "N. E. G." say—"Fiddler, forbear; you grow too forward, sir. Have you so soon forgot the (*class-books*) *a Fid?* I am no breeching scholar in the schools. I'll not be tied to hours, nor pointed times. But learn my lessons as I please myself. And to cut off all strife, here sit we down—Make you your instrument, *work* you the whiles; my lecture will be done ere you have tuned."

I am much obliged to our friend "N. E. G." for his notice, but will he make a violin without a soundpost against one of mine? Proof is better than declaration. Mr. Davies will no doubt be umpire. Let it be understood that I have not made a profit out of my connection with the "E.M.," and do not intend to do so. It is out of pure love for true science that I have given, and will give, what I know. "N. E. G." has not proved the existence of nodes formed in the length of a free vibrating string, and no one, not even Helmholtz can, without altering the condition by applied pressure, or otherwise damping the string, whereby it becomes harmonic and not an open string. If "N. E. G." did not mean to form a node between bridge and soundpost, Mr. Schutz did, and said so, and he has his reasons for it, because, what takes place on the string is reduplicated on the soundboard. Now look. It is taught in our books, &c., that a string vibrates as though two wave-lines began at each end and approached the middle, passing each other, forming bellying segments, and returning to the ends till they subside, thus causing sound-waves in the air and the soundboard. This is wrong; because the sound begins in the middle. If you hold the middle you stop the vibrations, but not if you hold the end; in fact, they are already held, so the vibration can only begin in the middle, thus dividing the string into two halves. The string vibrates transversely from side to side, or else up and down, according as the bow actuates it on the top or on the side (at the neck). The point in the middle of the string is the centre of sound, and the width of the vibrations is the diameter containing the harmonics, and forming a circle in itself, which form is communicated to the air and the soundboard. The same thing happens at the mouthpiece of an organ pipe, and only those sides move which are in a line of the vibratory directions. To show that vibrations will produce a circle—take a darning-needle and push it (head first if you like, but a stiff, steel wire will do), into the side edge of a 1in. deal, 6in. long and 4in. wide, or any size; draw your bow across, and it will sound louder with the board upright than lying down; but that is a detail. Now take a halfpenny, or a metal disc, perforated in the middle—a penny is not too heavy—make the hole large enough to hang on the needle and it will turn round when the free reed is vibrated by the bow; and to show that it is not the mere movement of up and down that drives the wheel, press the free end against the door-post, so that the end of needle can't move when it is bowed, and the vibrations of sound will cause it to turn round exactly the same. The air moves in circles, but in a smaller ratio than the disc, or than water would, because it is not so dense. What is now called the interference of sound-waves, I call the interference of sound-circles. And indeed they illustrate the same idea partially in the class-books, by a sonorous bell vibrating through the small end of a cone and causing a corrugating succession of rings till the larger end is reached, to extreme diffusion. But there is no cone in one direction, for the whole of the surrounding air is vibrated, and not in waves, but in generating circles. Besides, how can there be waves under a surface without completing the circle? and even on a surface where they meet with resistance, they form a half-circle, as on the sea-shore, &c. Again, What is a node? It is part of the circle of sound, viz., of the fundamental whole, in a gong, bell, and a string, it is the division of the diameter of the radius caused by the transversal vibration. If I stop the third string on a cello to sound C, the fourth open or C string will sound harmonically with it, forming a node in the middle and two ventral segments. This is because the diameter of the upper C is too small to fit the lower C's fundamental. This rule obtains with a tuning-fork held over the mouths of different sized bottles, as when they agree the sound is reciprocated. But lower the G string to unison lower C, and both the strings vibrate together, because the diameter is the same. Amplitude of vibrations does not make the sound louder, only as it induces a better reaction consequent on increased pressure; for if you bow a thin string to a greater amplitude than a thick string, it sounds weaker, for want of sufficient tension. The loveliness of a violin depends more on the player than the instrument itself. What we want is more power, especially in the orchestra: this is universally acknowledged. **Fiddler.**

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[46748.]—**Sharpening Carpenter's Saws.**—In the number of this paper for August 4, "Jack of All Trades" gives me an additional answer in respect of straightening a saw. I have done my best to understand it, but have failed. As I feel convinced that the "dodge" he describes is a valuable one, I am emboldened to ask him to describe the apparatus more fully, and to recollect that he is teaching a—TIRO TIRONUM.

[47004.]—**Bread.**—Your correspondent, "A Disgusted Foreigner," has, I should say, been very unlucky in his experience of English bread. There is, in the first place, a greater variety of bread made in England than in any part of Europe. He can have it underdone or overdone. The Aërated Company's bread is, I should say, the purest to be got. My own experience of Continental bread is that, with the exception of the nice, little, sweetish rolls that they give you with your morning coffee, it is simply abominable—with about as much flavour as sawdust.—F. R. C. S.

[47207.]—**Resistance Coils.**—To "Ll. B.A."—I must indeed apologise to "Nosredna" for having kept him so long. The query had entirely escaped my notice till I saw it in the list of "Unanswered Queries." I hope I have not inconvenienced him by my seeming inattention. The size of wire stretched on Fig. 2 is of no importance, and may be of any resistance (unknown), since its only use is to give a ratio, by the lengths on either side of the sliding contact, since the resistance is proportional to the lengths. Practically, wire about No. 28 B.W.G. is the best, since it is neither so thin as to be quickly worn, nor inconveniently thick. If there be any excess on the coils, it must just be left: but all the coils may be joined up in series, so that the piece left on one is part of the next resistance. In Fig. 5 one end of a coil goes to one side of the plug, and the copper wire, which is soldered to the coil at the required point, goes to the other side of the plug.—Ll. B.A.

[47239.]—**Vegetarianism.**—"H. O'B." says that "Vegetarians are thin, spare people." I always thought that farinaceous substances were more fattening than meat; if so, vegetarianism would not suit persons inclined to be stout. Does "H. O'B." include eggs or milk in "Vegetarianism"?—NEMO.

[47239.]—**Vegetarianism.**—I am not going to enter into an argument with "H. O'B.," but merely to state facts. Some years ago I was much afflicted with indigestion. My life was miserable. I was at times completely prostrated, unable to work or hardly walk about. I tried all remedies suggested—lentils, vegetable food, milk diet, exercise as far as I could, rest, pepsine, alcohol, total abstinence, Turkish baths, quantities of medicine prescribed by a doctor (and a good doctor, too)—sometimes obtaining relief for a day or two, but at once falling off again. I suffered intense pain; I continually lost strength and weight. At last I consulted a physician, and his only prescription was: "Meat three times a day, and do not miss it. Eat anything else you fancy, but do not miss the meat." I followed his advice, and I have had no indigestion since, and I take no care as to food, eating pastry or anything that turns up. I do not find it necessary to eat meat so often now; but if I feel anything of a premonitory symptom, I at once increase the meat. I think my experience worth a library of theory on this matter. It will take a good deal of evidence to satisfy me meat-eating is a mistake. Let me tell "H. O'B." that it is vegetarians who have "superfluous fat, &c." All vegetable-feeding creatures are bulky-bodied. It is the meat-feeders who are free from "superfluous fat, &c." Here appears to me a guide. Men who approach the bovine build can live on vegetables. Those who are not all stomach and intestines cannot eat enough vegetable food to keep the steam up. One word more. The first food we ever had was animal (milk), and children will seldom eat vegetables if they can get meat.—EDWIN HOLMES.

[47239.]—**Vegetarianism.**—Vegetarians finding that whole-meal bread supplies all that is really needed as food, make it the basis of every meal. Perhaps I may be allowed to call attention to a few of our ordinary dishes, just to show how well we can do without "cabbages and cauliflowers," if they are not to be had fresh. To begin with, there are the tasty and nourishing soups made (thicker than ordinary soup) of lentils, split or whole, haricot beans, or split-peas, and flavoured with onions and any other vegetables. Soup made of Spanish onions, with milk added, thickened with fine whole-meal, the yolks of two eggs stirred in when the soup is taken off the fire and served with fried brown-bread. Then, again, tomato soup—a tin of tomatoes pressed through a wire sieve, placed on the fire with some milk, thickened with fine whole-meal, the yolks of two eggs added, served with fried brown-bread and grated cheese. There are also the numerous other ways in which the above-named articles can be cooked. Spanish onions, for instance, cut up and put with salt, pepper, and a small piece of butter, but no water, to bake for about three hours in a covered jar, and eaten with potatoes. Besides the numerous substantial dishes which can be prepared with brown-bread crumbs:—Bread-crumb omelette, or tomatoes, peeled (throw into boiling water for a minute or two to loosen the skins), cut into slices, sprinkle with salt and pepper, then cover with brown-bread crumbs mixed with grated cheese and sweet herbs, a few little bits of butter put over the top, then baked. Celery, stewed, and served on brown toast (the water in which it is cooked saved to add to next day's soup, or for drinking by itself). French beans and runners, shred down each side, but not otherwise cut, boiled and served with grated cheese (water saved to add to next day's soup.) Lastly, cabbages and cauliflowers boiled, then well-sprinkled with grated cheese and browned in the oven. There are scores of other dishes I should like to mention, but space does not permit. Professor Newman's "Gloucester Lecture," price 1d., gives valuable information about Vegetarianism and its aims. A penny whole-meal cake, to be had at any of the Aërated Bread Company's depots, and a handful of fruit render one independent of eating-house fare.—M. H.

[47239.]—**Deafness and Vegetarianism.**—To "H. O'B."—If "H. O'B." is a vegetarian I have a question to put to him. Where, in London, can I get *good* vegetarian cooking? To follow his letter *verbatim et literatim*. Many people who feed on roast beef are thin and spare, and have "no superfluous fat." As I cannot get a decent meal at any London vegetarian eating-house I am perforce a "meat-eater," and a beer-drinker. If I could get vegetables properly cooked at a vegetarian eating-house, I *might* become a vegetarian and pure-liquid swiller; but at present I am a meat-eater and beer-drinker. With every desire to live simply, I have tried all the vegetarian restaurants in London, and found it impossible to get a decent meal (I eschew porridge strongly). I have gone into the subject thoroughly, and find no vegetarian cook-shop can cook potatoes, French beans, peas, or cauliflower fit to eat (to my taste, of course). I once came across a dining-place in Farringdon-street, where I had a good dish which they called vegetarian roast goose. It was two pieces of vegetable marrow, cooked and browned, with sage and onion sauce and a rich gravy, and was really good. I have introduced it in two or three friends' houses (all meat-eaters) with great success. When I eat at the usual dining-rooms in the City I usually have a vegetable brought up as a separate dish, such as "potatoes sautees," or plain boiled peas or beans, to which I add butter, or plain cauliflower with grated cheese. This last cannot be got at the generality of "British" eating-houses. "Greens," as served at such places, are my abomination. I am very fleshy although I take plenty of exercise, and I have sincerely tried to find some place where I could try the vegetarian system, but have quite failed. A vegetarian dinner (minus porridge), taken after consultation with the managers of the various vegetarian dining-rooms, has with me always resulted in a feeling of fulness, most oppressive, while the appetite an hour or so after has returned quite unsatisfied. The soups supplied at such places are usually very good, but, beyond that, "food," so far as I have tried them, is not to be got. My question to "H. O'B.," or any other vegetarian reader, is this: is there a place in London where a well-cooked vegetarian diet can be fairly tried? I will not eat porridge, and I cannot say I enjoy a dish of plain boiled potatoes; all the places I have tried supply these primitive dishes, but I want something to take the place of the plate of meat, the chop, and the steak of the meat-eater's dinner. My eating at present is confined to coffee, 1 slice of bread and butter, and 1 small rasher of bacon for breakfast at 8.30 a.m.; 1 glass of bitter beer and a sandwich or bread and cheese at 1 p.m.; and a chop, sometimes preceded by soup, at 7 p.m. I cannot eat less, and yet it seems to me that a simple diet (minus porridge) ought to satisfy me, as I am getting stouter every day, in spite of as much Saturday and Sunday walking as I can stand. All my drinks, after breakfast, are one or two glasses of bitter ale, not more, and fourpennyworth of brandy in soda-water at night.—C. L. HART.

[47450.]—**Repairing Mirrors.**—"W. T. S." is wrong. Quicksilvered mirrors cannot be repaired as he states. He can only make a mess.—E. HOLMES.

[47345.]—**Boomerang.**—I have often tried throwing the boomerang concave edge foremost, and throwing at an object some distance in front of me, but always failed, and in despair used my boomerang to keep a curtain back. An Australian told me to throw as though throwing at an object in front, but by a quick movement of the arm and wrist to throw to backwards. You must stand sideways. He also told me that it did not matter which edge was forward, and he stood in rather a stooping position when showing me how to do it.—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[47346.]—**Boomerang.**—"H.'s" reply, though taken from an encyclopædia, is not in accordance with my experience; and as I have sight of these weapons, brought by myself from Australia, and all selected after careful trial—for it is not every boomerang that will "come back"—I am induced to write to you to correct the account given by "H." None of my boomerangs is flat on either side, nor can I see any difference of the sides. The *concave* edge is always in front when thrown, and the implement is nearly vertical when it leaves the thrower's hand, which it does with immense velocity, and making a loud, whizzing noise. It is discharged above the shoulder, and in no instance is it ever skimmed away horizontally. When thrown in the commonest way, a little upwards, it speedily assumes a horizontal position, always rapidly revolving, and mounts up in the air in a curve like the half of a suspended cord until, in some cases, it is almost out of sight. It then rests a moment or two, and retraces its course, and describes the whole of the catenary curve, when it again stops—sometimes a good way behind the thrower, and repeats the swing in the air, getting lower each time, until it comes to the ground, skimming along in a course so rapid and uncertain that the performer and spectators have often to clear out of its way very smartly indeed. There is another way of throwing it: when it is directed downwards towards the ground, along which it runs like a wheel, taking long bounds after every touch, and retaining its original perpendicular position. It will sometimes run in this way for a hundred yards or more; then it leaves the ground, screws up into the air, and works its way back to somewhere near the thrower in a kind of long arch. This is the prettiest experiment of the two; but the blacks do not like it so well, as the boomerang is apt to come against trees and get injured; the immense velocity with which it must be sent in order to make it perform at all, making it dangerous to either itself or to anything it may strike, according as the obstacle is harder or softer than itself. I believe the latter way of throwing it is the usual one in a fight. If it hits its man, it probably floors him, and certainly does itself—and it has done its work; but if it misses, it may come back to its owner and be used again. I may add that it appears to require great exertion to throw it—the "black fellow" bending his body back and forward, and running along for a good way before he discharges it; and I never yet saw a white man who could use it, nor do I think it is every black fellow who can do so.—Umbra.

[47459.]—**Silvering Looking-Glasses.**—"J. T. M." is wrong as to respective cost of mercurial silvering and patent processes with metallic silver. Mirrors are silvered much more cheaply by the new processes, but it does not last. A very large proportion of the new-process mirrors deteriorate sadly in the first twelve months, while the mercurial ones improve with age, if properly used.—E. Holmes.

[47486.]—**Euclid's Axioms.**—Mr. Romanes seems not to understand what is meant by a petitio principii, or begging the question. Of course I see the step taken in deducing $A - D = B - C$ from $A + B = C + D$; but that step is simply an application of axiom 3, which is just what we want to prove true.—A. J. Smith.

[47504.]—**Bottling-Wax.**—Several recipes have been given; for instance, on p. 550, Vol. XXXIV.; but "J. R. H." must remember that the "cheap qualities" are usually made by recipes kept secret, or at least not likely to be published for the benefit of those who might become rivals in the manufacture.—T. P.

[47509.]—**The Modern Harp.**—There are some desultory notes on harp construction in back volumes, but scarcely I think sufficient to help you in constructing one so far away from the shops. The head alone, with the tuning pins, could be bought here for much less than in Australia, and, as to making it, the time consumed would be enormous. So with other parts.—E. G.

[47512.]—**To Mr. Lancaster.**—I am sorry I have been unable to answer your query before. I have been wandering through Wales, and have only just returned, or I would have written earlier. The difference between the Leclanché and Grenet's is that the former used, and does so now, a porous cell; the latter dispenses with the cell, and in its place uses a canvas bag. I dispensed with both, and had no partition between carbon and manganese and zinc. There is nothing gained in current by any alteration from the original cell. You will find the Grenet will work as well for bells as the Leclanché. You have only to keep them clean and free from any accumulation of dust, and you will have no fault to find with the cells.—W. J. Lancaster.

[47513.]—**Dry Collodion.**—If you have not yet obtained what you want, send another query, and I shall be pleased to help you. There are a score and more methods of making dry collodion-plates, and if you will let me know what you wish to use them for, I shall be pleased to tell you the best process for you to employ.—W. J. Lancaster.

[47517.]—**Pumping Engine.**—Such a query as this can be answered only by trial. If the pump were of the same dimensions in feet instead of inches, and other things in proportion, it would not be difficult to calculate what it would do and what would be required, although even then the calculation would occupy a considerable time. But what can anyone say of the power of a boiler 3½in. diameter, 1ft. long, of "ordinary thickness," and with four inside tubes? Personally I should say that such a boiler will not do the work at a pressure of 15lb.; but really I don't know, and don't believe any one else does, without trying.—Essar.

[47521.]—**Monochord.**—About the best size you can make a monochord is 60in. by 6in. by 4in. The 60in. is, of course, the length; the 6in. the width; and the 4in. the depth. Make the ends out of 1in. mahogany or birch, the two sides out of pine, ½in. will do well; and the top, out of three pieces of veneer glued together in different directions; see that the glueing is well done from end to end of the pieces of veneer; then glue and screw the top on to sides, and have an open bottom, the two ends and two sides resting upon the table when in use. You will next make a scale in feet and inches, to run along one side of string, commencing with fixed bridge, and it is well to have a second scale on the other side with feet and decimal parts of a foot; this scale is much easier to work with than feet and inches. You must then have a second bridge, and this one a movable one. If you can get two pieces of hard wood for these bridges, do so; the harder the better. Don't put any bearers or anything else under the top board; leave it entirely free except, of course, where it is fastened to sides. You can have one, two, or three cords stretched at the same time, but one cord is sufficient to work with at a time. Get a series of cords from some musical instrument maker, and as to stretching, you can do this with a screw if you like; but a weight over a pulley must also be used. I shall be pleased to give you any further information you may require.—W. J. Lancaster.

[47522.]—**Konig's Adjustable Resonators.**—The tubes should be made of brass, and a good fit must be obtained, smooth, and to slide nicely. All this can be done with but little trouble. The main thing is to get good tubing of the sizes you require. The tube should be three times its diameter in length when closed down, and the holes may be one-sixth of the diameter of end plate. Of course other ratios may be employed; but I have found the above to be most satisfactory. The tubes need not be heavy; you may use tubing of 18 to 24 gauge, the thinner tube, of course, for the smaller resonators. The outside of the tubes (not the sliding ones) should be polished and lacquered. You will have to determine lengths of resonators from lengths of waves of notes you intend using.—W. J. Lancaster.

[47523.]—**Cubical Revolving Mirror.**—Looking-glass will do, of course; but what is the meaning of the question about size. If it is cubical any size will do, if all sides are of same dimensions.—J. T. M.

[47523.]—**Cubical Revolving Mirror.**—The mirrors should be 8in. square, mounted in a square frame. You must use plate-glass, preferably thin, and the best kind you can use is that which is silvered with silver and not with mercury. It will pay you better to buy the glass ready silvered than to attempt to silver it. Build the framework up, not too heavy, and have a spindle down the centre of framework, on which it will rotate. You will also have to make a large wheel to carry a cord, which must go round a small wheel fixed on spindle of mirror frame. This multiplying wheel will enable you to get a good speed in the revolutions of mirror, and the greater the number of revolutions of mirror, so much further apart will tongues of flame appear from each other.—W. J. Lancaster.

[47529.]—**Electric Lamp.**—There is no means of guarding the filaments except by controlling the current. You can surely get it to white incandescence, and then see that your connections are of such a calibre that they will pass only a certain maximum strength of current. These carbon filaments, when you get a really good one, will stand an enormous amount.—E. G.

[47532.]—**Medical Coil.**—I must apologise to Mr. Wright that I missed his query, having only just seen it while looking through the back numbers. A wooden bobbin with central hole for core will be best, and No. 16 c.c. wire will be too bulky, as you would have to use 1½lb. Use ¾lb. of No. 22, and your coil will be about 3¼in. diameter, when wound. You may, however, fit two wooden discs upon each end of core, insulate with asbestos paper, or writing-paper soaked in paraffin, and then wind upon core.—Fred. Walker.

[47533.]—**Secondary Batteries.**—To Mr. Lancaster.—I would not advise you to make an inner box of lead, but make merely a watertight box, and have sheets of lead in the usual way. You will find the plates better in many ways, besides taking up less room than any cubical form, with cuttings, &c.; the latter would be much more likely to hold the hydrogen vesicles than the oxidised leaden plate.—W. J. Lancaster.

[47537.]—**Musical Box.**—You must drive out the pins, and put new ones in; for which purpose, I suspect you will have to melt out the filling of the barrel, as the pins are usually put in from the inside.—T. P.

[47541.]—**Coil.**—To Mr. Lancaster.—You should rather find out cause of failure than add a condenser; the latter will not improve it at all for medical purposes. You should first send the current through and test the lifting power of iron wires forming core. You will soon find if anything is wrong with primary; then, if that is good, unwind secondary until you find the fault. Most probably there is some part broken, or the insulation gone, causing the loss.—W. J. Lancaster.

[47542.]—**Insects.**—A "small white insect, which does not fly, but runs quickly," is rather too vague. Probably, if you sent some specimens to one of the papers which answer entomological questions, you would obtain the name; or probably Prof. Westwood, of Magdalen College, Oxford, would reply to a courteously-worded note, inclosing specimens.—T. P.

[47545.]—**Daniell Battery.**—No easy, accurate way. You want galvanometer, &c.—rather expensive instruments.—J. M.

[47546.]—**Crystallisation on Metals.**—The tinplate is crystallised by means of acid. I believe Mr. Wenham was the first to invent a process, which is described in back volume. I don't think brass or any other metal can be done that way; but you can put a splendid appearance on brass by scraping up in short strokes (frosting), and then lacquering. Look in some of the opticians' windows, and then try your hand with a scraper—or an old three-square file, ground to a sharp edge, will do.—Essar.

[47550.]—**Dynamo.**—To Mr. Lancaster.—Let me know whether an answer now would be of use to you. I am afraid I have neglected you too long; but, if not too late, will be pleased to help you.—W. J. Lancaster.

[47551.]—**Coil.**—To Mr. Lancaster.—The core for such a coil should be 12in. long and 1in. diameter. The primary wire, two layers of No. 12 silk-covered wire, closely wound and insulated one from the other. For condenser use 70 pieces of foil 10in. by 6in., well insulated. Shall be pleased to tell you anything else you may wish to know. Well insulate the secondary, and wind as carefully and closely as you can.—W. J. Lancaster.

[47552.]—**Japan.**—"Ontario's" requirements are rather stringent; but perhaps the following will answer, although "steam heat" is an uncertain factor. Black pitch and gas-tar asphaltum 25lb. each, or really 50lb. of pitch; boil for five hours, then add eight gallons of linseed oil, 10lb. each of litharge and red lead; boil again for several hours, and thin as it cools with 20 gallons of turpentine. N.B.—A really good Japan cannot be made without asphaltum.—F. C. R.

[47553.]—**Problem in Dynamics.**—Could "Vesuvius" show that the result he arrives at is a necessary consequence of the conservation of energy?—A. J. Smith.

[47566.]—**Spectacles.**—"Engineer" should consult a respectable optician if there is anything special about spectacles for his work. If he is shortsighted he wants glasses of a different curve to those necessary for long sight, and possibly the blue tinted ones may be better; but there is nothing injurious in the use of spectacles, provided they are properly adapted to the eye.—Practical Printer.

[47592.]—**Telescope.**—Has it ever occurred to Mr. H. Bridle to perform an experiment which would enable him to answer his own question? Take a common double-barrelled opera-glass, first use both eyes, and then put your hand over one without shutting it, and observe the distance at which you can read small print. The pair which you speak of is in no way equal to 3½in. The magnifying power is in no way increased by using two telescopes instead of one; and as to its capacity for showing fainter objects, it will be exactly the same in comparison with a single one as will be the capacity of seeing with naked-eye observation with two eyes or with one only.—W. G. P.

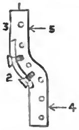
[47651.]—**Examination of Malt, &c.**—Erratum.—Line 2 from end, for "0·50 of grape-sugar," read "·050." Line 14 from end, for "such analysis," read "for each analysis."—J. C. Belcher.

[47671.]—**Institute of Chemistry Examinations.**—I may add that the examinations of the Science and Art Department are held in connection with every class throughout the country in the special subjects taught to such classes; also (and perhaps more convenient for "Old Subscriber") a certain number (limited) can be accommodated at the Science Schools, South Kensington, by giving early notice, say, on or before 31st March, to the secretary of department, and forwarding at the same time an examination fee of 2s. 6d. Advanced chemistry and advanced magnetism and electricity may be taken in the same year, as the examinations are on different dates (such dates may be obtained on application to the secretary of Science and Art Department in month of April). Would strongly recommend "Old Subscriber" to obtain a copy of the "Directory," which is very lucid and clear on all points, and may be obtained for 6d. from Messrs. Chapman and Hall, Piccadilly, W.C.—F. G. S.

[47682.]—**Electro-Magnetism and Magneto-Electricity.**—Mr. Sutcliffe has mistaken the nature of my query. I had not wished an historical account of the discoveries intermediate between those of Oersted and Faraday, but a proof of how, if the former had been acquainted with the principle of the conservation of energy, he could have at once deduced the discovery of the latter as a necessary consequence of his own.—J. H. G.

[47683.]—**To Electricians, &c.**—To Mr. J. Sutcliffe.—Thanks for your answer to my query; but I do not quite understand how I am to connect up my 50 double-fluid bichromate cells to get the best effect. Am I to join every two zincs and every two carbons to make a battery of 25 cells, and connect these 25 zincs to carbon, zinc to carbon, &c., instead of having 50 cells half the size? Should the outside jars be half-full of broken carbon, and should I gain anything by putting a little mercury in the porous pots?—S. H. Salt.

[47693.]—**Printing Press—Fractured Staple.**—The following sketch will serve you. Put some pieces ½in. thick and ¼in. projecting over cheek of fork 3; fit to your stalk first, and drill holes into the plate and cast iron at 4, as large as you can, and deep for tapping; countersink the plate right through, get some soft iron wire and screw both home in the holes prepared, and rivet up; then put your piece in and fix between, and proceed the same way; now turn upon its face, and dovetail a piece right across the box 2; proceed with screw rivets as before, and rivet the dovetail upon edge. It must be made a tight fit, that in the last process it may not draw or break the rivets. File and finish off as best you can. I repaired a lever similar to that some years ago, and found some 14 years after that it was doing good work. The material I used for the job was portion of a stout pit saw. It should be steel; you cannot depend upon iron for such a job as that.—Jack of All Trades.



[47701.]—**Platinum in Smee Cell.**—It would be better than silver as far as the force generated is concerned, but it would increase resistance if as thin as the silver usually is. This would not be of much moment, as the metal resistance is only a fraction of the total. This subject is mentioned in my book. I consider the extra cost would be well repaid.—Sigma.

[47708.]—**Cast-Iron Pipes.**—To give the particulars in detail asked for in this query would fill a page of the "E.M.," and be of interest to but very few readers. Formulas for calculating weight from a given size and thickness, and for weight and thickness required to stand given pressures, are to be found in "Molesworth's Pocket Book," and also tables of a number of sizes worked out. The usual commercial lengths and weights can be obtained by asking for a list from any of the founders, whose names can be found in the directory. Lead required for joints is, roughly speaking, about 1¼lb. per inch size, i.e., for a 6in. pipe 7½lb. This of course does not include the whole expense of making a joint.—M. F.

[47714.]—**Teste.**—(Estimation of potash in K_2CrO_4 and $K_2Cr_2O_7$.)—The querist might try the following method:—Take 1 or 2 grms. of the sample, dissolve in water, add a little acetic acid and an excess of acetate of lead, heat gently, filter, and wash thoroughly. Remove the excess of lead acetate from the filtrate and washings by acidifying with HCl and passing an excess of H_2S. The solution is now warmed, the precipitate filtered off and thoroughly washed. The filtrate and washing are now evaporated to dryness with a little HNO_3, the residue gently ignited, moistened with HCl, again ignited, and weighed. Dissolve the residue in water, add a concentrated solution of bichloride of platinum (as neutral as possible) in excess, and evaporate in a porcelain dish or a water bath nearly to dryness, taking care not to heat the water bath quite to boiling. Pour alcohol of 80 or 90 per cent. over the residue. Let it stand for some time, and then wash the residue that remains undissolved on to a weighed filter, wash with alcohol, dry at 212° Fahr, and weigh. Calculate this into KCl, deduct from the total chlorides; the remainder is NaCl. Now calculate each of these into K_2O and Na_2O (potash and soda). The above is a method of my own, and as I have only tried a few experiments with it, I cannot give any information as regards its accuracy.—J. C. Belcher.

[47717.]—**Problem.**—Let us write m in the place of $1 + x$, and, therefore, we shall have $m - 1$ in the place of x; the equation will become $1 + (m - 1)^5 = am^5$, or $m^5 - 5m^4 + 10m^3 - 10m^2 + 5m = am^5$. Now, it will be seen that the only uncomfortable coefficient (so to speak) is a, and it will consequently be most convenient to have this uncomfortable quantity in a term which does not contain the unknown; hence, we must divide by m^5; the equation then becomes $1 - 5/m + 10/m^2 - 10/m^3 + 5/m^4 = a$; if now we change $1/m$ into y we get rid of the awkward fractions, and the equation becomes $1 - 5y + 10y^2 - 10y^3 + 5y^4 = a$; this may also be written $5y^4 - 10y^3 + 5y^2 + 5y^2 - 5y = a - 1$, and it is then seen to be the same as $5(y^2 - y)^2 + 5(y^2 - y) = a - 1$. Now represent $y^2 - y$ by the letter p, and the equation is $5p^2 + 5p = a - 1$. This is evidently a quadratic, and can be solved in the usual way; the two results will be awkward expressions, containing surds, but let us represent the results by the letters b and c. Then it is evident, since p is equal to b or c, that $y^2 - y$ is also equal to b or c. Hence we have two quadratics to find y, and, consequently, we shall obtain four values of y. From these values of y we easily find the values of m and thence the values of x. Since the original equation contained the fifth power of x there must be five solutions: I have indicated how four are to be obtained; the fifth involves a point which might be too abstruse for a novice, as the querist describes himself. I shall, however, be glad to deal further with this if the querist wishes, or if he will advertise his address I will write to him fully on the subject.—C. W. B.

[47732.]—**Coil for Lighting Gas by Electricity.**—To "Sigma."—The coil used for this purpose is a small induction coil capable of giving a ¼in. or ½in. spark. For this purpose the primary must not be joined to the secondary, but must be constructed carefully as a tension induction coil. Even a smaller spark than I have mentioned will serve, if carefully arranged; and the operation can be effected even with a spark from an electrophorus—a system which was introduced a few years ago.—Sigma.

[47734.]—**Microscope.**—One word in addition to "P.'s" advice. When "O.O." goes to Baker's to see *Zeiss's* lenses, let him ask them to show him Seibert's of corresponding powers at the same time, and try the 1-14th, and be satisfied before purchasing. Seibert's 1-16th at a much lower price will beat it hollow.—E. Holmes.

[47738.]—**Analysis of Paint.**—The oil might be estimated by treating a weighed quantity of the paint with ether, filtering, evaporating the filtrate to dryness, and weighing the residue. The water may be estimated by drying a weighed quantity of the sample at 212° Fahr., provided no other volatile substance be present.—J. C. Belcher.

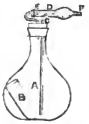
[47743.]—**Discharge of Egg-Shaped Sewers.**—The first formula "Etna" gives is deduced from the elaborate investigations of the German mathematician, Eytelwein, and most of us will, therefore, have to be satisfied that it fairly represents the discharge. Of course, if the discharge is to be calculated in cubic feet per second, the formula becomes—

$$Q = 35\sqrt{d^5\frac{f}{l}}$$

According to Hurst this value of Q is not so accurate as that derived from Neville's formula, but the former is best for bent pipes. I do not quite see why the above formula should not be satisfactory; d represents the diameter of the large end. The area of an egg-shaped sewer is $1{\cdot}1597d^2$. The area of the part below the diameter d is $\cdot767d^2$. The area of the part above $d = \cdot3927d^2$. The perimeter $= 3{\cdot}9649d$. The perimeter of the large end to the diameter $d = 2{\cdot}39415d$ (Hurst's "Surveyor's Handbook"). The dimensions given by "Etna" are correct.—C. H. Romanes.

[47756.]—**Electro-plating.**—There are a great number of galvanometers in use, and it is impossible to say which is the best. You will require two for your purpose; one to show the electromotive force may be made with 4oz. of No. 39 silk-covered wire for the coil, and a light needle which with the current of five small Bunsens in series will be deflected to an angle of about 45°. Mark the deflection No. 5 on a paper circle fixed under the needle, take one of the batteries out of the circuit, and mark the reduced deflection No. 4; remove the other batteries in succession, and in like manner mark No. 3, No. 2, No. 1. Your galvanometer will then show the electromotive force of any battery suited for electro-plating in five powers. You can use eight cells Danielle instead of five Bunsens, and make eight divisions if you like. The other galvanometer may be made with a piece of No. 14 copper wire 18in. long, bent into a ring of 6in. diameter, and a magnetic needle to deflect 45°. With the current of the five Bunsens, joined as one large battery, mark No. 5, as in the previous case, and graduate as before by withdrawing one cell at a time to reduce the surface. The use of these two instruments is as follows:—The degree of hardness or texture of the deposit is found by the fine wire coil galvanometer, and the surface of copper suited to any given battery by the ring galvanometer. The amount of surface required for each division you must find by trial, and the size of the needles by making several and selecting those nearest what is required.—J. Sutcliffe.

[47757.]—**Manganese.**—Impurities — Argillaceous matter, silica, peroxide of iron, calcium carbonate, &c. There are many methods for the analysis of manganese ores. The total amount of manganese may be estimated as follows:—1grm. of the ore is dissolved in HCl, filtered, and bromide added; when this has dissolved, add chloride of ammonium, and then ammonia in slight excess. Heat the solution for some time, filter, wash, ignite, and weigh as Mn_3O_4. If the precipitate contains iron, it may be removed previous to the precipitation of the manganese, by precipitating as basic acetate with acid ammonium acetate, or the precipitate may be dissolved in HCl and estimated by colour test with potassium ferrocyanide. I see that the querist has signed himself "Chlorine," and if it is his object to get a means of valuing his manganese for making chlorine (which depends upon the amount of MnO_2 contained in the sample), it may be done as follows (carbonates must, however, be first removed):—Weigh out 4grm. or 6grm. of sodium oxalate; introduce into the tube B, along with 2grms. of the ore and 10cc. of water; fit a little plug of wax in the tube C, pour some concentrated sulphuric acid into the flask A. See that the apparatus is perfectly dry and weigh. Now gently incline the flask so that some of the acid may run into the tube B, when the CO_2 will escape through the tube D, which contains fragments of $CaCl_2$ to dry the gas. There should be a small piece of cotton wool at F. When the gas ceases to come off, the remainder of the acid is allowed to run into the tube B, the flask gently heated and allowed to cool. When the apparatus is perfectly cold, the plug C is removed, and air drawn through the tube D at E; the plug is now replaced, and the apparatus reweighed: the loss in weight equals CO_2. The quantity of MnO_2 is calculated as follows:—If 44 of CO_2 = 43·5 of MnO_2, what does x quantity of CO_2 found. The quantity thus found, multiplied by 50, equals the quantity of MnO_2 in the sample.—J. C. Belcher.



[47758.]—**Carbolic Acid.**—Carbolic acid may be estimated in disinfectant powders, in the absence of lime, as follows:—Heat 20grms. of the sample in a retort of hard glass, and collect the oily distillate in a graduated cylinder; the number of cc., multiplied by 5, equals the percentage of carbolic acid. It should dissolve in caustic soda. "Disinfectant" will find a very good method for determining the above in Mr. A. H. Allen's "Commercial Organic Analysis," Vol. I. The process is rather too long to describe here.—J. C. Belcher.

[47762.]—**Smee Cell.**—To "Sigma."—The difference in E.M.F. would be very slight. Size, however, does affect E.M.F. in these cells, because of the reduced force due to hydrogen coating, and the difference would depend upon the amount of current drawn from the cells. The strength of acid has little effect upon E.M.F., but a good deal on the internal resistance, and, it may be added, still more on zinc consumption.—Sigma.

[47767.]—**American Loco.**—The Eames locomotive, which ran from Leeds to Doncaster in March last, was on view, I suppose, at the Alexandra Palace about July 20 last.—Iron Horse.

[47768.]—**G.N.R. Engines.**—In reply to "H. W.," I beg to give numbers of 8ft. single engines. At King's Cross, 544, 53, 94; Peterborough, 7, 8, 22, 48, 69, 98, 221, 545, 549, 663, 665; Grantham, 60, 62, 93, 95, 2, 3, 5; and at Doncaster, 33, 34, 47, 1, 546, 547, 548, 550, 664, 662; and there are also two others, I believe, 666 and 667. The above were the stations a month or two ago, and, therefore, may not now be quite correct. I may state that the G.N.R. have had just lately 20 fine 6-wheel coupled goods engines, by Dübs and Co., just delivered; the numbers begin with 730.—Iron Horse.

[47773.]—**Voyages in Small Craft.**—One of the most interesting accounts of a long voyage in a small craft is the "Voyage of the *Forlorn Hope*," written by Mr. Jefferson Stow, and published in Adelaide, South Australia. It is an account of a voyage in a small open boat, from Port Darwin in North Australia, round to Western Australia.—H. B. T. S.

[47776.]—**Reading the Morse Code.**—From a MS. index I gather (for I have not the volume by me) that your querist will find some serviceable information on pp. 14, 231, and 278 of Vol. XXII. of the "E. M.," and if he will look through the index of that vol. he may find other matter of interest to himself (as indeed he will in all your volumes).—Ploni Almoni.

[47785.]—**Bisulphite of Lime in Beer.**—Take some of the beer, and heat gently with HCl, and observe if there is any smell of SO_2 (odour of burning sulphur). Now take a fresh portion of the sample, add HCl, and put a strip of filter paper, dipped in potassium bichromate, in the mouth of the test-tube; heat gently, when if SO_2 be present the paper will be turned green, owing to the formation of Cr_2O_3.—J. C. Belcher.

[47801.]—**Rectification.**—By adding dilute HCl to the partly-saponified oil you can obtain the fatty acids. You may recover some of your oil, as it is only partly saponified, by treating with hot water to dissolve the soap, when any excess of oil will rise to the surface.—J. C. BELCHER.

[47805.]—**To "Jack of All Trades."**—These toys are for everlasting cropping up, and it is difficult to come to any conclusion as to what they will do, and so we have nothing to work from. What class of tubular boiler do you intend to use? A Cornish or multitubular, at 40lb. per sq. in., you might possibly be able to drive an 8in. screw and 10in. or 12in. pitch. Your boiler, if Cornish, shell 10in., 2ft. long, interior tube for firing 6in. But these things are difficult to fire, and a better arrangement can be made in a multitubular boiler, according to space you have at your command.—JACK OF ALL TRADES.

[47808.]—**Telephone.**—You had better try a pair of boxwood bobbins; wind them with an ounce of No. 36 silk-covered wire, and see that magnet is as close to armature as possible without touching, and see that all connections are right. I think you will find a much better result.—A. K. CHISLEHURST.

[47810.]—**Heating Soldering Irons.**—A copper bit, I presume, is meant. See one of Rippingille's batchelor's stoves for cooking, price 10s. They run about 8in. or 9in. square, and 12in. high, with a round hole in the top for kettle, with ventilators on the four sides; a square lamp underneath, with a 2in. or 2½in. wick. To a stove like this add a miniature waggon-tilt, about 2½in. wide, and as long as the round hole will take it; place it down in upon the baffle-plate inside, and pass two or four wires across it to lay the iron upon, about 1½in. from the plate. There is nothing you will get cheaper. When well regulated, they consume about a pint of petroleum in 11 hours for one penny, and do good duty.—JACK OF ALL TRADES.

[47812.]—**Hydraulic Cylinders.**—These require a mixture of close metal, and should be cast on end, base at bottom, and sufficiently long that the spongy top can be cut off. A porous cylinder can be made to stand pressure by standing with a weak solution of sal-ammoniac in, and, when emptied, exposed to the action of the atmosphere. But the sweating is not always proof that it is leaky, as I have seen a perfectly tight cylinder running a stream of water outside, which is the cold caused by the circulation of water inside, condensing the humid atmosphere outside.—JACK OF ALL TRADES.

[47813.]—**Transit of Venus.**—My reasons for suggesting the Southern Port Royal Mountains as a suitable site for a telescopic observation of the transit of Venus, are these:—its easy access from Kingston—viz., a ten-mile drive across the plain, and from six to 10 miles horseback ride to get at either Flamstud, Bellehnr, Bloxburgh, or Hope. I should prefer the former, as the nearer and the most suitable. At each of these places is a good residence, on a small plateau, at elevations varying from 2,500ft. to 3,500ft., and the mountains abutting the plain very closely. Moreover, they are clothed in a mantle of green, sufficient to prevent the radiation of heat from interfering with first-class definition, and not so dense as to cause the rapid formation of rain-clouds as the Blue Mountain range does, some ten miles further back. The gentlemen who reside there will, no doubt, do their best to accommodate a few gentlemen on an occasion of that sort for a night or two if required. A more hospitable class of gentlemen can scarcely be found than used to be met with in Jamaica, and I have no doubt, it is so still. As to provisions, they may be taken from Kingston; but I think they may be obtained of the peasantry on the properties. Conveyance can be obtained also at Kingston, to drive across the plain to foot of mountains, if Flamstud be selected, 10 miles, then horses can be had to ride the remaining six miles, and negroes to carry the instruments, and by no means expensive. Clothing should be a suit or two of light wool—say, of the tweed kind; an umbrella to screen the sun's rays; and the lightest of all mackintoshes to throw over shoulders if caught in a sudden downpour. Temperature on the plains, from 80° to 90°, at Flamstud not much over 70°. On the plains, there are, probably, not more than 20 days on which rain falls in the 12 months, and on those mountains referred to, probably 40, and principally confined to the rainy seasons—viz., the end of May and October. But on the Blue Mountain range and its northern slopes, the forests are dense, and the rainfall almost daily. After transit, a peep at the glorious panorama spread on every hand must not be omitted, and, if agreeable, a cup of real mountain coffee may be taken, neither of which will be easily forgotten.—S. B.

[47815.]—**Thermopile.**—I can only answer the question approximately, as I have not at hand much information on the subject. I think the 100 iron and copper plates would only give about one-fifth the E.M.F. of Daniell cell. As to relative resistances that would depend on the size of the cell. The force of a bismuth and antimony couple would be more than five times as great as that of iron and copper; but the quality and physical condition of the metals would largely affect the result.—SIGMA.

[47816.]—**Silicate of Magnesia.**—You may prepare magnesium silicate without a furnace by adding an excess of $MgCO_3$ to some HCl, filtering, and to the clear filtrate add a solution of sodium silicate; filter, and wash the precipitate.—J. C. BELCHER.

[47819.]—**Electrical.**—The reason your Griscom motor does not turn is probably because the springs do not touch the commutator at all points of the revolution, or else they are set across at right angles to their proper position. The remedy is to make the springs press hard, or to alter their position. The bichromate battery will not work more than three or four minutes on a short circuit, such as heating wire, &c., but will run a motor engine much longer; the quicker the engine goes the longer the battery will drive it. I have worked an electro-motor continuously three hours without a porous cell, but it was specially made for the purpose. A bichromate battery as commonly made is not suited to produce the electric light, for which the cells should be very large size. Your 6-cell battery will only show a spark between carbon points, or light a toy incandescent lamp for a minute or two when it is new charged. The effect is most constant when the zincs are not amalgamated, and the following solution is used:—Water, one quart; bichromate of potash, 1½oz.; sulphuric acid by weight 2½oz. It is, however, more economical to amalgamate them.—J. SUTCLIFFE.

[47822.]—**Tempering.**—To harden in lead you should take a block of lead, drive the tool into it cold to impress its shape, heat to cherry red, and plunge into the impression, cooling the lead with water. But were I in your place I should heat my tools cherry red, and harden in urine, work with a very slow speed, and use oil of turpentine, or paraffin oil, as a lubricant to the tool. I know this proceeding will cut chilled iron, and I don't think your hubs are harder than that.—FRED. WALKER.

[47823.]—**Drinks.**—I this week heard Mrs. Lucas, of London (a good authority on temperance matters), recommending the use of hot water as a substitute for alcoholic beverages of all kinds, saying also that she knew of several cases in which individuals who had adopted it, during the last few years, had found it fully satisfactory and efficacious.—H. O'B.

[47823.]—**Drink.**—The following is a recipe given by a medical man:—Liq. ferri perchlor, 2 minims; chloroform, I minim; infus. quassia, 6 drachms; to be taken twice a day before meals. I have many other recipes, recommended by medical men and others, suitable to the various conditions of persons suffering from drink-craving, which I should be very glad to send "M. P." privately if he will communicate with me. Cocoa is often found beneficial.—A., 16, New King-street, Bath.

[47824.]—**Fuller's Mercury Bichromate Battery.**—To H. STOOKE.—I can hardly suggest cause of failure in your case, as all my cells work exceedingly well. The porous pot may be too hard, for this is a very frequent defect, which is just as frequently overlooked. Sometimes, too, the acid is put in with the bichromate, and the water afterwards added: this is a mistake, as it causes the bichromate to deposit on the bottom of the cell in a hard cake, when powdered bichromate is used; but if stirred up the next morning the cell ought to go on with a moderate amount of work for from two to four months. The following are the maker's instructions, to which I work. The zinc is in the porous pot and the carbon is placed in the jar. To charge: Place in the jar about 3oz. of bichromate of potash and 4oz. of sulphuric acid. In the porous pot, in which zinc stands, place 1oz. of mercury, adding about a tablespoonful of acid; then fill up both the jar and the porous pot with water. The battery should then work well; but should the tint of the solution be found to have changed from orange to blue potash must be added. If the colour remains orange, and yet the battery fails in power, add three or four ounces of acid, removing at the same time some of the solution from the porous pot, refilling with water only. When the contents of porous pot turn blue, replace a portion of it with water. Keep porous pot and outer jar nearly full of liquid. These are all the instructions required. With regard to the Leclanché cell, the porous pot must be somewhat deteriorated after two years' constant use. I presume the porous pot has been repacked with crushed carbon and peroxide of manganese? And as you say the sal-ammoniac is pure, I cannot account for the failure otherwise than that the pot is worn out. If that is good, as well as the zinc and carbon, there should be no cause of failure. Your carbon had not, perchance, become in any way coated with zinc?—H. STOOKE.

[47830.]—**Plating Solution.**—To determine free sulphuric acid in presence of a sulphate, the following (Girard's process) is said to be the only direct method which can be relied on. Evaporate on the water-bath very carefully to dryness and exhaust the residue with absolute alcohol. This removes all the free acid. The alcoholic extract is then mixed with water, and heated until the alcohol is evaporated off; the resulting liquid, which contains the whole of the free acid, can then be analysed gravimetrically, or titrated according to the acidimetric method. The following is a good method of gravimetric analysis:—In the first place, the volume of liquid originally taken for analysis must be noted; we will suppose it to be a decilitre. The liquid containing the free acid is placed in a beaker, two or three drops of HCl added, and the temperature raised to the boiling-point. The lamp is now drawn aside and solution of $BaCl_2$ is added, drop by drop, until it is in excess—that is, until the precipitate having subsided, a drop of $BaCl_2$ poured down the side of the beaker causes no turbidity. When the precipitation is complete, the beaker is covered and set in a warm place for a few hours. This is to allow the $BaSO_4$ to become denser and more granular, otherwise it would run through the filter. The filtration is conducted very carefully on a Swedish filter, and the precipitate is then washed cautiously four or five times with hot distilled water, allowing all to pass through each time before a fresh quantity is added. The precipitate is dried on the filter and transferred to a weighed porcelain crucible, the filter being burnt and the ash placed in the crucible. The crucible is now heated cautiously with the lid on for two or three minutes, and afterwards at a red heat for ten minutes: it is then allowed to cool in a desiccator, and weighed. I have found this to give very accurate results. The calculation will then be made as follows. We will suppose the following results to have been obtained:—

$$\begin{array}{rr} & \text{Grammes.} \\ \text{Crucible} + \text{lid} + BaSO_4 + \text{ash} = & 15{\cdot}374 \\ \text{Crucible} + \text{lid} = & 14{\cdot}212 \\ \hline BaSO_4 + \text{ash} = & 1{\cdot}162 \\ \text{Allowing for wt. of ash, say} & {\cdot}002 \\ \hline BaSO_4 = & 1{\cdot}16 \end{array}$$

What we wish to estimate is the SO_4. Now, the atomic weight of Ba = 137·1; S = 32; O = 16: whence $SO_4 = 96$ and $BaSO_4 = 233{\cdot}1$. Therefore, $SO_4 = \frac{1{\cdot}16 \times 96}{233{\cdot}1} = {\cdot}477$ gramme. And we therefore find that the solution contained ·477grm. of free acid in each decilitre, or 4·77 grammes per litre.—C. HARRIS.

[47833.]—**Coil.**—After each layer or helix has been wound that requires a power, the top or bottom coil alternately should be laid bare of cotton, or insulation, and the power wire soldered to it, then pushed through its hole in the base of coil, then go on winding; the insulation of the connection need not be remade if the wire is well insulated in the next helix or layer.—FRED. WALKER.

[47840.]—**Microscope.**—I am sorry I cannot give a full answer to this query, as the volvox is a most interesting subject. I learnt from Mr. Ingpen, of the Hill, Putney, who makes them a special study, and is always pleased with specimens, that at certain periods of their existence they lose their cilia and that beautiful network, and also are not always in an active condition, requiring certain conditions to bring them into activity. I have since learnt that rain and sunshine are essential. I have not found any this year.—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[47840.]—**Microscope.**—Very many specimens of Volvox are without the cilia and reticulations.—E. HOLMES.

[47843.]—**Acoustics.**—On referring to any good work on the subject, "A. E. T." will see that the material composing the case exerts no influence on the pitch of the note, the only alteration being a slight change in the quality of the sound. If the wooden sides of the violin be replaced by steel, the note will remain the same; but the tone will not be so rich and mellow.—TAM O'SHANTER.

[47843.]—**Acoustics.**—This is a very interesting question. I am at variance with old ideas, however plausible they seem, but more especially when they quote finality. The column of air *seems* necessary for a violin, not for the piano. Curious, but true, say the masters. If I take a violin without the sides the column of air is there, and it will not act with the strings so well; and if I remove the back the air is still there; it won't resonate at all. Apparently, when I inclose so much air, 122 cubic inches, the sound gets stronger without greater amplitude of vibration. However, I must wait two or three days for the best results. Why? Ay, there's the rub. Why do old violins sound better than new? Is it because they are more uniformly consolidated? Metal organ-pipes will sound, but not an iron or steel fiddle, yet the column of air is there. My advice to those who want to know is to experiment and try and hunt this fox to earth. Mind you bow the soundboard the right way.—Fiddler.

[47844.]—**Tricycle Riding.**—There is certainly none of the danger suggested to be feared in tricycle riding. The world is infected just now with people who find danger in everything. The most sensible answer I think I have ever read in the "E.M." is that (No. 47735) at p. 601. What with Dr. Richardson, who objects to our having a small amount of curtain at the heads of our beds to keep off the abominable draught from doors and windows, or to prevent the sunlight waking us up at unearthly times on a summer morning, and all those who won't let us eat meat, or salt, or tea, or coffee, leaving the greater part of us nothing to drink but filthy water that has come through miles of lead piping, life would certainly soon not be worth living, Mr. Mallock! I would suggest that all these people who have nothing to do but to make themselves miserable in this way, should be transplanted, with Dr. Richardson and Sir Wilfrid Lawson at their head, to Ireland, to make a kingdom of their own.—F.R.C.S.

[47844.]—**Tricycle Riding.**—The tendency to hernia in any exercise is not increased solely by a general strain on abdominal muscles, unless the position of the thighs is such as to cause the abdominal rings through which the intestine escapes, to be relaxed at the same time. This would be the case on a bicycle or a tricycle, if the machine were not large enough for the rider to avoid raising the thigh to a right angle with the body. In such a position the rings are relaxed, while the exertion is still causing tightening of abdominal muscles, and therefore pressure on intestine. The old "boneshaker" bicycle did this. The large modern machines do not, as the rider does not raise the thigh to a greater height from the full stretch of the leg than the modern short crank and upright position necessitate. Have the seat of your tricycle raised to such a point that at the highest your thigh does not come up more than 7 or 8in., from the perpendicular. Sit upright for the same reason, and you need not fear that tricycle-riding will cause hernia any more than other exercises. The intestine is supported from the upper and back part of the abdomen by the mesentery. If you bend your body down you to some extent lose this support; if you bend the thigh close up you relax the rings; if you strain and tighten the abdominal muscles in your exertions all at the same time, you are in the most favourable position for the escape of the intestine through the rings—in other words, a hernia. I have ridden both tricycle and bicycle in medical practice for years, and can speak from experience. —Drareg.

[47844.]—**Tricycle Riding.**—I am acquainted with tricyclists afflicted with rupture who find they can dispense with their trusses when riding. Violent falls or awkward dismounting from a bicycle might cause rupture, but I have never met with any cases. The former are not likely to be so severe, and the latter should not exist at all in connection with the tricycle.—A Surgeon.

[47846.]—**Electro-plating.**—The small portion used of nitrate of mercury is of no consequence. The use of it is pernicious. Do not dabble about in it with your hands, but get a bit of stout cane about 4in. long, seal the end for handle with a hot iron and rosin or beeswax, and wet the other end and hammer it to a pulp for a fine brush; use this to apply a strong solution of cyanide of silver in cyanide, and a very small portion of nitrate of mercury; first cleanse with lime and potash, then apply the above. Dip in hot water and transfer to bath direct.—Jack of All Trades.

[47846.]—**Electro-plating.**—As the coating of silver covers the nitrate of mercury completely, I do not think any harm can result from its use. When this is not used it becomes necessary to deposit copper on some articles before the silver will adhere.—H. Stooke.

[47847.]—**Electro-plating.**—I should say that the deposition was too rapid. Reduce your battery power, and try again. You also appear to have left the article in the solution too long.—H. Stooke.

[47847.]—**Electro-plating.**—Perhaps you have too much battery power, or your spoons may not be clean. Rub the surface to be plated with a piece of water-of-Ayr stone, and waterwash in clean water, and put them wet into the plating bath. Read my letters on plating again, and attend carefully to all the directions there given; but do not let the battery power be too great at first. The white, frosted appearance is all right, but I think you coat them too quickly at first. It is impossible to tell exactly the reason of your failure unless you give more particulars.—Os.

[47848.]—**Replating Worn Steel Pickle Fork.**—This must first be plated with copper. Copper solution made by adding a solution of pot. cyanide to sol. of cop. sulphate; wash the precipitate, and dissolve in pot. cyanide; use a copper anode.—Os.

[47849.]—**Strength of Pipes.**—"Glatton" has taken the arithmetical mean, instead of the mean proportional. To get this he must multiply together the dimensions given, and extract the square root. Thus, $24 \times {}^1/_{48} = \frac{1}{2}$, and the square root of this is $\frac{1}{2}\sqrt{2}$, or 0·7in., a very reasonable thickness, unless the head of water be over 350 feet, as per first part of "Glatton's" rule.—Ploni Almoni.

[47849.]—**Strength of Pipes.**—"Glatton" quite misunderstands the second part of Rankine's rule. A "mean proportional" means a geometrical mean, and not an arithmetrical mean, as "Glatton" has supposed it to be for his 24in. pipe. For a pipe of this diameter, Rankine's rule gives:—

$$\text{Thickness} = \sqrt{24 \times 1/48} = \sqrt{\tfrac{1}{2}}$$
$$\text{,,} \quad = 0{\cdot}707\text{in.,}$$

or nearly ¾in., which would be a "reasonable" thickness.—J. E. Gore.

[47849.]—**Strength of Pipes.**—The arithmetical mean has been made use of by "Glatton" instead of the mean proportional, as intended by Rankine. If A : B : : B : C, then B is the mean proportional between A and C and $B^2 = A\,C$, or $B = \sqrt{A\,C}$; the mean proportional between 24 and ${}^1/_{48}$ will therefore be about ·7in. With a head of water of 300ft., or a pressure of 130lb. on the square inch, this would give a strain on the metal of about one ton on the square inch, which is about what cast iron will safely bear; but in practice the pipe could be made 1in. thick. A good formula being thickness $= {}^1/_5 \sqrt{\text{diameter}}$.—M.I.C.E.

[47849.]—**Strength of Pipes.**—"Glatton's" example should stand thus:—$\sqrt{\left(24 \times \frac{1}{48}\right)}$ which he can work out for practice. To give a plain illustration: The mean proportional between 48in. and 1-48in. is 1in., 1in. being 48 times 1-48in., and 48in. being 48 times 1in. The mean proportional between 12in. and 1-48in. is ½in., and between 3in. and 1-48in. is ¼in.; and by the latter part of the rule given, 1in., ½in., and ¼in., will be the thicknesses required respectively for a 48in., a 12in., and a 3in. pipe. The meaning of there being two parts to the rule is this. A pipe must have a certain thickness if there is only sufficient pressure on the water to fill the pipe; this thickness is given by the second part of the rule, which is so framed as to give the thickness requisite to resist pressure up to a certain point, beyond which the first part of the rule comes in to provide the increased thickness required to resist the extra pressure caused by an increased head of water, which pressure increases in direct proportion to the increase in the head of water. Now, to look at this first part of the rule. Supposing that "pressure of water in feet" means head of water in feet, the rule, as given by "Glatton," seems to me to be inadequate to make provision for this increased pressure, as this part of the rule would not, in the case of a 24in. pipe, come into action until the head of water had reached over 350ft.; if, however, we suppose that in transcribing the rule 12,000 was put for 1,200, the first part of the rule would come into action, in the case of a 24in. pipe, when the head of water reached about 36ft., and would from that act provide for the increased pressure caused by an increased head of water. The practical working of the rule is as follows. A 3in. pipe should have, according to the second part of the rule, a normal thickness of ·25 or ¼in.; this would not be increased by the first part of the rule until the head of water reached 100ft.; after that the thickness of the pipe should increase in direct proportion to the increase in the head of water; so that with a head of 200ft. the thickness should be ·5 or ½in.; a 6in. pipe should have a normal thickness of about ·36, which would not be increased until the head of water reached about 71ft.; a 12in. pipe should have a thickness of ·5, which would not increase until the head of water reached 50ft.; a 24in. pipe should have a thickness of about ·71, which would not increase until the head of water reached nearly 36ft.; and so on—the greater the diameter of the pipe the lower the head of water at which the thickness should be increased by the first part of the rule; but in every case, when once it began to be increased, it would increase in direct proportion to the increase in the head of water to the pressure of which it was subject. I hope that the above will make plain to "Glatton" the principle on which the rule in question is framed, as well as the method of using it. I cannot refer to Rankine's book to see if I am right in my conjecture that an error has crept in in transcribing the rule.—G. J. H.

[47850.]—**Sensitised Paper.**—May be kept unaltered for months in a dry atmosphere. For this purpose it is convenient to keep it in a box with a false bottom, beneath which is placed a vessel containing dried calcium chloride, which will absorb all moisture present. The box should be kept tightly closed.—C. Harris.

[47854.]—**Reaping Machine.**—About 10 per cent.—Jack of All Trades.

[47855.]—**Gas-Engine for Dynamo.**—This query should read ½ h.-p., and not 1½ h.-p. gas engine.—B. M. S.

[47855.]—**Gas-Engine for Dynamo.**—"B.M.S." would have plenty of power in his 1½ h.p. gas-engine to work a small dynamo to give 6 or 8 incandescent lights. Such a dynamo could be obtained for £20.—A. J. Jarman.

[47858.]—**The Berliner Violin.**—I have received a letter from Mr. Berliner advising me that I shall not get his violin for a week or two, owing to the long-shoremen's strike. He, however, has a new addition to submit, which increases the tension without destroying the elasticity of the soundboard. This I can say nothing about till I hear the sound. Mr. Fennessy will excuse my earnest desire, but I want him to brace his string support from the front, instead of tying it to the button. Some arrangement from end of finger-board and through the bridge might be sufficient. Mr. Fryer will perceive from these efforts where weak violins fail; it is because the tension is not maintained throughout, though the tail-piece is attached as usual, yet the wood has not been graduated in thickness to suit the lower notes. The original Berliner resonator produced or allowed more elasticity, but did not provide for an equivalent tension. You will all be pleased to know how it is done when the instrument arrives.—Fiddler.

[47859.]—**Dirty Oil.**—Put in a few gallons of strong hot soda-water, and well agitate two or three times; let it settle. Then make a hole in the side of tank as near the top as you can, and insert a pipe. Place a pipe from another tank with cold-water within an inch of bottom, and let the water in quietly. Your clear oil will overflow into whatever you like to place to catch it in, and it may be used for lubrication.—Jack of All Trades.

[47862.]—**Painting and Gilding Wooden Letters.**—If the querist requires the letters to show up well on a black ground, he may paint them over with a bright red paint, say vermilion, and gild only the face of each letter. Paint the letters first. Let the paint get thoroughly dry. Afterwards apply the gold size to face of each letter. When tacky, apply the gold leaf. When dry, varnish over with good pale varnish. If done in this way, the sides of the letters will appear red, and the face of the letters being gilded, will show up well on a good black ground. The sides of the letters may also be gilded, if preferred. Either way will, no doubt, answer the requirements of the querist.—G. Fryer.

[47864.]—**Chemistry Examination.**—I have always found "Dewar's Organic Chemistry" to contain all the matter required for the second stage, Subject XI., of the Science and Art Department, published by Collins and Sons, 2s. 6d.—F. G. S.

[47865.]—**Utilisation of By-Products.**—Save in a cistern, and convert it into sulphate of ammonia—a valuable manure.—Jack of All Trades.

[47865.]—**Gas Products.**—The ammonia liquor can be used diluted with water upon grass and vegetables. It must not be used strong, as it contains substances which will kill vegetation. The best way to use it is to distil it from a boiler with sulphuric acid; after a time add a little lime to the boiler. The liquor obtained is sulphate of ammonia, and may be used as a liquid, or evaporated and crystallised. It would not be safe to mix the liquor with offal for a manure.—Sigma.

[47867.]—**Magnetic Sands.**—The N.Z. Titanic Steel and Iron Company, formed in 1873, to smelt the iron-sand at Taranaki, N.Z., has been wound up. The result of a trial in August, 1876, was three tons of pig-metal, at a cost which proved that it would not pay to work. Another company has been formed lately, who have bought the plant, and are to commence work next month.—New Zealander.

[47870.]—**Desmids.**—Various recipes are in use for media by which the natural colours of desmids, algæ, &c., may be preserved. Every man, of course, has his own hobby, and it is hard to say what is really the best medium; but, I believe, "H. A." will find the following all fairly good:—1. Acetate of aluminium 1 part, distilled water 4 parts. Said to be very good for preserving all vegetable colours. 2. Deane's compound:—Gelatine 1oz., honey 5oz., water 5oz., spirits of wine ½oz., creosote 6 drops. 3. Ralf's liquid:—Bay salt 1 grain, alum 1 grain, distilled water 1oz. 4. Glycerine jelly. Very favourite medium:—Gelatine 1oz., glycerine 6 drachms, camphorated spirits of wine ½oz. Soak the gelatine in cold water, then dissolve by gentle heat; when nearly cold add a very little white of egg, then boil till white of egg sets, filter through fine flannel, and add the glycerine, which should be previously mixed with spirit; mix well. When wanted stand in jar of boiling water. The great objection to fluid media for mounting is that the cells are apt to leak; I always make it a rule to stand my slide-boxes vertically (like books in a book-case), the slides being thus kept horizontal, leakage or settlement of the objects is, to a large extent, obviated.—C. HARRIS.

[47878.]—**Electro-Gilding.**—All parts of the work on which the gold is not to appear must be covered with shellac varnish, the points of contact with the wires must not be covered, and if this is arranged on some plane or flat surface the gold can be removed with a little rouge.—OS.

[47883.]—**The "Vicar of Bray."**—In the "Beauties of England" we find that his name was Simon Symonds, possessing a benefice in the reigns of Henry VIII. and the three succeeding monarchs, and dying in the forty-first year of Queen Elizabeth. In the *Mirror* of March 26, 1831, you will find this and other information, as well as the song.—A. E. BANNISTER.

[47883.]—**The "Vicar of Bray."**—The celebrated "Vicar of Bray" was Simon Aleyn, a Canon of Windsor; he held his benefice of Bray for 48 years, from 1540 to 1588; he was a Papist under Henry VIII., a Protestant under Edward VI., a Papist again under Mary, and a Protestant under Elizabeth. The song is said to have been written by a trooper of dragoons in the reign of George I. The tune is much older.—G. J. H.

[47883.]—**The "Vicar of Bray."**—D'Israeli gives in his "Curiosities" the following paragraph, but does not, unfortunately, give the name of the parson in question:—"The Vicar of Bray, in Berkshire, was a Papist under the reign of Henry the Eighth, and a Protestant under Edward the Sixth; he was a Papist again under Mary, and once more became a Protestant in the reign of Elizabeth. When this scandal to the gown was reproached for his versatility of religious creeds, and taxed for being a turncoat and a changeling, as Fuller expresses it, he replied: 'Not so neither; for if I changed my religion, I am sure I kept true to my principle, which is, to live and die the Vicar of Bray!'"—H. STOOKE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47304. Division Plate, p. 388.
47306. Slide-Rests, 388.

47499. Model Electric Railway, p. 484.
47512. To Mr. Lancaster, 484.
47514. Tennis Balls, 484.
47516. Splitting Stone, 484.
47520. Inspecting Weights and Measures, 484.
47525. Hay Barn, 484.
47526. Quickest Railway Run, 484.
47534. Dutch Rhenish Locomotives, 484.
47539. Wear of Brake Blocks, 485.
47560. Self-Acting Feed to Planing Machine, 485.
47564. Photographic Lens, 485.
47565. Valve-Motion, 485.

A Novel Clock.—The American Watch Company of Waltham has forwarded to the headquarters of the United States Signal Service Bureau at Washington, a novel clock for the use of the service. The case is made of brass, of sufficient height to allow the swing of a pendulum one metre in length. The case is made perfectly air-tight, and has been constructed in such a manner that the air can be exhausted and the movement run in a vacuum, thus avoiding the variations incident to atmospheric changes. A very ingenious electrical attachment has been affixed to the movement, whereby the clock is wound as it runs, thus overcoming the variations usual when the mainspring is fully wound or partly spent. The manner in which this is accomplished is by alternately breaking and closing an electric circuit, and using the motion thus obtained and the power of the electrical current in re-winding the spring by means of a worm and other mechanism, which is so graduated as to motion that the winding keeps exact pace with the running. The slightest variation from this is shown on a delicate indicator attached thereto.

AN exhibition of electric light appliances, with especial regard to the artistic side of the question, is announced to be held at Munich from September 16th to October 8th.

QUERIES.

[47884.]—**Removing Copal Varnish.**—Would some of the readers of the "E. M." inform me by what means copal varnish can be removed from teak and pine wood? I have a boat which has been in use for several seasons and varnished each year. I am anxious to restore the original bright colour of the wood, if possible; but my attempts to do this by using steel scrapers and sandpaper were not successful.—ELEPH.

[47885.]—**Turbine Pit.**—I have got a turbine, and I intend giving it a new footstep, but will have to put a dam in at tail race, and pump water out, which I intend doing by steam-power, as the shafting (5½in.) the turbine drives will be running (20 revs. per min.) over top of pit, and I intend using an 8in. pump. What speed should I drive it at, and size of pulleys should I use, and how long will it take to empty it? The pit is 16ft. by 18ft. by 6ft. The last time it was pumped out it took four men 12 hours, I am told, with a common 8in. or 10in. plunger pump.—A TEMPLAR.

[47886.]—**Pumps.**—What size of suction-pipe and valves should a 30in. plunger pump have, and what speed should it go at, and oblige?—A DRIVER.

[47887.]—**Hot-Air Engine.**—Will some correspondent kindly give sketch of a hot-air engine to pump a small jet of water 2ft. high? I want the engine to be as small as possible, as I have very little space. Also, please give dimensions of force-pump, and oblige.—A SUBSCRIBER.

[47888.]—**French Locos.**—Can Mr. E. C. Gobert oblige with the details of the outside cylinder goods engines of the Chemin de Fer de l'Ouest?—N. W., Ealing.

[47889.]—**Linen Bleaching.**—Will any reader kindly tell me the ingredients and quantities for bleaching new white linen, as I cannot get it white enough for the purpose I require?—IN A FIX.

[47890.]—**Lathe Flywheel.**—I am fitting up a rough lathe (5in. centres) for wood-turning, and as I cannot conveniently get an iron flywheel, I will be glad of dimensions for wooden one: diam., weight, width and thickness of hoop, &c., also, diam. of pulley for lathe mandril?—GEO. H.

[47891.]—**Engine Query.**—In D. K. Clark's "Modern Locomotive" I find a paragraph which asserts—"That the compound movement of the valve produced by the combined action of two eccentrics. . . . . . The distribution is, in fact, that which would be due to the employment of a simple eccentric having an equal length of travel directly connected to the valve. Thus the mystery of the link-motion, if it ever existed, is explained" (vide p. 109). In Forney's "Catechism," p. 188, I find quite a different opinion expressed; and having consulted a friend who has had great experience in various workshops in different parts of the world, he says that it is generally acknowledged that the "vibration of the link" has a great influence on the valve-motion. The vibration being caused by the motion of the back eccentric while working in forward gear, and vice versâ. It must be understood I allude to working expansively, say, cut-off at 50 per cent. of stroke. I would, and so would many of our readers, consider any information on this subject a great favour, indeed, as it is a knotty subject.—TRIPLE-VALVE.

[47892.]—**Pianoforte Hammer Covering.**—Will Mr. Davies kindly oblige me with the proper way to cover hammers and how to prick them?—NOVICA.

[47893.]—**Cement for Gas-Stove.**—Will any skilled reader kindly say what is the best cement to make the flue connections of a gas-stove perfectly air-tight, while at the same time not giving off any odour or deleterious exhalation?—X.

[47894.]—**Steinheil's Eyepieces.**—Would any correspondent who has actually tried one of these for a telescope e.p. kindly report result? I should also like to know if they are obtainable in England. The form, though not the optical principle, suggests the resemblance to a Coddington lens imbedded in a Stanhope lens. The latter I remember trying as an eyepiece many years ago: but if I remember right, the effect was to produce a good deal of distortion.—A. S. L.

[47895.]—**Pole Star.**—To "F. R. A. S."—Will "F.R.A.S." please inform me whether a transparent diaphragm with a circle marked on it could be fixed in the finder of a telescope so that, when pointed to the Pole, the Pole-star should, in its revolution, constantly coincide with such circle. If so, what diam. would such circle have to be in a finder magnifying, say, six times? I fear the field would be too small; but if it could be applied, some such arrangement would form a convenient method of getting a portable equatorial into position—LENS.

[47896.]—**Photographic.**—Will Mr. Lancaster be good enough to reply to the following queries?—DEAD BLACK.—What is the best dead black for the inside of a camera and slides, and also for the brasswork of the lens? —BLACK PAPER.—What is the best way of preparing the dense black paper put between the sensitive plates in the dark slides?—ENLARGEMENTS.—What apparatus is required for making enlargements on glass and on paper and what are the best processes? I want the means of making enlargements from the quarter-plate negatives taken with the very excellent cheap apparatus advertised by Mr. Lancaster in the "E. M." I know the theory, but am not acquainted with the practical dodges? —H. B. T. S.

[47897.]—**Cleaning Engravings.**—Can any of our readers tell me how to make a solution which will remove dust, dirt, and flyspits from an old engraving without injuring it?—J. W. J.

[47898.]—**To Art Students.**—I shall be much obliged if any artistic correspondent can inform me whether there is any landscape by the old Dutch painter, Camphuysen, in any of the public picture-galleries in London, or if not, where one can be seen to compare it with an alleged original in the writer's possession.—J. W. J.

[47899.]—**Ladder.**—I have a new ladder 22ft., and it has got twisted so bad that it is almost unsafe for any person to go upon. Could any of our readers tell me how to get it straight? It is used indoors, and is hung on a wall horizontally when not in use. It has also two iron rods through it.—STEEPLE JACK.

[47900.]—**Weather-Glass.**—A short time ago I made a weather-glass with potassium nitrate, ammonium chloride, and alcohol of 94 per cent. These kind of weather-glasses are, I believe, very well known. Rain is indicated by the substance rising to the top of the tube. Now I should be very glad if Mr. Lancaster, or other correspondent, could tell me the reason of mine not giving the above indication previous to rain? Is the alcohol too strong or too weak? Are those made with potassium nitrate, ammonium chloride, and proof spirit better than the one referred to? Any information will greatly oblige.—J. C. B.

[47901.]—**Bath-Pipes.**—I am having a bath at the top of my house supplied with hot water from kitchen-boiler. The position being awkward, I shall have great difficulty in getting iron pipes to conduct the hot water—would lead pipes do? They are much easier fixed; but I am wanting to know if lead would stand the hot water circulating in them. Height of bath from boiler and circulating cistern 23ft. I have the lead pipe ¾in. by me. —COUNTRYMAN.

[47902.]—**Preventing Silver from Tarnishing.** —How and of what strength is the solution of hyposulphite of soda made which will, as stated in No. 908, p. 544, prevent silver from tarnishing; ought water or spirit be used to dissolve the hyposulphite?—STUPID.

[47903.]—**Submarine Telegraphy.**—Would any reader inform me what are the qualifications necessary for entrance into the above service, or any information relating thereto?—EDINA.

[47904.]—**Thorough Bass.**—Could any reader kindly recommend me the best books on thorough base for a beginner? I know something of music as regards playing, and I now wish to study the scientific part. If anyone can mention some elementary and easy books, he will greatly oblige.—MUSICIAN.

[47905.]—**Legal.**—To MR. FREDK. WETHERFIELD.—Below is an extract from my stepmother's will: shall I be obliged to pay 10 per cent. legacy duty? The will does not provide for the paying off the mortgage out of the personal estate. There is no actual transfer of money only that of the mortgage deed.—"I hereby appoint trustees and executors of this, my will, upon trusts following—viz., upon trust as to a mortgage debt of £1,500 secured upon premises belonging to my stepson, Richard Mechrin Harris, situate near Saint John's Bridge, Coventry, for the absolute use and benefit of the said 'R. M. H.,' and to be transferred to him accordingly."—R. M. H.

[47906.]—**Notes on Dynamo-Machines.**—In note 15 I find it stated that for the best results to be got out of a dynamo R_1 should be somewhat greater than $R + R_1/2$, where R is the resistance of the wire on the field-magnets, and R_1 is the resistance of the wire on the armature. In an American publication just received there is a design for a small hand-dynamo, in which the resistance of the field-magnets is given as 1·9 ohm, and the resistance of the wire on the armature as ·9 ohm. The armature is of the I type. Is this ratio of resistances correct, or ought it to be resistance of field-magnet wire 1·9 ohm, and of armature wire about 2·2 ohms, according to formula $1·9 + 2·5/2 = 2·2$. This information will greatly oblige, as I am not asking for the sake of controversy, but for the purpose of a correct knowledge of electrical machines and theories.—G. JESLEY.

[47907.]—**Problem in Co-ordinate Geometry.** —A straight line (length $= l + l'$) moves with its ends on the circumferences of two circles (radii $= r, r'$; distance between centres $OO' = 2d$). What is the equation to the locus of the point P dividing the line into two parts, l and l'? OO' to be taken as axis of x, and the point where P meets it as origin. I may add that the equation in the particular case where $l = l'$ and $r = r'$ is $x^2 (x^2 + y^2 + l^2 - r^2 - d^2)^2 + y^2 (x^2 + y^2 + l^2 - r^2 + d^2)^2 = 4 l^2 d^2 y^2$.—A. J. SMITH.

[47908.]—**Tricycles.**—Can any of "ours" suggest a method of attaching a seat at back of Coventry Rotary to carry eight or nine stone weight? I have the seat which I had with machine, and which is replaced by a saddle and Arab spring.—BENEDICT.

[47909.]—**Engineering.**—Will some of your engineering readers kindly recommend me some good works to read for an examination in the following subjects?—Marine engineering, including harbour, dock, sea, and reclamation works; and hydraulic engineering, including water supply, sewage and irrigation.—TEKTA.

[47910.]—**Electric Clock.**—I have bought a second-hand incomplete electrically driven clock. The clockwork and the electric magnet are right, but the contact-breaker will not work, and either the breaker is incomplete or I have made the pendulum-rod wrong. The contact-breaker is a piece of watch-spring fixed about midway from suspension of pendulum and magnet, and rests on a platinum point. In the centre of this spring is a small pendant which the pendulum-rod touches as it vibrates, but without breaking contact. Information how to repair this breaker, or to make a simple one to slide backwards and forward, will be esteemed a favour. —I. J. C.

[47911.]—**Photo-Zincography.**—In the "E. M." for June 16 last, reply 46771, there was given a process for preparing a zinc plate for printing from by the use of a photographic negative. There seemed one or two obvious inaccuracies in this which were pointed out the next week and correction solicited; but no replies have yet appeared. I now learn that this is being worked by two or three firms both on zinc and stone. The zinc can be used either for typography or lithography. Can any readers of the "E.M." oblige by giving a correct method for either or both of these?—P. L. T.

[47912.]—**Turning Taper.**—Is there any quick way of turning fishing-rods taper in the lathe? Is there any way of running a cutter of some sort along the rod that would open or close as it went from one end to the other, so as to give the right taper?—FISH.

[47913.]—**Electric Bath.**—Will some reader kindly tell me how to make a bath like those used by the late Dr. Caplin, of Baker-street, and now in use in several towns. The following is a rough description of a Baker-street bath:—The patient was placed in a brightly-polished copper bath containing warm water, to which had been added some particular acid; he then placed his hands on a bar (covered with wet flannel) which ran across the bath and the electric current began immediately to pass through his body. Now what I want to know is this: Must the bath be of copper, what is the kind and size of the battery used; what is the name and quantity of the acid put into the water; is the bar connected to the positive and the bath to the negative pole of the battery, or vice versâ; and lastly, what is such a bath likely to cost? The above information is wanted to enable an invalid who has received great benefit from a course of baths to have a bath fitted up at home. The writer will be much indebted to any one who will kindly give the desired information.—Au Ravoir.

[47914.]—**L.B. & S.C. Engines.**—Can any London reader give the names and classes of the following Nos. of engines on above railway?—3, 6, 7, 17, 28, 44, 45, 73, 75, 101, 102, 104, 200, 205, 208, 210, 212, 231, 243, 245, 248, 249, 252, 258, 265, 250, 260, 272, 273, 279, 285, 286, 288, 289, 291, 293, 294, 298, 303, 330, 333, 341.—Sydenham.

[47915.]—**Centre of Gravity Problem.**—Find centre of gravity of three equal rods, A B, A C, and A D, in the same plane and diverging from the point A, each of the angles B A C and C A D being 30°.—F. G. S.

[47916.]—**Midland Tank Engines.**—Would "Camomile" kindly state what brakes are fitted to the new classes of Midland engines he mentions? Also, what brakes have the Midland 780 and 1,252 types of tank engines? How many of the 800 and 890 classes of M. R. engines are in existence?—A Driver.

[47917.]—**Voss Induction - Machine.**—Would Mr. John C. Frank (20419), or some other reader of the "E. M." kindly give full instructions for making a Voss electrical machine with dimensions?—W. J.

[47918.]—**Maclaurin's Theorem.**—If "$e^{2x}(3-x) - 4xe^{x} - x - 3$ be expanded by Maclaurin's theorem, the first term is $-\frac{4x^5}{\underline{|5}}$" (Todhunter's "Diff. Cal.," p. 96). Will some reader kindly show me why this term is negative? I get the same result with a positive.—C. H. Romanes.

[47919.]—**South Kensington Training.**—I have been selected by the Science and Art Department as a student in training in Physics (Part I.). Would some one give me an outline of the work I shall be set to do? What text-book would be most serviceable, and whether there will be more than one examination during the term? Any other hints would be thankfully received.—W. H. R.

[47920.]—**Westinghouse Brake.**—Would our valued correspondent, Mr. Stretton, kindly tell me why the connecting-pipes of the above brake on the L.B. and S.C.Ry. have all been fitted with stop-cocks? They may be necessary, but awkward results might happen if one was left unturned near the engine.—Au Ravoir.

[47921.]—**Brake Trials.**—Will any kind reader be good enough to furnish me with a short list of the brake trials which the Midland Company made between the years 1870 to 1875, that is, previous to the Newark trials, giving, if possible, the date, name of brake tested, and where the trials took place—that is, if they were not all, as I believe, tried upon what we know as the Newark ground or the race-course, as we call it?—A Driver, Mem.A.Ry.S.

[47922.]—**The Parker-Smith Brake.**—Having heard that the above-named brake has now been made to perform the Board of Trade requirements, and that it is proposed to try a train fitted with it on the North-Western Ry., I shall be glad of any description of the same.—A Driver, Mem.A.Ry.S.

[47923.]—**Polishing Speculum.**—To "Prismatique."—I have polished a 5in. speculum by "Prismatique's" paper method, but find that I get a wavy surface. This is evidently not due to insufficient grinding, as the polish is perfect all over the surface. Can he oblige me with the reason and the remedy?—E. C. A.

[47924.]—**Electro-plating.**—What weight of silver should be deposited on the following articles to give a durable coating, such as is called A 1 quality?—Tea-spoons, dessert-spoons, table-spoons, cream jugs, half-pint mugs, salt-cellars, &c.—J. F. A.

[47925.]—**Electric Engine.**—I wish to make a small model electric engine. I do not wish it to drive anything, but only want to make it to show such things can be made.—Electrician.

[47926.]—**Street Medical Coil.**—To Mr. Lancaster.—Will you please answer Mr. F. Rowe's query, 47325, in No. 902 as soon as possible, as I am waiting for the same information, and oblige?—Medical Coil.

[47927.]—**Electric Time Signals.**—Will some ingenious reader kindly tell me how to make and fix a contact to my eight-day dial clock (not striking) that will cause an electric bell to ring at the following hours—viz., 8 a.m., 8·30 a.m.; 1 p.m., 2 p.m., 5 p.m., 5.30 p.m., and 7.30 p.m.?—Timekeeper.

[47928.]—**Magic-Lantern.**—I want to make a large limelight magic-lantern with 4½in. condensers. Will some reader please give the curves, refractive indices, distance between lenses, diam. of stops, &c., for condensers and o.g.'s? I cannot find what I want in all that has been given in back numbers. A small sketch would greatly oblige.—Poor Amateur Glassgrinder.

[47929.]—**Ernest's Coil.**—May I ask "Ernest" to give a more detailed account of the construction of the secondary, especially of the mode of wrapping the wire in the spaces formed by the discs? Am I right in supposing that there is no insulating layer of paraffined paper between each layer of wire? Is it too much to ask for a rough sketch of the secondary with the discs shown thereon? Finally, will "Ernest" be so obliging as to put into simpler language the condenser capacity?—J. W.

[47930.]—**Raising Water.**—I have a 3ft. fall of 1,000 gallons of water per minute. I wish to utilise this power by raising as much water as possible to a height of 30ft. above the head of fall. I should like to know the largest quantity that I can raise, and the best way of doing it, whether by ram, waterwheel, or turbine, and how to proceed in the construction of either?—T. A. G.

[47931.]—**Making Miners' Boots Waterproof.**—Can any brother-reader inform me of anything that will make boots waterproof? My employment (underground miner in a colliery) necessitates a deal of travelling in the water which contains a deal of ochre, which destroys the boot-uppers in a very short time.—G. C.

[47932.]—**Looped Figures by Gearing.**—To "J. L."—Would "J. L." kindly state, in his next article on Looped Figures by Gearing, the height that lathe-head should be raised from bed to allow it to oscillate? Whether it is necessary to make any alteration in height of slide-rest? Whether the quadrant arm for holding change-wheels of spiral apparatus would be sufficient with an arbor instead of a second mandrel on which the sleeve might be placed for holding the geared wheel when revolving? Also, does the disc work against the rubber or the geared wheel? I assume the latter. What amount of eccentricity should be given to the disc?—An Amateur.

[47933.]—**Refrigerating Meat.**—I have to kill pigs all the summer, but am in a small manufacturing town where but little pork is needed until towards the week end. I need everything except the pork, but if I cut up the pork it spoils; and if I leave the pigs uncut up until I have sale for the pork I cannot cure the sides; so I want a simple and economical chilling arrangement, and shall be grateful for any help. I have engine-power and plenty of room, but as I only expect to escape loss without adding much to profit, it must be an arrangement that would not be costly, as my trade is limited. What would be useful in this respect would also help me to cure my bacon and hams with more certainty; and as there are many in our small towns in the same position as myself, any hints given to me will be largely circulated through your columns, and in view of the present high price of meat would be a public benefit.—Anxious Inquirer.

[47934.]—**Induction Coil Failure.**—Will Mr. W. J. Lancaster, or any other electrician, kindly give a new subscriber some information regarding induction coils? I have made one as follows:—Core, ¾in. bundle of No. 18 soft iron wire, and 6in. long; primary consists of 6oz. of No. 19 double cotton-covered wire, making four layers; secondary consists of 10oz. of No. 30 silk-covered wire, making ten layers. I insulated well every layer with paraffined notepaper, and made a tube (between the primary and secondary) of brown paper 1-16in. thick, and then paraffined it well. The core was also soaked in paraffin, and I am sure the insulation is complete. I have a battery of four cells, consisting of copper, zinc, and blue vitriol, which gives a strong current; yet I cannot get the coil to work at all. I unwrapped the coil and took off one layer of the primary, but with no better success. The coil will not work a small contact-breaker I have on a small bell. Consequently, I desire some advice. Have I proportioned the wires properly? The primary bobbin is 5¼in. long, the secondary 4½in. long, and diam. of whole coil is 1¾in. I shall be highly pleased if any kind friend will volunteer to give me advice, or tell me where I may be wrong. Please tell me, also, how to make a simple contact-breaker or spring?—Geo. W. Tea, Pittsburg, Pa., U.S.A.

USEFUL AND SCIENTIFIC NOTES.

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A Novelty in Foundry Practice.—Herr G. Ahlemeyer describes in *Glaser's Annalen* a new system of melting iron, and at the same time incorporating in it scrap, wrought-iron, &c. The inventor is Herr Ibruegger, a well-known engineer, who has built one furnace at the Michelbacher Hutte, at Michelbach, Hesse-Nassau, and another at the works of Julius Meyer and Company, at Norden. The cupola is supplied with blast through two sets of tuyeres, one above the other, there being eighteen in each set. The tuyeres or ports, which have the form of a vertical slot, are directly connected with a circular tuyere-ring. The particular feature of the cupola is, that the bottom is a slightly inverted arch, which is pierced by two openings through which both blast, or rather imperfectly-consumed gases of combustion, and the fluid iron can flow. Below it is a small chamber in which the iron collects. It is heated by the gases forced downward from the cupola above, which are supplied with the necessary air for combustion by a special tuyere leading from the main blast-pipe. This chamber at the same time serves for pre-heating scrap, &c., which need only be pushed into the bath for dissolving it. Of course, it is well known that considerable quantities of scrap can be used by directly charging in any ordinary cupola; but it is claimed that in this case there are economy of fuel and a greater facility in making sharp, strong castings and a purer metal. The best iron for this purpose is said to be inferior pig, like No. 3 Middlesbrough, holding considerable silicon and little manganese. To it from 40 to 50 per cent. of scrap, &c. may be added. The total consumption of fuel is stated to be 10 per cent. of the weight of the product.

There are now in France 52,520 steam-engines, of a total force of 3,341,000 horse-power, whereas, in 1850, the collective horse-power was only 22,025, and in 1854, only 35,263.

CHESS.

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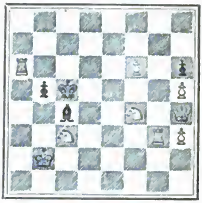
All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXIX.—By J. K. Zim.

Black.



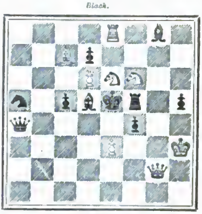
White.

White to play and mate in two moves.

PROBLEM DCCLXXX.—By G. Hume.

From the *Boy's Newspaper* Third Problem Tourney. First Prize.

Black.



White.

White to play and mate in two moves.

SOLUTION TO 775.

White.		*Black.*
1. Kt to K 6.		1. P takes B (a).
2. P to K B 5.		2. Anything.
3. Mates accordingly.		
	(a)	1. K takes R (b).
2. R takes P.		2. Anything.
3. Mates.		
	(b)	1. Anything else.
2. R to Q B 5.		2. Anything.
3. Mates.		

SOLUTION TO 776.

White.	*Black.*
1. Q to Q R 8.	1. K moves.
2. Q mates accordingly.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 775 (but main variation omitted) and 776 by Schmucke; to 771, 772, 773, 774, 775, 776 by G. Hume.

G. Hume.—Thanks for the problems. We hope to hear from you again soon.

A new paper recently started, entitled *Youth*, offers prizes for the best set of verses from 8 to 14 lines on Chess. They may be comic or serious; and must be posted to the Editor, 172, Strand, not later than Nov. 1st. This paper supplies a want long felt in giving a literature connected with Chess of a character lighter and more chatty than is usual.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock street, Covent garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 6, and unacknowledged elsewhere:—

THRASHING MACHINE.—Enquirer.—Ditton.—Electrician.—D. W. N.—E.—G. L. Addenbrooke.—Clyde.—R. G.—C. G. W.—Prismatique.—Jas. Galloway.—F. R. C. S.—Moulder.—A. H. Swinton.—C. Richardson.—T Bolton.—W. R. Strange.—R. Healy.—W. S. Brown.—Tried.—W. E. K.—W. Morris, Ealing.—W. Barton.—F. E.—An Old Reader.—A Down Mechanic.—Engine Fitter.—Practical Metal Engraver.—Silversmith.—Dubious.—J. H. B.—X.—J. M. L.—Amateur Gardener.—A. B.—A. E. Moores.

A NEW VOLUME.

THE last number was the last of volume XXXV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXV. will be published in the number dated Sept. 22, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the past volume are recommended to do so at once, as the back numbers soon run out of print.

C. H. R. (You can try the effect of exposing to sun and air, but it is doubtful if anything else will do any good You might overpower it with some other scent. 2. You must wait until it wears off. You should ventilate thoroughly.)—DRILLER. (Moisten the drill-point with turpentine, in which a piece of camphor has been dissolved, and turn the work over before going right through. Any good drill; a three square file ground up at the point answers well.)—LL B.A. (Spons, Charing-cross; but see a letter in this number.)—J. R. H. T. (Cannot spare space for any question about perpetual motion. See Mr. Dircks' book on the subject. You will find something about it there.)—TAL-ESTR. (You will find much information on the subject in recent back volumes, and any of the respectable boat-building firms would build a suitable craft.)—PROGRESS. (About 20. Yes, but it would be better to build specially.)—STUDENT. (See the papers on the subject in last two volumes.)—C. F. A. (Try again, modifying the arrangement of the carbons.)—S. E. O. (Merely a sum.)—ONE IN A FIX. (Multiply 300 by 900, and divide by 97,020.)—W. E. (See p. 436, No. 880, for coupler for harmonium; or p. 275, No. 557; p. 146, No. 552.)—YOUTH. (Measure the crank centre to centre, and twice that will be length of stroke. Mean pressure of steam in cylinder can be found only by the indicator.)—AGARIC. (Many books give analyses of such things. A little one published by J. and A. Churchill gives many, but not much is known of the chemical composition of the last-named.)—G. B. T. (When the valve closes, the resistance to the motion of the piston is the air within the case, and is clearly just as much as if the piston were exposed to the whole weight of the atmosphere. Besides that, there would be a great deal of friction about, as even the pistons would have to be air-tight.)—ENGINEER. (According to Mr. Brudenell Carter (see his "Eyesight, Good and Bad") there is little choice as to the material; pebble is harder, that is all. The important thing is having the spectacles properly adapted to the eyes.)—HAJAJA. (Several recipes in back volumes.)—INJECTOR. (Several times in back volumes. See any of the textbooks.)—G. STONIER. (You will find such a table in Mr. Sprague's book, or in No. 817, p. 98; but it is calculated for pure copper. The thickness varies, and the quality, too, in ordinary wire, so that the resistances are only approximate. B. W. G. 18 has a resistance of 4·1348 ohms per 1,000ft.; B. W. G. 20, 6·4603; B. W. G. 36, 165·62.)—A DRIVER AND MEMBER, &c. (Gresham's automatic vacuum brake, illustrated on p. 108, last volume.)—ROBT. GORDON. (See "Hints" No. 4 above.)—JOHN WOOD. (See the indices of recent volumes.)—ALEX. COOK. (There are several, we believe, some fairly effective, but the economy here is so small or invisible that handwork is generally preferred.)—YOUNG MECHANIC. (Several recipes in back volumes. See reply 47737, p. 601.)—W. L. O. (You do not say what sort of machine it is; but for hill-climbing you want it geared so as to gain power. Refer to the index of Vol. XXXIV., and you will find that there was a long discussion on the subject in that volume.)—BLACKSMITH. (Illustrated many times, most recently in No. 905, p. 466.)—G. H. D. (We must refer you to the back volumes. Many telephones have been described.)—CALSOMETER. (If your receipts say "one quarter's rent," you are a quarterly tenant; but we suspect they read "three months' rent," and that being the case, in the absence of any proper agreement, the letting would probably be held to be monthly, the actual time of payment having nothing to do with the question. You can remove the lock, because that is attached by screws, but the other things appear to have become "fixtures." It is impossible to say, without knowing how they are attached to the premises.)—S. S. (It is peculiarly a case for examination by a surgeon.)—M. A. GAGE. (You must advertise for it in the usual way. We do not publish the addresses of correspondents.)—AGENCY. (As the information is required for purely business purposes, it must be put to him professionally.)—ANXIOUS. (There is no other way than to seek employment at an electrician's; but what inducement would he have to engage you? Do you understand the subject?)—W. H. R. (The plaster was not good—probably the common stuff used for walls. You had better purchase proper porous pots.)—J. M. (See pp. 315, 337, 362, last volume.)—ANXIOUS FATHER, Newport. (You will have to bring an action, unless you prosecute for the theft. Consult one of the magistrates in your district.)—D. W. N. (You cannot register a name for a piece of apparatus unless it is in the nature of a trade mark. The registry of trade marks is at the Patent Office, Southampton-buildings, Chancery-lane.)—L. L. (Can be done by what is called cold silvering. See p. 601, No. 857, and many other places in back volumes.)—SCOTA. (The construction has been described many times. It is an expensive instrument, and would involve rather more outlay than you would care about.)—R. J. H (You should have exposed to the vapour of the acid; the direct application leaves it clear.)—MONITOR. (Answered once for all on p. 100, No. 806. You can obtain information at any mercantile marine office.)—DELTA. (Nothing of the kind; but there are some useful preparations sold at the usual shops. A rub over with a rag dipped in paraffin oil is very simple and effective.)—PERPLEXED. (See p. 9, No. 859. There is no book treating the question thoroughly. For much information, see the last two volumes. 2. If we understand the second question, Yes.)—STAFFORD. (Has he not already done so?)—J. R. (Answered several times. You have merely to put a contact piece on the clock-dial and connect it with one wire, and then if the other wire is connected to the hour-hand and properly insulated, the bell will ring when contact is made.)—F. R. C. S. (We are afraid such a drawing could not be reproduced in our pages. The speed at which the machine works is very detrimental to the production of such diagrams.)—A. J. C. (You left the acid on too long. Try again, giving it a couple of minutes or so. Are you sure the damp does come through? If so, you can coat with Portland cement or paint with tar.)—P. M. G. (Such a query should be put direct to some of our advertisers. We cannot specify one, for there are several who would make such an instrument.)—CHARLES. (See the indices of recent volumes, that for Vol. XXXIV., for instance.)—A. SLOPER. (See some replies this week and lately. It is a matter for trial.)—H. J. C. (See the indices. Several methods have been given.)—IGNORAMUS. (The second marriage was illegal.)—ANXIOUS INQUIRER. (We do not know, but should imagine the statement to be highly coloured.)—VERITAS. (They are occasionally advertised for. You could apply to the Civil Service Commissioners, Cannon-row, Westminster, for particulars.)—A. NUS. (See a letter in this number.)—C. B. (Look through recent numbers.)—W. G. P., L. L. I., M., E. MAARIS, PLONI ALMONI, SCOTCH WORKING MECHANIC, SHAKESPEARE (In type.)

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Indexes for each half-yearly volume up to Vol. X. (except Vols II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each Indexes to subsequent vols., 3d. each, or post-free, 3½d. Cases for binding, 1s. 6d. each.

*** Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

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Holloway's Pills.—No amount of wealth, no means of pleasure are of the slightest value without health. It is inconceivable how small a disturbance of the animal functions begets wretchedness, and how readily it may be rectified by a few doses of some purifying and regulating medicine, such as these world-renowned Pills, which are ever the sufferer's surest friend.

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The address is included as part of the advertisement and charged for.

Advertisements must reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number

OUR EXCHANGE COLUMN.

◆

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆

Lathes. 1 3ft. 6in., with chucks, and two drawers, £7 One 4ft. back-geared, £8. Both in good order.—C. N., 15, Oxford-street, Reading. What in exchange?

Magnetic Electro Apparatus, nearly new, in mahogany box, complete, cost £2 2s., in exchange for watch maker's Treadle Lathe.—WATCHMAKER, Laughton, Hawkhurst.

Large handsome inlaid **Musical Box**, cost nine guineas. Pins bent, two teeth broken, otherwise perfect. Photographic or other offers to £1.—MUSICUS, Belbroughton, Stourbridge.

Wanted, pair of single-needle **Telegraph Instruments** and Batteries, or good Induction Coil. Exchange modern Scientific Books.—L., Fair Bank, Oaklands-grove, Uxbridge-road, W.

For Sale or Exchange, for a single **Launch Engine**. 2½in. by 4in. cylinder, a pair of Tricycle Wheels, 54in. diameter, quite new, or the Tricycle complete.—To H. FREEMAN, Meadow Cottage, Teddington.

Wanted immediately, Tinman's 36in. **Bending** Rollers, for good exchange.—EASTON, Towcester.

Melodeon, splendid instrument, double steel reeds, beautifully finished. Exchange for Field-glass or Microscope.—W. GREEN, 29, Hufford street, Leeds-road, Bradford, Yorks.

Four **Gas Lamps** for lighting outside shop, with fittings ready for sockets in good condition. Exchange for old silver, old china, old paintings, or offers to value 30s.—H. NICHOLSON, Horncastle.

Bicycle, 48in., in first-class condition, cost £8. What offers in exchange? Good Safe, or Lathe preferred.—G. MOORE, 60, Westbourne-road, Barnsbury, London.

50in. **Bicycle**, nearly new, superior finished and best make; cost £10 10s.; would take good Steam Engine and Boiler or Locomotive Engine.—R. TICKNER, Deanery-road, Godalming, Surrey.

Half horse-power Horizontal **Engine**, highly finished, made for an exhibition, quite new, cost £18 10s., cash price, £10 —R. TICKNER, Deanery-road, Godalming, Surrey.

Quantity of new **Plumber's Castings and Finished** Work, very cheap.—W., 1, Catherine-terrace, Ashton-under-Lyne.

Inlaid **Musical Box**, 3 tunes, new, 25s., or exchange.—T. GORDON HOWARD, 24, Compton-street, Brunswick-square, London, W.C.

Wanted, **Induction Coil** and Electro-motor. Offers in exchange.—G. H. FERGUSON, Gillingham, Dorset.

Wanted, **Fret Saw**, in perfect condition. Exchange Microscope in case, value £3.—H. HISCOX, 41, Longbrook-street Exeter.

Wanted, 2 or 3 horse **Steam Engine** and Boiler combined. Exchange dynamo, value £12, or buy if cheap.—H. DOWSING, Romford.

Two **Lathe Heads**, 6½in. centre, 3-speed cone pulley on mandrel, and cone bearing, socket, rests, and 4 chucks, 30s. What offers?—C. BLANCHARD, 3a, Little Church-street, Edgware-road, London.

THE SIXPENNY SALE COLUMN.

◆

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

◆

For Sale.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—KING and Co., electricians, Bristol. (List Twopence.)

Paints.—Armstrong's full instructions for making Paints is now sold by STEVENS and Co., 312, Old-street, London Price 2s. 6d.

Cyclists.—Challis's **Stop Bell**, with patent vibrating bracket, is best, 2s. 6d., 3s. 3d.—E. M. CHALLIS BROS., Homerton

American Organ Actions, complete. Any ingenious mechanic or amateur can construct cases.—PARKER and SMITH, Plymouth.

Electrical Depot and Manufactory.—MILLAR's, 126 Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Bells, 5s.; Batteries, 7s. Telescopes, Microscopes, Field Glasses, Spectacles. None better or cheaper —MILLAR, as above.

Fretwork.—For Catalogue of Machines, Tools, and Miniature Designs, send two stamps.—HARGER BROS., Settle.

Model Engine, horizontal, Cylinders 2in. by 1in. All castings complete. Partly fitted up, very neat, 20s. Bargain —F. ADAMS, 2, Albert Drive, Crosshill, Glasgow.

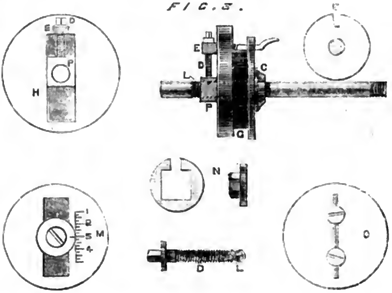
The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 15, 1882.

ON THE PRODUCTION OF LOOPED FIGURES BY GEARING.—III.

THE complications producible by a single eccentric disc connected with the lathe-mandrel by suitable gearing, are readily multiplied and modified by working two such discs at right angles to each other as regards their eccentricity, or at an intermediate position between this and coincidence. One may have also greater eccentricity than the other, by which the loops so formed will be longer, and will alternate with the shorter. It is easy to make two or three rubber holders to slide on to the bar side by side, so as to work two or three discs or rosettes simultaneously, in which arrangement it will be quickly seen how valuable a plain eccentric becomes in another way, especially if some contrivance is devised for altering the amount of eccentricity in the disc. Suppose a cog-wheel mounted concentrically, and a disc eccentrically, with a rubber acting upon each. It is plain that during part of each revolution the eccentric will prevent the cog-wheel (used here merely as an easily-obtainable rosette) from coming in contact wih its own rubber, while during another part of the revolution it will be fully acted on. The result will be that part of the lines of the pattern will be quite plain and even, and part wavy. The cog-wheel should have a thick rubber, rounded off, so that it cannot descend too far into the intervals between the teeth. It will then cause the line to be made up of small and even undulations, and will work very well. The rose engine proper, as commonly made, has a complete row or set of rosettes upon the main mandrel upon a sleeve with a key, or, rather, a feather running along it from end to end, and the division-plate is carried upon the same sleeve; but as the whole needs to revolve with the mandrel, the index or catch is attached to the pulley and not to the lathe-bed. The pulley is fixed to the mandrel; but the sleeve, it will be remembered, is loose upon it, but can be fixed by a clamping nut at one end when necessary. To shift the rosettes, this nut is eased, and after the rosettes have been shifted round one or more divisions the nut is screwed up, and they revolve with the pulley and mandrel. In the geared lathe some similar plan of shifting round the rosette is advisable, but two or more key-ways, as shown, may answer the purpose. Another simple mode is to lift the quadrant arm, shift the rosette spindle and its gear-wheel one or two teeth of the latter, and then drop the arm again so as to gear the wheels together; but for this purpose the wheel upon the rosette shaft should have an even number of teeth. To prevent the rubber from touching at the same time two adjacent rosettes accidentally, they should be separated by discs of wood of rather less diameter than the rosettes themselves. I am now supposing that a sleeve is used with discs and several rosettes mounted upon it, as in the rose engine. This is, in fact, the best plan, and rosettes can be made and added to the number as desired. But I wish the reader not to lose sight of the fundamental arrangement of a plain eccentric disc. Without a single extra rosette an infinity of patterns are obtainable by its means, and this, when neither the direction nor amount of eccentricity is capable of adjustment. But if both these conditions can be met, the range of work will be increased greatly. I shall now, therefore, detail what I consider the cheapest and best method of making this addition. Setting aside the plan of mounting the eccentric on the back spindle, let an entirely separate one be turned and fitted for rosettes. I think, in this case, the eccentric should, with its fittings, occupy one end of the spindle or mandrel, the waved or other rosettes occupying the other part of it.

FIG. 3.



The mandrel is shown in Fig. 3. It is a plain cylindrical bar, with a flange at C firmly attached to it. It has a notch cut out, as seen at K, to receive a little catch, which will be explained presently. The mandrel might be of ⅝in. iron or steel for a small lathe, and of ¾in. to ⅞in. for a 5in. or 6in. centre lathe. It requires to be tolerably stiff, owing to the jar caused by the oscillations of the headstock. The face of the flange must be turned true. Next comes a cogwheel, which fits nicely on the mandrel, and rests also against the flange. This wheel, G, has a boss, P, which is filed up square on the outside for the eccentric disc to slide upon, and this boss projects about ⅜in. beyond the face of the disc. This wheel is not geared, but is intended solely as a division plate, by which the direction of the eccentricity of the disc can be nicely regulated. It can be replaced by a worm-wheel and tangent screw; but the latter needs special appliances to make it, and it is generally possible to get hold of a wheel with flange which can be filed up; or a clock-wheel can have a brass flange soldered on. Of course, a cast and cut wheel is better still if it can be got. In any case, this wheel must be of less diameter than the flange, because the little catch hinged in the notch of the latter has to drop into the space between the wheel-teeth. H is the face of the eccentric disc, showing the square boss of the cogwheel on which it slides, and also the screw by which its eccentricity is determined. This screw, marked D in both figures, is tapped into the boss E, which is fixed for that purpose in the face of the disc. The end of the screw rests in a hole in the square boss of the wheel behind it. Its end is turned with a groove, into which a pin drops, as shown at L. It can turn freely, therefore, but is, nevertheless, prevented from rising out of its bed. Thus the disc is raised and lowered by a key applied to the end of the screw, and its head may be divided or lines drawn on the face of the disc at M, which can read against a line marked on the square boss. The head of the screw must be kept below the edge of the disc, so as not to come in contact with the rubber. If it is feared that the disc will work loose, a washer with square hole N can be slipped on, and a nut added at N to secure the whole. This will be the most advisable plan, and will render the arrangement strong, compact, and complete. The washer needs a notch to allow it to pass the screw. At M is shown a simpler plan for those who may not wish to go to the trouble of fitting a screw. The disc slides as before upon the square boss of the cog-wheel, but the boss is now flush with its face, and the two are secured by a screw and washer. A division plate is engraved at the side, and is read off against a line on the washer (or against the corner of the square boss). Another plan is to dispense with the square boss altogether, and allow the eccentric to slide upon two screws inserted in the face of the cog-wheel. This arrangement is illustrated at O. If the dividing-wheel is also objected to, these screws may be in the face of the flange itself. The slit is shown narrower than it would be in practice, as it must be of the full diameter of the mandrel upon which it moves. I think all these details will suffice to render the arrangement clear to the reader. There are other plans by which the same result can be obtained, and the eccentricity varied in amount and in direction; but I think there is not a much simpler than that shown. As regards size of the parts, it wholly depends upon that of the lathe, and upon the contents of the home workshop, which will supply the wheel and eccentric disc, and probably also the flange and mandrel. Unless it be a real novice's shop, there is sure to have accumulated a quantity of odds and ends—old clock-wheels and plates, iron cog-wheels, bits of gas-tube, brass and iron, not, perhaps, quite like Solomon's store, "without weight," but of various shapes and sizes. All these become precious, and from time to time declare their own value by supplying the more pressing needs of the amateur. The rest of the mandrel, at the rear of the part which carries the disc and its fittings, is intended to carry ordinary rosettes, of which I have already said a few words. They are undoubtedly difficult and tedious to make, but are well worth the attempt. Probably the easiest way is to make the disc first of all, turning it true on the edge and each face, and then cut out the pattern in stiff paper, stick it on one side, and file accurately to the outline. The design should be a work of no great difficulty; and after the apparatus is set up, it will itself, owing to the geared connection, supply from one rosette several varieties of design. The disc alone, with proper ratio of gearing, will set out a design of 3, 4, or 20 loops, which will be quite evenly spaced, and will afford an outline, transferable to the new rosettes, through the medium of a paper-holding chuck. I need hardly point out the mode of evenly setting out curved or waved outlines by folding paper and cutting such curves at once with scissors—a most useful and simple plan for those not gifted with geometrical tastes, and to whom compass and ruler are often sources of trouble. The reason there is more difficulty when the design repeats itself after given intervals is because the rosettes of a rose engine move round under the influence of a tangent screw and wheel, so as to vary the monotony of having merely concentric rings exactly alike as the design, with curve under curve and point under point. By shifting the rosettes each time a little upon its axis this monotony is done away; but if the divisions of the pattern are unequal, the result will be an irregularity of design most unpleasant to the eye.

(To be continued.) J. L.

THE EDISON ELECTRIC LIGHT INSTALLATION IN NEW YORK.

WE have previously mentioned that the Edison Company were laying down mains and fitting up wires for an installation of the electric system of lighting over about one square mile of the busiest section of New York. The district includes 946 subscribing consumers whose premises are already wired, the number of lamps being nearly 14,500. About one-third of the whole area has now been working for some days; but before all the subscribers in the square mile can be accommodated, the plant must be nearly doubled, as each generator is equal (in practical working) to only about 1,200 lamps (nominally 1,800), and at present six dynamos only are ready. About fourteen miles of street mains have been laid; and the experiment, so far as news has yet reached this country, is a success, about 5,000 lamps being steadily supplied, including those at some of the newspaper offices. The central station is located in Pearl-street, a short walk from Fulton Ferry, the building itself being merely a shell inclosing the platforms or floors on which the apparatus is placed. The building is about 50ft. by 100ft., and is divided by a middle wall into two equal portions, one only of which is at present completely fitted. Originally erected for commercial purposes, it was quite inadequate to support the great weight of the machinery, and so it now forms merely a cover to a structure which is composed of iron pillars and girders resting on a substantial base of concrete. The boilers in the section at present working are four in number of the Babcock and Wilcox type, each being of 250 horse-power. These boilers are of the water-tube class, having long inclined tubes over the firebars, connected at each end with a shell reservoir, the bottom of which is exposed to the gases rising between the tubes. The fronts are completely inclosed by iron frames, and the boiler-house presents a neat and tidy appearance, a gallery running round it over the tops of the boilers for the convenience of visitors. The area of the building under the footwalk is used as the delivery for coals, and an engine of about 20 horse-power is placed there for working a fan to supply air to the furnaces, and keep the stokehole cool, while, at the same time, by means of screw conveyers, it keeps up a constant supply of coal to, and removes the ashes from, the stokehole. The boilers being arranged on opposite sides, the firemen have only a short distance to walk to reach the coals, and the place is kept as clean and tidy as possible. Each boiler has an injector, and one large steam pump is so fitted that it can supply any or all of the boilers. The feed-water is heated as high as possible, by being forced through a heater which receives the exhaust of all the engines. The object is not merely to secure the greatest degree of economy, but to deposit as much as possible of the impurity of the water before it reaches the watertubes of the boilers. The steam is taken by an 8in. pipe, from which 5in. pipes rise vertically to the engines on the floor above. Each dynamo has its own engine on the same baseplate, the combination weighing nearly 28 tons. The engines are of the Porter-Allen type, with cylinders 11 3-16in. diameter, stroke 16in. The cut-off is regulated by the governor, the engines being set to run at 350 revolutions, with a pressure of 120lb. per square inch. The connecting-rods drive direct on to comparatively small disc flywheels carried on shafts coupled directly with the armature shafts of the machines. Some idea of the enormous dimensions of the dynamo may be gleaned from the following figures:—Length of armature, 5ft. 1in., diameter 2ft. 3⅞in., weight 9,800lb. The field-magnets, of the horizontal pattern, weigh nearly 15 tons, and the height of the machine from floor is 6ft. 4in. The resistance of the armature is ·0038 ohm., and the current of so low an intensity that it can cause no injury to anyone inadvertently handling or touching the wires. The six dynamos are arranged in a line on one side of the room, and are alternately connected to the heavy copper bars forming the main leads on opposite walls, the bars of like sign being connected together at the front of the building, where the entire current is collected into two large horizontal copper bars with which the leads laid under the streets are coupled. These street-mains vary in size, some of them being equal to a copper rod of about half-inch sectional area, while others are equivalent to about ten wires of No. 10 gauge, and others again so comparatively small as to equal only about two No. 10 wires. The leads, except where they diminish to the size of wires, are of nearly semi-cylindrical section, and are placed in iron tubes which are filled in with insulating material. Here and there are service-boxes, in which the leads are so shaped that they serve the double purpose of taking up expansion, and allowing for contraction, while affording a ready means of making connections with the wires which convoy the current to the lamps in the buildings. The regulating apparatus consists of a circular switch and a number of resistance coils, with an indicator to enable the attendant to judge of the strength of the current. The field-magnets, it should be mentioned, are placed in a shunt circuit, the resistance of which can be increased from a fraction of an ohm to seven and a half ohms, which is the greatest resistance necessary to control the current used to excite the field-magnets. The circular switch is operated by a horizontal shaft through sets of mitre gearing, and the indicator is an ingenious arrangement by which unskilled labour can be utilised in regulating the current. Thus the indicator consists of a couple of lamps, one of blue, the other of red glass, neither of which is illuminated when the current is normal. The electrical arrangements are so made that when the resistance of the shunt circuit is too small, the blue lamp is illuminated, and the attendant turns his wheel switch, throwing in one resistance coil after another until his blue lamp goes out. If, on the other hand, the red lamp shines out, the switch is turned in the opposite direction, and the resistance in the shunt circuit is reduced. All six dynamos work on the same circuit normally, but each is provided with a switch for cutting it out. This switch consists of a couple of bars pivoted at one end, and united at the other to form a handle, near which a cross-bar carries three plates, about 4in. broad, which can be brought down between three pairs of fixed contact-plates, each pair thus clasping, as it were, one of the plates on the movable lever. A powerful spring tends to force up the bars forming the movable portion of the switch, and a catch keeps it in position when the dynamo to which it belongs is required to be in the circuit. If there is any reason to suspect that a dynamo is not doing its proper amount of work, a touch on the catch of the switch at once releases the movable arm, which flies up and breaks the contact. The suspected dynamo is then connected up to the test battery of lamps, 1,000 in number, which is erected in one of the rooms on the top floor, and if it raises those to a state of brilliant incandescence, the machine is credited with being in proper order, and the supposed defect must be looked for elsewhere. The machine, as we have mentioned, possesses a nominal capacity of working 1,800 lamps, but it is not intended to do more than put 1,200 lamps to each machine; hence, if one will raise 1,000 to brilliant incandescence, it is in a condition to exert its full capacity, the normal condition of Edison's lamps being just short of what would be termed brilliant incandescence. The reason the dynamos are not worked up to what is alleged to be their full capacity can be easily gathered from what we have said. At present, the half of the generating establishment is supplying only one-third of the whole area to be lighted. When the other half is complete, we may assume that the two sets will be able to supply the 14,500 lamps, more or less; but clearly there is no reserve in case of accident to one of the machines. That apparently has been provided for in the alleged fact that the machines are capable of doing more work than they are called upon to do in regular practice. How the arrangement succeeds we shall probably learn in a few months; but considering the price of gas in New York, it is certain that the electric light ought to succeed there if it can supplant gas here. Given only candle for candle at the same price, the incandescent electric light will, if it can be shown to be as trustworthy as gas, be preferred to the latter in many places, for it is steady and pure, and while scarcely heating the air, certainly does not vitiate it by increasing the amount of carbonic acid. No doubt sundry defects will be discovered in the arrangements before many weeks are over, although it must be acknowledged that Mr. Edison and those who are working with him have endeavoured to make the installation as complete as possible in every detail. We have heard of some defects in the insulation of the main leads, and the New York papers may be relied upon to imagine some extraordinary freaks of the "electric fluid"; but up to the present the installation has met with no serious mishap, and as the pioneer on the large scale, it will unquestionably be of great advantage to the projectors of similar installations, especially if, in the course of a few months, full and accurate accounts of the actual cost are published.

THE ACHROMATIC OBJECT-GLASS.—IX.

By W. Bradbury.

(Continued from p. 538, Vol. XXXV.)

THE following table will serve for the indices in common use; it is preceded by corresponding equations having literal coefficients,

TABLE OF ABERRATIONAL EQUATIONS.

Ref. Index.	Parallel Rays.					Vergent Rays.					
	m	[x^2	− Ax	+ B]	$\frac{y^2}{F^2}$	m	[x^2	+ A. ax	+ C. a^2	+ D.]	$\frac{y^2}{f^2}$
1·50	1·166	[„	− 1·429 „	+ 1·429]	„		[„	+ 1·429 „	+ ·464 „	+ ·965]	„
1·51	1·115	[„	− 1·458 „	+ 1·464]	„		[„	+ 1·458 „	+ ·484 „	+ ·980]	„
1·52	1·07	[„	− 1·488 „	+ 1·503]	„		[„	+ 1·488 „	+ ·503 „	+ 1·000]	„
1·53	1·025	[„	− 1·520 „	+ 1·527]	„		[„	+ 1·520 „	+ ·514 „	+ 1·013]	„
1·54	·984	[„	− 1·548 „	+ 1·574]	„		[„	+ 1·548 „	+ ·544 „	+ 1·030]	„
1·55	·941	[„	− 1·583 „	+ 1·623]	„		[„	+ 1·583 „	+ ·568 „	+ 1·055]	„
1·56	·908	[„	− 1·612 „	+ 1·656]	„		[„	+ 1·612 „	+ ·589 „	+ 1·067]	„
1·57	·874	[„	− 1·640 „	+ 1·692]	„		[„	+ 1·640 „	+ ·609 „	+ 1·083]	„
1·58	·841	[„	− 1·670 „	+ 1·736]	„		[„	+ 1·670 „	+ ·634 „	+ 1·102]	„
1·59	·808	[„	− 1.704 „	+ 1·779]	„		[„	+ 1·704 „	+ ·657 „	+ 1·122]	„
1·60	·780	[„	− 1·733 „	+ 1·816]	„		[„	+ 1·733 „	+ ·680 „	+ 1·136]	„
1·61	·751	[„	− 1·767 „	+ 1·862]	„		[„	+ 1·767 „	+ ·704 „	+ 1·158]	„
1·62	·723	[„	− 1·796 „	+ 1·905]	„		[„	+ 1·796 „	+ ·730 „	+ 1·175]	„
1·63	·700	[„	− 1·823 „	+ 1 947]	„		[„	+ 1·823 „	+ ·754 „	+ 1·193]	„
1·64	·676	[„	− 1·872 „	+ 2 000]	„		[„	+ 1·872 „	+ ·779 „	+ 1·220]	„
1·65	·653	[„	− 1·888 „	+ 2·034]	„		[„	+ 1·888 „	+ ·804 „	+ 1·230]	„
1·66	·630	[„	− 1·920 „	+ 2·080]	„		[„	+ 1·920 „	+ ·830 „	+ 1·250]	„

which are convenient for reference. One part is devoted to equations for parallel rays, as they have simpler form than those for vergent rays. The number under m is not repeated, but belongs to both of the parts; and the final quantity outside the bracket must also be repeated with every equation.

When two lenses are aplanatised, we must have:—

$$\left.\begin{array}{c}\text{abrn. eqn. of 1st lens}\\ \text{for parallel rays ..}\end{array}\right\} = \left\{\begin{array}{c}\text{abrn. eqn. of 2nd lens}\\ \text{for vergent rays.}\end{array}\right.$$

For the sake of brevity, let N represent the whole value of the parallel equation, except the last factor; and n the corresponding value of the vergents equation. Then the condition is:—

$$N \cdot \frac{y^2}{F^2} = n \cdot \frac{y^2}{f^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(6.)}$$

But since the lenses are in contact, their diameters are alike, and y disappears. also $F / f = \delta$, and the condition eventually becomes:—

$$N = n \cdot \delta^3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7.)}$$

that is, neglecting the last factor, the equation of the crown lens, whether it be first or second, must always equal that of the flint lens multiplied by the cube of the dispersive ratio.

To illustrate the use of these formulæ, we will take the same glasses as in previous examples—viz., Chance's hard crown and dense flint—indices, 1·51 and 1·62, respectively; dispersive ratio, 0·63: find what the ratios of curvature must be, in order that the inner curves may be alike?

When the crown lens is in front, we find for its equation:

$$1{\cdot}115\left\{\, x_1^2 - 1{\cdot}458x_1 + 1{\cdot}464 \,\right\}.$$

For the flint lens, the prefixed number must be multiplied by δ^3 or ·216, and substituting the value of $a = (2/\delta - 1) = {}^7\!/\!_3$, we get:—

$$\cdot156\left\{\, x_2^2 + 4{\cdot}19x_2 + 5{\cdot}149 \,\right\}.$$

In this case, $\delta\rho$ will be found = ·493, whence $x_1 = ({\cdot}506 - {\cdot}493x_2)$, the required relation between x_1 and x_2 for internal contact. Substituting this value in the crown equation, it gives:—

$$1{\cdot}115\left\{\, {\cdot}243x^2 + {\cdot}22x + {\cdot}083 \,\right\}$$

Multiplying each equation by the number prefixed to it, and subtracting the less from the greater:—

$$\begin{array}{r} {\cdot}271x^2 + {\cdot}245x + 1{\cdot}096 \\ {\cdot}156x^2 + {\cdot}653x + \;\; {\cdot}803 \\ \hline {\cdot}115x^2 + {\cdot}408x + \;\; {\cdot}293 = 0, \text{ or—} \\ \hline x^2 - 3{\cdot}54x = -\,2{\cdot}54 \end{array}$$

Solving this equation, we find $x = +{\cdot}1$, or + 2·54, of which the first alone is a suitable ratio, showing the flint lens to be a plano-concave. And when $x_2 = +1$, $x_1 = +{\cdot}013$, showing the crown lens to be very nearly equi-convex, the back side being slightly flatter than the front side.

So far all is general; we will now find what radii these ratios would give for a compound of, say, 50in. focus.

$$F \text{ (focus crown)} = 50\,(1 - \delta) = 20.$$

$$f \text{ (focus flint)} = 20 / \delta = 33{\cdot}33.$$

$$\left.\begin{array}{l} r_1 = 2\,F(\mu - 1)/(1 + x_1) = 20{\cdot}4 \div 1{\cdot}013 = 20{\cdot}13. \\ r_2 = \qquad 20{\cdot}4 \div (1 - x_1) = 20{\cdot}4 \div {\cdot}987 = 20{\cdot}66. \end{array}\right\}$$

$$\left.\begin{array}{l} r_3 = 2f(\mu_1 - 1)/(1 + x_2) = 41{\cdot}33 \div 2 = 20{\cdot}66. \\ r_4 \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{plane.} \end{array}\right\}$$

By reference to the table of curves, computed by Barlow's rules, it will be seen how close in agreement are the results yielded by two very different methods. The two sets of curves may be called identical in every respect. By means of the process just used, the results are obtained directly; whereas in Barlow's method, it would be next to impossible to apply the condition of inner contact.

It will be observed that the three curves are nearly alike, and they continue to approach to equality as the indices decrease. For 1·5 and 1·6, the table gives the curves as exactly equal with plano-concave flint.

With Coddington's formula I conclude my notices of the recognised methods of computing the curves of object-glasses.* I have tried to avoid as much as possible, the purely algebraical treatment of spherical error, and have given those equations only which seemed necessary to the successful application of the tables. I have made use of such particulars as I have been able to procure, respecting the methods of Dollond and Tulley. They were practical men: Barlow, Coddington, and Herschel took up the matter as an interesting problem in mathematical optics. It may be urged that a still simpler method of computing the radii is very desirable; but I do not think an *exact* formula can be found less complicated than Coddington's. Approximate rules may be formed, but the value of a rule depends upon its general applicability: and it seems exceedingly unlikely that the same degree of correctness can be ensured, with refractive and dispersive numbers differing widely.

There is one name, eminent among the older British opticians, concerning whose practice information seems scarce; I allude to Andrew Ross. Beyond some particulars of his process of glass-grinding, furnished by Holtzapffel, I have met with only one reference to an article from the pen of this celebrated artist. It is given below; and I must rely on the kindness of some correspondent, who has the opportunity to read it, to send a summary to these pages.†

At this point I conclude the historical part of my essay. I have been furnished by "Prismatique" with particulars of several forms of o.g.'s. now in use among the chief English and foreign opticians. A general description of these is, for the present, all that is necessary; some of them will require a more particular account afterwards. But in no case shall I attach a name to the forms described: so long as a combination gives satisfactory results, it matters not by whom it is used.

There seem to be three characteristic forms in use, which may be classified as English, French, and German. The English form is shown in Fig. 1.

The crown lens is in front; it is double-convex, with the shorter radius outside. The flint is double concave, with the longer radius outside; and its inner curve is deeper than it convex neighbour, thus leaving a meniscus air-lens, as we may term it, in the interior. This object-glass is evidently on the same model as the early work of Dollond and Tulley, and it is spoken of as an excellent form.

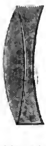
FIG. 1


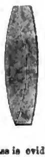
FIG. 2


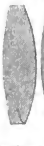
FIG. 3


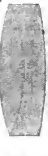
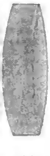
FIG. 4


FIG. 5


The French form is shown in Fig. 2.

The crown lens is in front; it is double-convex, with the longer radius outside. The flint is concavo-convex, or, has only one concave surface; hence the combination is on Herschel's plan. I have represented the inner curves in contact, but possibly this condition is not always applied. This construction has been tried by at least one English optician, but it has not been largely adopted.

The German form is shown in Fig. 3.

This is essentially different from the other combinations; it is really the French form reversed. The flint lens is in front; it is convexo-concave, or a long convex curve in front with a deep concave curve behind. The crown lens is double-convex, having its longer radius outside: generally the inner curves are slightly separated.

I am also enabled to give two triplet combinations; they are represented in Fig. 4 and Fig. 5. Both have the interior curves alike and are cemented.

In the first, the anterior convex-lens is of unequal curvature, the flatter side being in front; the back lens is equi-convex. The inner flint lens is of unequal curvature, corresponding with the adjacent convex sides.

In Fig. 5 we have a simpler combination. The first and second lenses are equi-convex and equi-concave; the third lens has its outer radius much longer than the inner one.

A very convenient, practical combination may be formed on the German plan, Fig. 3. With two particular kinds of glass, each outer curve may have the same radius, and also the two inner curves may be alike. "Our" authority says respecting such an arrangement:—"This is the most simple form an amateur can have, as only two pairs of tools are necessary."

The details relating to the specific radii and kinds of glass suitable for some of these combinations will be given afterwards.

In treating of the general theory of the object-glass, there are two parts to be dealt with: first, the correction for colour; and second, the elimination of spherical error. To obtain these corrections, use is made of a second lens, having errors of a similar but opposite character to those of the first. By this means, an approximate balance only can be effected. First, we will treat of the correction for colour.

By duly proportioning the foci of a convex and concave lens, achromatism, to a certain extent, may be attained; but this will only apply to rays very near to the axis of the combination. Chromatic spherical error has not, so far as I am aware, been brought under mathematical treatment; and, indeed, it does not seem likely that such can be done in any convenient form. A few general deductions may be made, which must guide us in arranging curves, so as to secure the best effect. Chromatic and spherical error both arise, in some respects, in a similar way; and, therefore, we are justified in concluding that means which will remove the latter will also lessen the former.

Chromatic aberration may be divided into three sections: first, primary or axial chromatism, arising from the refraction of light by a prismatic substance; next, spherical or lenticular chromatism, caused by the shape of the lens; and lastly, residual chromatism, or, as it is usually termed, secondary spectrum, produced by the unequal action of a substance upon rays of different colours.

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* Since writing this I have received from "J. C. Z." an account of Robison's method, which I will give in my next section.

† An article on the "Achromatic Object-glass," by Andrew Ross. Vol. LII, page 324, *Transactions of the Society of Arts*.

With regard to primary chromatism, when a ray of white light passes through a glass prism, it is refracted or bent from its original path; and also dispersed or spread out into colours over an angular space, which varies with the nature of the substance, and the manner in which the ray falls on it. Now if, by another substance, an equal but opposite dispersion be produced, the ray will practically emerge in the same state in which it entered. The dispersion varies, among other things, with the refracting angle of the prism; and a much less angle in flint-glass than in crown-glass will produce a given amount of dispersion. Hence, the correction of primary chromatism involves a relation between the refracting angles of the lenses, or, which is the same thing, between their principal focal lengths. Secondly, with regard to spherical chromatism. The effect of refraction becomes more apparent, as the angle of incidence is increased, or as the ray approaches the margin of the lens. It causes the emergent ray to cut the axial ray nearer to the lens than those about the central part. If this aberration exists for one colour, it must exist for all; but as the surface may be figured so as to remove the appearance of unequal refraction, spherical chromatism will be at the same time very much diminished. It is not usual to regard the sphericity of a lens as having an effect upon the correction for colour; but I see no reason why it should be omitted. We regard the aberration (spherical) of a lens as being of one kind, the same as exists in a spherical mirror; but it is evident that this comparison is not a just one. We cannot say accurately what would be the index of a white ray, giving the same circle of aberration. It arises from the aggregation of a number of coloured discs; and though, to all appearance, the white disc may seem invariable, yet we cannot be sure that the same proportion of colours is always united in it. I do not see how any surfaces can be so fashioned as to *entirely* obliterate spherical chromatism. It may be possible to find, by experiment, a combination of surfaces which will do this approximately; and I think the counter-action which may be thus obtained can be made to play an important part in neutralising the next species of chromatism.

Residual colours or "secondary spectrum" arises from the nature of dispersion. Each substance has its own length of spectrum, and within this each colour is expanded in a varying degree. But by unequal refractions we may cause two substances to yield spectra of the same length, though when this occurs the intermediate colour spaces will not be equal for each substance. Hence two opposing media cannot act equally on each of the colours. They may be so arranged that one shall disperse and the other combine any two colours, but not more. The rest will still be slightly dispersed, therefore in selecting colours for combination, choice must be made of those two which will leave the least number of rays uncombined, or which gave the least "secondary spectrum." There is some latitude of choice in this matter, so that the predominating tint of residual chromatism is not always the same.

Thus, it appears that the achromaticity of a combination is consistent with a slight variability in the outstanding colour, one tint being spoken of as showing "undercorrectness," and another "overcorrectness." Now, if it is possible to apply the same conditions to the correction of spherical chromatism without essentially disturbing the general balance of aberration, there seems no reason why these two kinds of chromatic error should not be set in opposition. Sir D. Brewster, from experiments with prisms, found that the spectrum of a substance was susceptible of a slight variation in its internal constitution, when the same amount of dispersion was obtained from a large-angled prism with a small angle of incidence, and from a small-angled prism with a very oblique incidence. The effect of this variation he denominates "tertiary spectrum," and it seems to me analogous to that which I believe may be obtained by an extension of the process adopted for the removal of general spherical aberration. Brewster found that in prisms this "tertiary spectrum" could be made, not only to correct, but even to overpower and reverse the secondary colour.

(*To be continued.*)

Errata in Section VIII.—The second paragraph on p. 587, beginning with "The next short table," is misplaced. It refers to table three, and should have immediately preceded it. On p. 588, equation for spherical error, read $(3\mu + 2)$ instead of $(3\mu \times 2)$.

PRACTICAL NOTES ON PLUMBING.—XLII.*

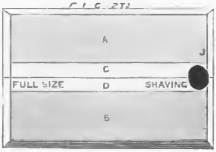
By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page 587, Vol. XXXV.*)

Preparing Work for Burning.—Flat Burning.

TAKE two pieces of lead, and prepare the edges to butt together. Shave the edges the exact width, as shown at C D, Fig. 232.

FIG. 232

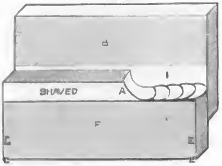


Do not use soil, touch, or rosin, nor handle it after it has been shaved.

Upright and Horizontal Burning.—Preparing.

Shave the lead, and put it together, as shown at SHAVED, A and I, B E, Fig. 233. Be

FIG. 233.

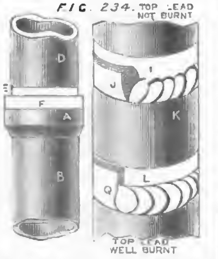


sure and shave all parts that touch and are required to be burned—viz., back and front of the lead.

Pipe-Joint Preparing.

For upright joints prepare as illustrated at Fig. 234. Let the male enter at least 1in., and

FIG. 234.

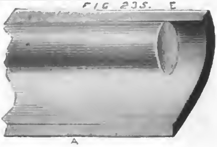


let the lead fit thoroughly all up the socketed part, and be perfectly cleaned for burning.

For Pipe Making.

Prepare the joint in a similar manner as when for soldering up, except the use of soil, touch, or rosin. Pull and dress round the mandrel as

FIG. 235.



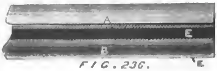


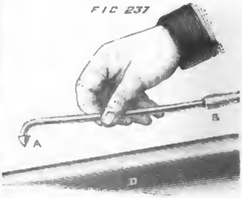
FIG. 236.

illustrated at E B A, Fig. 235, and as finished ready for closing, and tacking together as at Fig. 236.

Burning.

Suppose it is required to burn a flat seam, as already prepared and illustrated in Fig. 232: here you require a large burner, and in proportion to the substance of the lead and width of the seam. With a good supply of gas and wind, also a stick of pure lead about ¾in. wide and thick—in shape much about the same as fine stick solder bars, but not larger than specified, take hold of the pipe at B, Fig. 231, and hold it loosely, and upon the balance between the forefinger and thumb—the back part of the pipe lightly resting upon the third and little finger in such a manner that it will swing in an easy seesaw style, as shown in Fig. 237.

FIG. 237



Regulate the gas so as not to roar, but to come out freely after a while; and when no air is present, it will be found to be rather shaggy, as at U G H, Fig. 238, or at A B C D, Fig. 239, with a yellowish, inclined to red, tint. Next turn on the wind-cock full, D, Fig. 231, and most likely the flame will become reduced, and appear as at T U, Fig. 239; after which it will pop out, because you have had too much wind; then you can turn off the wind and light the gas again. Now turn on the wind, but very slightly, by degrees, and notice the difference you will have in the flame. It will get more pointed, and become a blueish, soft purple, and pencil-shaped intense flame, in shape similar to A B C, Fig. 240, and B D E F H J, Fig. 243. There is a wonderful difference between these flames and those illustrated at Fig. 238, and A B C, Fig. 239. The latter is large and rugged; whilst the former, Fig. 240, &c., is smaller and more compact. Too much care cannot be taken to select a proper flame; for if you have too much gas, the flame is apt to be large and weak, and will burn the parts not required. If too much wind, the flame is wanting in power. This flame will be very dark in colour, blue inclined to black, and will continually steal sneakingly out. Keep at this, occasionally trying the heat upon a piece of stick-

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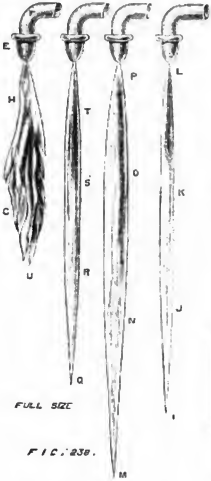


FIG. 238.

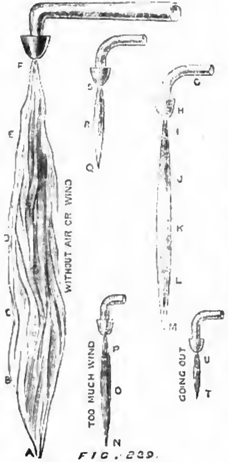
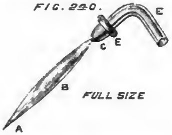


FIG. 239.

lead. Having mastered the flame, so that you can work it downwards from A B C D to T U, &c., Fig. 237 and Fig. 248, next apply such a flame, as shown at M, Fig. 238, or M, Fig. 239, to the stick-lead, and drop a bead of lead upon the flat seam, as at the dark spot near J, Fig. 232; then bring down the point of the flame, and melt the bead of lead, together with the two edges of the lead, taking care to apply the hottest part of the flame to the centre of joint. Let the whole flow together, raise the flame instantly, and with all speed melt off another bead to drop just upon the inner edge of your last (and at the same time that the whole is in a molten state) at about G in SHAVING; then melt this bead and the two edges as before, and so on from J to D, Fig. 232. Notice.—It is important that you hold the blowpipe straight, and in a line with the shaving and nearly level, over that part which you have burnt, as illustrated at A B C, Fig. 231. To put the pipe before the part which you have burnt is burning back-handed.

FIG. 240.



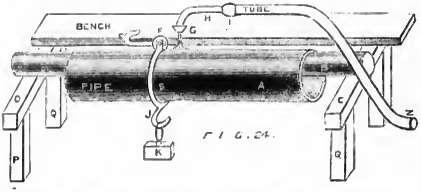


FIG. 241.

Soil and other pipe-burning is illustrated at Fig. 241. In this diagram may be seen the pipe placed over an iron mandrel, and supported upon two fixed tressels. Commence to burn at B, and proceed towards G. I have invented and introduced a roller, F, to be kept about 1in. in *front* of the flame. This prevents the heat from drawing the lead off the mandrel, which enables the lead-burner to proceed rapidly with his burning. Such work will have a herring-bone appearance, as illustrated at Fig. 241 A. When this tool cannot be had, at first, when learning, burn the seam slowly (in the manner known as button-burning), but see that the amalgamation of the burning is perfect. The shape of button-burning is well illustrated, full-sized, in Fig. 242.

FIG. 241A.

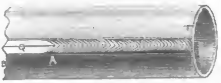
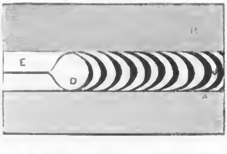


FIG. 242.



This is a slower process; and for learners a flame is required about the size of that shown at H, Fig. 248, which may be increased to that shown at M, Fig. 239. The button-burning crystallises slowly, and is, therefore, more the shape of a button.

(To be continued.)

BASSNETT'S SOUNDING INSTRUMENT.

AN improved instrument for sounding the depth of the sea, or other waters, has been recently patented by Thomas Bassnett, nautical instrument maker, Liverpool. The invention relates to apparatus in which the pressure of a head of water or liquid compresses air within an inclosed space, and in which a certain portion of the water entering th

FIG. 1.

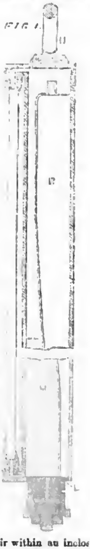
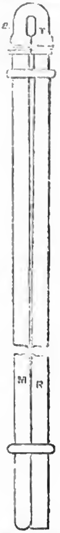


FIG. 2.



apparatus is retained to serve as a record of compression. The main objects are to provide apparatus in which equal increments of pressure shall be represented by equal, or nearly equal, divisions on the scale used for ascertaining the depth of immersion, and in which a long range of measurement shall be obtained in a comparatively short apparatus or instrument.

The patentee constructs the instrument with two chambers, or compartments, one of which tapers or increases in cross section from one end to the other, the second chamber or compartment being of any desired shape, but preferably taper. The larger end of the tapering or, as it is called, the measuring, chamber or compartment is hermetically closed; the smaller end communicates with one end of the second or receiving-chamber. The other end of the receiving-chamber is made with an opening, or openings, through which water is free to flow. The measuring-chamber is provided with a stop-cock, or plug, through which the liquid retained after use is discharged when desired, and with a gauge, or sight-glass, through which the quantity of water is observed and read off against a scale, provided with or fitted to the instrument. In practice the instrument is constructed advantageously as follows:—A solid drawn brass tube is divided longitudinally and obliquely into the receiving and measuring-chambers, or compartments, above mentioned. One end of the tube is hermetically closed, a small opening being left between the two chambers, or compartments. At the other end of the tube the large end of the measuring-chamber, or compartment, is closed, and an opening is left into the receiving-chamber. The oblique longitudinal division is obtained by cutting the tube, inserting a piece of sheet-brass between the two divisions, and afterwards securely soldering or brazing the whole together. A template is used, and the line of section is preferably curved. The ends of the tube are closed by pieces brazed or screwed thereon. A gauge-glass is fixed to and communicates at each end with the measuring-compartment, or a sight-glass is used for that purpose. The patentee also constructs sounding apparatus of two tubes, connected by a flexible joint, either indiarubber or mechanical, one end of such combined tube being hermetically closed and the other end open.

Fig. 1 is a longitudinal section of an instrument constructed in accordance with the first part of the invention. A solid drawn brass tube is divided longitudinally and obliquely by the sheet-brass division into the receiving-chamber R, and measuring-chamber M. The tube is cut in the required direction, preferably in a curved line, as shown, by means of templates, and the two portions are brazed together with the strip or riband of sheet brass between them, as shown; the two compartments communicate with each other at the top by means of a short tube. The top, or cover, is brazed or otherwise hermetically secured in position; H is the carrying-ring, to which is secured the sounding-line. At each end are nipples, through which openings lead into the measuring-chamber M, from gauge-glass, which is provided with hinged cover. The openings leading into the receiving-chamber are shown at L, with the end of the instrument closed by a tap, or valve, for opening and closing the measuring-chamber. It will be obvious that the receiving-chamber may be of any desired size and capacity, that the apparatus may be square, oval, or of other desired shape, and that the chambers may be made of other material than brass, and may be connected in many ways. The construction shown and described answers well in practice, and is the one which the patentee prefers. When in use the instrument or apparatus is loaded or secured to a sinker of lead or metal of any usual or suitable construction, and attached to a line or wire, and allowed to sink to the bottom, or any desired distance in the liquid, the depth of which is to be ascertained. The liquid enters the receiving-chamber R, through the openings L, and compresses the air into the measuring-compartment. When all the air in the receiving-compartment is compressed into the measuring-compartment (which will be at a pressure of two atmospheres if the chambers are as shown, of equal capacity), the liquid will flow into the said measuring-chamber or compartment. When the instrument or apparatus is drawn up the liquid will flow out of the receiving-chamber through the openings L, and the liquid forced over into the measuring-chamber will remain. The depth to which the instrument has descended can then be read off on the scale by noticing the height of the water in the gauge-glass. After reading off, the tap, or valve, is opened and the liquid allowed to flow away. The scale is obtained by calculation, experiment, or both in the first case; after which any desired number of instruments may be made to the same scale, care being taken to verify their accuracy.

Fig. 2 is a side elevation of a sounding apparatus, constructed under the second part of the invention. Here two tubes are connected by the indiarubber tube T, or a hinged metallic joint, such as are used in gas-brackets, may be employed. In use the apparatus is placed as shown, and connected to a sinker. The liquid enters the open end of the tube R, and flows into the tube M, which is closed at one end. When drawn up, the water flows out of R, and remains in M, the amount remaining being measured or read off on a scale. In practice the tube R is of metal and M of glass. By straightening the tubes, the water will flow out of M, and in case of breakage any of the parts are easily renewed.

THE ELECTRIC FURNACE.

ALTHOUGH the electric furnace does not at present form part of the plant of a steelworks, nor even of all metallurgical laboratories, there seems no reason to doubt but that, given a cheap supply of current, it will be found a very useful addition. In a paper by Dr. C. W. Siemens and Prof. A. K. Huntington, of King's College, read at the recent meeting of the British Association, the authors give an interesting account of a number of experiments they have made, which shows that whatever may be the ultimate fate of the electric furnace in connection with metallurgy on the commercial scale, it will be, and is now, of special advantage in the laboratory. For instance, the temperature attainable is practically limited only by the refractoriness of the materials used in the construction of the furnace, and the heat is developed directly in the metal or other substance it is desired to fuse. The temperature obtainable by means of fuel is limited by dissociation, carbonic acid for instance, according to Deville, being dissociated at 4,700° Fahr. under atmospheric pressure. Ordinarily, the furnace consists of a crucible, through the bottom of which the positive electrode slightly projects. The negative electrode passes through a hole in the lid, and is suspended from one end of a beam, the other end of which is attached to a hollow cylinder of iron free to move vertically in a solenoid, one end of which is connected with the positive, the other with the negative electrode. A sliding weight on the solenoid end of the beam acts as a counterpoise, and the length of the arc is regulated automatically—a point of great importance, for the resistance of the arc rapidly diminishes as the temperature of the atmosphere within the crucible increases. The crucible is surrounded with some infusible substance such as gas-retort carbon or sand, but on this point only experiment can determine the best means. With a current ranging between 250 and 300 ampères, the most refractory clay crucibles were cut through in a few minutes; but plumbago crucibles stood well: only for certain purposes they cannot be used, as they cause carburisation of the metal experimented on. The authors have, however, effected the fusion of metals in a bed of lime, sand, and carbon-dust from the electrodes used for electric-lighting. From a number of experiments the authors deduce the following conclusions: That the quantity of any metal which can be fused in the electric furnace, and the time occupied in fusion, depend—(1) On the relation between the volatilising point and the fusing point—that is, on the extent which the volatilising is higher than the fusing point; and (2) On the conductivity of the metal for heat. Thus platinum can be more readily melted than steel, and in greater quantity for a given expenditure of energy. Amongst the experiments made, we find that wrought iron fused in the furnace and poured into a mould, was found to be crystalline, and could not be worked. As much as 20lb. of steel files have been poured at one operation; but with such quantities the metal is invariably found full of blowholes. White iron, fused in a clay crucible for thirty minutes, when fractured did not appear to have undergone any change. White iron and coke were introduced into the furnace: the resultant metal was slightly greyer than the original. When, however, retort-carbon was substituted for the coke, a good grey iron, soft and easily workable, was readily obtained in fifteen minutes, starting with the crucible hot. On another occasion, starting all cold, at the end of thirty minutes the metal, although it had been well fused, had not been rendered greyer. The difference between these two results was probably due to the temperature being somewhat higher in the one case than in the other. This is a point of considerable practical interest. Four pounds of white iron, fused with carbon dust for three-quarters of an hour, yielded a very grey crystalline iron. In another experiment, in which 8oz. of grey iron, produced in the electric furnace from white iron, were remelted in carbon dust for ten minutes, a very grey metal was obtained, from which, on slow cooling, a large quantity of graphite separated. Cast iron, fused and kept under the action of the arc for 45 minutes in carbon dust, was not materially changed as to greyness, and the general character of the metal as to the way in which it worked under the tool was not materially altered. When spiegeleisen was fused in a plumbago or clay crucible, graphite separated as the metal cooled. Silicious pig-iron, containing about 10 per cent. silicon, was fused by itself. It showed but little change, except that some graphite separated.

A series of experiments was made to determine the maximum amount of carbon pig-iron is capable of taking up in the presence of a given quantity of silicon. Grey cast iron and pig-iron containing 10 per cent. of silicon were fused together in carbon dust, the ratio between them being varied so as to yield metal with from ½ per cent. to 9 per cent. of silicon. A similar series was made, only substituting sulphur for silicon. No odour of sulphurous acid was perceived; therefore, presumably, no sulphur was volatilised. This is somewhat remarkable, considering the nature of the experiment.

A positive pole of nickel, ¾in. in diameter, was passed through a hole in the bottom of a clay crucible. A carbon negative pole was used, but soon after the commencement of the experiment a deposit of nickel formed on the end of it, so that practically it was a nickel pole. This deposition of metal on the negative pole was also observed with some other metals—notably with tungsten. In the furnace thus arranged, 1lb. of grain nickel was fused and poured in eight minutes. The fused metal had a brilliant granular fracture. It could not be cut properly in the shaping machine, shearing off under the tool. One pound of grain nickel fused in carbon dust for 25 minutes yielded a dark grey carburised metal, which worked well under the tool. On another occasion an equal quantity of nickel, similarly treated, gave a "blowy" metal, which could not be worked. Some carburised nickel, made as described above, was fused in a clay crucible for twelve minutes, and allowed to cool gradually in the furnace; the fracture became whiter and the grain closer.

Three-quarters of a pound of copper were fused for about half an hour in carbon dust. On examining the result, it was found that all but about ¾oz. had been vaporised.

Eight pounds of platinum were rendered perfectly liquid in about a quarter of an hour.

Half a pound of tungsten in powder was subjected to the action of the arc in a clay crucible. Dense fumes were evolved, a cavity about 1½in. across the top being formed. The furnace was allowed to cool down slowly. When the crucible was removed, it was found to have been very much attacked below the point to which the arc extended. The inference is that the crucible had been attacked by the metal at the temperature of the experiment. The metal was fused only to an inappreciable depth beneath the cavity formed by the arc. The unfused metal underneath was covered with very beautiful iridescent crystals of tungsten, which under the microscope appeared to be well-formed prisms. The crystals had evidently been formed by the slow cooling of the vapour distilled down from the surface. A very large number of experiments were made with tungsten, the results of which showed that it could not be fused, except in very small quantities at a time. It was possible to build up a small ingot by fusing a little of the tungsten, and then adding little by little gradually. Even then the pieces obtained were for the most part spongy and unsatisfactory. The best results arrived at were when tungsten which had already been fused was employed in the building-up process. Once the metal had been fused, it did not fuse much in melting, doubtless owing to the greatly reduced surface exposed. Tungsten fused in the electric furnace is, when untarnished, pure white, and brittle, the grain being very close. Tungsten hitherto has been obtained only as a grey powder, by reducing the oxide with carbon or hydrogen, or in minute globules in the ordinary small electric arc. Tungsten has its fusing point lowered by the addition to it of carbon. Under these conditions a solid piece of moderate size can, without much difficulty, be obtained. From 1,000 grains of powder fused in carbon dust 650 grains were recovered, the remainder having been volatilised, and from 450 grains of the fused metal 410 grains were obtained on refusion. One piece of tungsten which had been treated under the conditions most likely to cause it to be highly carburised was analysed. It contained 1·8 per cent. of carbon. The metal was very white, close in grain, and brittle.

These experiments serve to show that the electric furnace may ultimately become of very great importance in the metallurgist's laboratory.

HIGGIN'S GALVANIC BATTERIES.

WITH the object of lessening the cost of galvanic currents, Messrs. J. & A. J. Higgin, manufacturing chemists, of Manchester, have recently patented several improved forms of battery, in which they employ elements and materials, which, besides supplying the required current, furnish useful or valuable chemical products. They effect that by substituting tin for the zinc usually employed as a positive element, and by simple means recover the tin in a form suitable for certain chemical manufactures, into which that metal enters as a principal ingredient. In one form of battery, they employ two fluids, separated generally by a porous cell, and in the other they have only one fluid. For the double fluid cell they generally use a receptacle such as a stoneware jar, in which a hollow cylinder of tin or a plate of tin rolled into a cylindrical form is placed. The edges of the plate need not touch, as a narrow aperture left to establish a communication between the fluid inside the cylinder and that outside of it, will be beneficial. Inside the cylinder is a porous cell, after the manner of the well-known "Bunsen" cell. In the outside cell is dilute acid, and in the porous cell a liquid or substance capable of absorbing hydrogen. In one form of the double fluid cell, sulphuric acid diluted with from 5 to 10 times its volume of water is used as an excitant; and as an absorbent in the porous cell, a carbon rod or plate, surrounded by pyrolusite or native peroxide of manganese, broken into small pieces, which may be about the size of peas. The porous cell is filled with dilute sulphuric acid, as in the case of the outer cell. A copper wire is connected with the tin plate, and another with the carbon rod or plate. During the action of this battery, the dilute sulphuric acid produces proto-sulphates of tin and manganese, which remain in solution. When it is desirable to renew the liquids in this cell, the saturated or partly saturated solution is treated in the following manner to separate the tin therein contained. To the solution, which may be heated, sufficient peroxide of manganese in fine powder is added, to cause the protosulphate of tin to become persulphate. When the reaction is complete, the liquid is diluted largely with hot or cold water, when a precipitation of stannic acid or stannic oxide takes place. When this has been washed with water until free from soluble salts of iron and manganese, it is thrown on a filter, and drained to a paste, and may then be treated in various ways to produce valuable chemical products. Dissolved in an aqueous solution of caustic potash or soda, it forms the stannate of soda or potash, well known in the arts of calico-printing and dyeing. Dissolved in hydrochloric acid, it forms bichloride of tin, also used in calico-printing and dyeing, and by the addition of metallic tin to this latter, the bichloride of tin by assimilating more tin, becomes protochloride of tin, which may be at once used in the arts, or the solution may be evaporated and crystals of protochloride of tin be obtained. In a modification, the dilute sulphuric acid in the porous cell containing pyrolusite and a carbon rod or plate is replaced by a solution of persulphocyanide of iron, and in this case the pyrolusite is omitted. The solution of persulphocyanide of iron may be conveniently made by dissolving a persalt of iron such as persulphate or perchloride in water, adding thereto an alkaline or earthly sulphocyanide, in chemical proportion to the iron salt employed. A convenient strength for the persulphocyanide of iron solution may be 50 grains of the compound $Fe_2(CNS)_6$ in each ounce measure of water. In proportion as the outside cell becomes charged with sulphate of tin, the liquid in the porous cell becomes changed from persulphocyanide into protosulphocyanide of iron and free hydrosulphocyanic acid. By introducing a current of air by means of a small tube going down to the bottom of the porous cell, and connected with a blower, the continual reconstitution of the persulphocyanide is effected by the oxidising action of air. When it is desirable to renew the liquid in the porous cell, when using persulphocyanide of iron, it is first ascertained if there is any protosulphate of tin in solution, and if so, it is oxidised to persulphate, and diluted largely with hot or cold water, when the tin is precipitated as stannic acid or stannic oxide. After removing the precipitate by subsidence or filtration, a salt of copper is added. The subsequent addition of a reducing agent such as sulphurous acid, or an alkaline or earthy sulphite, or of protosulphate of iron, causes the precipitation of a white powder, which is the disulphocyanide of copper, which may be further purified by treatment with hot dilute sulphuric or hydrochloric acid, and is then capable of being used in certain processes of calico-printing, or may be reconverted into an alkaline or earthy sulphocyanide, by treatment with an aqueous solution of an alkaline or earthy sulphide, whereby sulphide of copper and an alkaline or earthy sulphocyanide are produced, which latter may be used to reconstitute the persulphocyanide of iron for the porous cell. In another modification, a mixture of a solution of caustic potash or soda and nitrate of soda or potash is used with carbon as a negative pole. The strength of the caustic alkaline solution may conveniently be of specific gravity 1·10, and when nitrate of potash or soda is dissolved in this, about 22 grains of nitrate to each fluid ounce of the alkaline solution is added. In the well-known bichromate cell, a plate of zinc is suspended between two plates of carbon, and the whole is immersed in a solution of chromic acid or a mixture of bichromate of potash and sulphuric acid. In Messrs. Higgin's modification they substitute a plate of tin for the zinc, and use as an excitant a mixture of either dilute sulphuric or hydrochloric acid and one or other of the salts of iron above mentioned. The strengths of these acids may be as before described, and the quantity of iron dissolved therein in the persalt employed may be equal to 20 grains of peroxide of iron in each fluid ounce.

FIG. 1

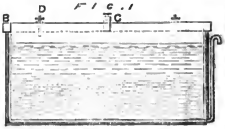


FIG. 2

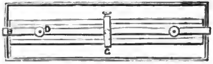


FIG 3.

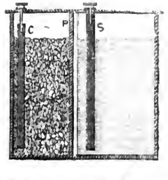


Fig. 1 is a vertical section of the single-fluid cell, and Fig. 2 a plan. A bar of iron B rests by its ends on the rectangular cell, and is secured to a plate of tin. In the example, pieces of wire are inserted in holes in the tin plate and are secured by running in melted tin. The projecting ends of these wires are screwed, and binding screws D are screwed on the ends, and the plate of tin is thus attached to the iron bar. Two plates of gas carbon are placed one on each side of the plate of tin, but are separated from it by means of two bars of insulating material such as vulcanite. A binding clamp of brass G provided with tightening and binding screws clamps together the carbons, the vulcanite bars and the tin plate. At one end of the rectangular cell and close to the bottom thereof is placed a curved glass pipe made of what is known as "quill-tubing," which is cemented into the rectangular cell midway from the sides and curled over at the top, the outlet being a little below the top of the rectangular cell. This pipe can be used either for forcing air through the solution, or as an overflow into another cell, so as to make a cascade battery. For battery cells of moderate power, but required to furnish a constant and long-continued current, the cell illustrated by Fig. 3 is preferred. It is a rectangular vessel of stoneware or glass, say about 6in. long, 4in. wide, and 6in. deep. Inside is a ledge or projection, and a thin slab of porous earthenware P is inserted in the smallest division of the vessel and rests against the projection. A plate of gas carbon C is placed about half an inch from the end and not quite touching the bottom, the remainder of the small chamber being packed with a mixture of pyrolusite and gas carbon in small pieces. To the top of the carbon plate is fastened a copper or other wire, sufficiently long to pass through a hole in the cover of the cell, which is a glass plate drilled with three holes. In the large division is mounted a plate of tin S, to one end of which are soldered two screwed copper wires, which are passed through holes in the cover. Dilute sulphuric acid is put into both chambers of the cell, so as to fill them nearly to the top. The glass covering plate is then put on and is secured to the cell with any suitable cement, which can be softened by heat. On the projecting ends of the three wires are screwed binding screws, and the two plates are thus suspended in the cell, the plate of tin being about half an inch from the porous slab.

A Pocket Photometer.—Mr. Robert Sabine, the well-known electrician, has devised a handy little pocket photometer which will be useful for estimating approximately the intensities of different electric lights. It is based on Ritchie's method, and consists of a telescopic tube having at one end a square box, two opposite sides of which are glazed with squares of opal glass cut from the same sheet. Within this box is a prism, or angle of a prism, made up of two plane mirrors meeting each other at a right angle, the apex of which points up the telescopic draw-tube. This tube is fitted with an eyepiece at the other end, and a small lens, so as to get a good focus in order to see the mirrors plainly. The principle of Ritchie's photometer consists in comparing the intensities of the two lights as reflected on the mirrors (or white card surfaces); and the observer moves until the relative distances between himself and the lights give a sensibly equal illumination of the mirrors. These distances then give the relative intensities of the lights by the law of inverse squares. In Mr. Sabine's photometer the lens and draw-tube take the place of the small hole employed by Ritchie; and this requires the tube to be drawn out about 4in. Were it not for the lens the tube would require to be much longer in order to get a good view of the mirrors. The instrument is made by Messrs. Elliott Brothers, the well-known opticians.—*Engineering.*

PLASTER of Paris is made hard enough for a mould for metal castings by the use of 10 per cent. of alum in the water used for mixing the plaster.

FIG. 5.

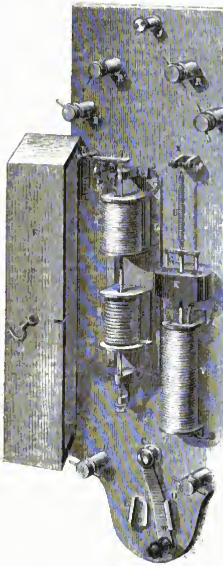


FIG. 1.

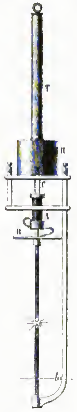


FIG. 4.

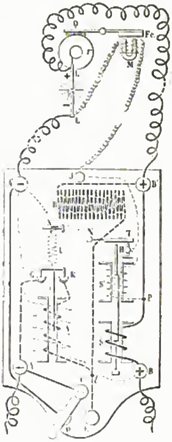


FIG. 6.

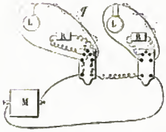
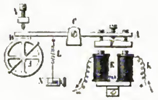


FIG. 3.



ON A NEW ARC ELECTRIC LAMP.[*]

By W. H. PREECE.

ELECTRIC lamps on the arc principle are almost as numerous as the trees in the forest, and it is refreshing to come upon something that is novel. In these lamps the carbons are consumed as the current flows, and it is the variation in their consumption which occasions the flickering and irregularity of the light that is so irritating to the eyes. Special mechanical contrivances or regulators have to be used to compensate for this destruction of the carbons, as in the Siemens and Brush type, or else refractory materials have to be combined with the carbons, as in the Jablochkoff candle, and in the Lampe Soleil. The steadiness of the light depends upon the regularity with which the carbons are moved towards each other as they are consumed, so as to maintain the electric resistance between them a constant quantity. Each lamp must have a certain elasticity of regulation of its own, to prevent irregularities from the variable materials of carbon used, and from variations in the current itself, and in the machinery.

In all electric lamps except the Brockie, the regulator is in the lamp itself. In the Brockie system the regulation is automatic, and is made at certain rapid intervals by the motor engine. This causes a periodic blinking that is detrimental to this lamp for internal illumination.

Mr. Abdank, the inventor of the system which I have the pleasure of bringing before the section, separates his regulator from his lamp. The regulator may be fixed anywhere within easy inspection and manipulation, and away from any disturbing influence in the lamp. The lamp can be fixed in any inaccessible place.

The Lamp.

The bottom or negative carbon is fixed, but the top or positive carbon is moveble in a vertical line. It is screwed at the point C (Fig. 2) to a brass rod (T), which moves freely inside the tubular iron core of an electro-magnet, K. This rod is clutched and lifted by the soft iron armature, A B, when a current passes through the coil M M. The mass of the iron in the armature is distributed so that the greater portion is at one end, B, much nearer the pole than the other end. Hence, this portion is attracted first, the armature assumes an inclined position maintained by a brass button (t) which prevents any adhesion between the armature and the core of the electro-magnet.

The electric connection between the carbon and the coil of the electro-magnet is maintained by the flexible wire S.

The electro-magnet, A, Fig. 1, is fixed to a long and heavy rack, C, inclosed in T, which falls by its own weight and by the weight of the electro-magnet and the carbon fixed to it. The length of the rack is equal to the length of the two carbons.

The fall of the rack is controlled by a friction break (B, Fig. 3) which acts upon the last of a train of three wheels put in motion by the above weight. The break (B) is fixed at one end of a lever, B A, the other end carrying a soft iron armature, F, easily adjusted by three screws. This armature is attracted by the electro-magnet, E E, whose resistance is 1,200 ohms whenever a current circulates through it. The length of play is regulated by the screw V. The spring L applies tension to the break.

The Regulator.

This consists of a balance and a cut-off. The balance (Fig. 4 and 5) is made with two solenoids S and S, whose relative distances are adjustable. S conveys the main current, and is wound with thick wire, having practically no resistance, and S^1 is traversed by a shunt current, and is wound with fine wire, having a resistance of 600 ohms. In the axes of these two coils a small and light iron tube, 2mm. diameter, and 60mm. (millimetre) length, freely moves in a vertical line between two guides. When magnetised, it has one pole in the middle, and the other at each end (G). The upward motion is controlled by the spring N T. This spring rests upon the screw H, with which it makes contact by platinum electrodes. This contact is broken whenever the little iron rod strikes the spring N T. The positive lead from the dynamo is attached to the terminal B; it then passes through the coil S to the other terminal B', whence it proceeds to the lamp. The negative lead is attached to terminal A, passing directly to the other terminal A', and thence to the lamp.

The shunt which passes through the fine coil S' commences at the point P. The other end of the coil S' is fixed to the screw H, whence it has two paths: the one offering no resistance through the spring T N to the upper negative terminal A'; the other through the terminal J to the electro-magnet of the break M, and thence to the negative terminal of the lamp L'.

The Cut-off.

The last part of the apparatus to be described is the "cut-off" (Fig. 4), which is used when there are several lamps in series. It is brought into play by the switch C D, which can be placed at E or D. When it is at E, the negative terminal A is in communication with the terminal positive B through the resistance R, which equals the resistance of the lamp, which is therefore out of circuit; when it is at D, the cut-off acts automatically to do the same thing when required. This is done by a solenoid, V, which has two coils: the one of thick wire, offering no resistance, and the other of 2,000 ohms resistance.

The fine wire connects the terminals A' and B. The solenoid has a movable soft iron core, suspended by the spring U. It has a cross-piece of iron, which can dip into two mercury cups, G and K, when the core is sucked into the solenoid. When this is the case, which happens when any accident occurs to the lamp, the terminal A is placed in connection with the terminal B through the thick wire of V and the resistance R, in the same way as was done by the switch C D.

Electrical Arrangement.

The mode in which several lamps are connected up in series is shown by Fig. 6. M is the dynamo-machine, the + lead is connected to B_1 of the balance, it then passes to the lamp L, returning to the balance, and then proceeds to each other lamp, returning finally to the negative-pole of the machine. When the current enters the balance, it passes through the coil S, magnetising the iron core F, and drawing it downwards (Fig. 4). It then passes to the lamp LL' through the carbons, then returns to the balance, and proceeds back to the negative terminal of the machine. A small portion of the current is shunted off at the point P, passing through the coil S', through the contact-spring T N, to the terminal A', and drawing the iron core in opposition to S. The carbons are in contact; but in passing through the lamp it magnetises electro-magnet M (Fig. 2), which attracts the armature A B, that bites and lifts up the rod T with the upper carbon, a definite and fixed distance, which is easily regulated by the screws, Y Y. The arc, then, is formed, and will continue to burn steadily as long as the current remains constant; but the moment the current falls, due to the increased resistance of the arc, a greater proportion passes through the shunt, S' (Fig. 4), increasing its magnetic moment on the iron core, while of S is diminishing; the result is, that a moment arrives when equilibrium is destroyed. The iron rod strikes smartly and sharply upon the spring, N T, contact between T and H is broken, and the current passes through the electro-magnet of the break in the lamp. The break is released for an instant; the carbons approach each other. But the same rupture of contact introduces in the shunt a new resistance of considerable magnitude (viz., 1,200 ohms), that of the electro-magnet of the break. Then the strength of the shunt current diminishes considerably, and the solenoid, S, recovers briskly its drawing power upon the rod, and contact is restored. The carbons approach during these periods only about ·01 to ·02 millimetre. If this is not sufficient to restore equilibrium, it is repeated continually until equilibrium is obtained. The result is that the carbon is continually falling by a motion invisible to the eye, but sufficient to provide for the consumption of the carbons.

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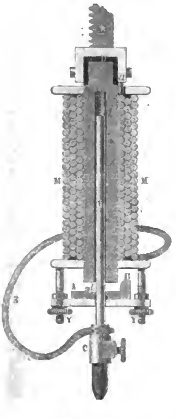
[*] A paper read in Section G at the meeting of the British Association.

Fig. 2.



The contact between N T and H is never completely broken; the sparks are very feeble and the contacts do not oxidise. The resistances inserted are so considerable that heating cannot occur while the portion of the current abstracted for the control is so small that it may be neglected.

The regulator acts precisely like the key of a Morse machine, and the break precisely like the sounder receiver, so well known in telegraphy. It emits the same kind of sound, and acts automatically like a skilled and faithful telegraphist.

This regulation, by very small and short successive steps, offers several advantages.

1st. It is imperceptible to the eye.

2nd. It does not affect the main current.

3rd. Any sudden instantaneous variation of the main current does not allow a too near approach of the carbon points.

Let, now, an accident occur—for instance, a carbon is broken; at once the automatic cut-off acts, the current passes through the resistance R instead of passing through the lamp. The current through the fine coil is suddenly increased, the rod is drawn in, contact is made at G and K, and the current is sent through the coil R. As soon as contact is again made by the carbon, the current in the coil S is increased, that of the thick wire in V is diminished, and the antagonistic spring U breaks the contacts at G and K.

The rupture of the light is almost imperceptible, because the relighting is so brisk and sharp.

I have seen this lamp in action, and its constancy and steadiness leave nothing to be desired.

HYDRAULIC MACHINERY.—I.*

By Prof. Perry.

HYDRAULIC machines are very wonderful to people who observe their action for the first time. Here is a model of the common hydraulic press, and with this little model a labourer, without any other help, can raise a load of 100 tons. If you go to any large docks, you will see how, by the manipulation of a few handles, a boy can lift heavy weights rapidly from ships, placing them on the dock. Visit any large steel works, and you will see great armour plates and great Bessemer converters and their appliances passed about nearly as readily as small objects are moved by a village blacksmith or a brass-moulder. Visit the Victoria Docks, and you will see the largest ships raised out of the water on a floating gridiron, and towed off for repairs. Visit the River Weaver, in Cheshire, and you will see sections of a canal rising and falling with canal boats. Instead of bringing a boiler or iron girder near a riveting machine, Mr. Tweddell takes a little riveting machine to the boiler or girder, and works it through small flexible pipes from a distance. Think of centrifugal pumps which discharge 100,000 gallons per minute, or those of smaller size, which, worked by their little steam-engines, would keep the leakiest ship afloat: of those insignificant little machines called turbines, which make up in speed for their small size, and whose development is really in the future, when electricity shall have become a handmaid of industry.

Fig. 1.

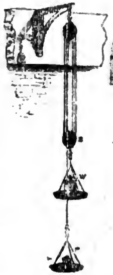


Fig. 2.

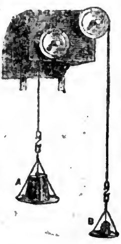
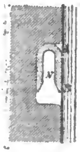


Fig. 3.



With few exceptions, the general public are utterly ignorant of the properties of electricity. People say that, when electricity is supplied to every house, as water is at present, everybody will get a knowledge of its properties. This reasoning is very fallacious. From our early swimming days, we have had much to do with water. We all take sea and river voyages, and are tossed about by water. We wash in it and drink it. It is supplied to our houses in large or small quantities. In spite of all this there is a wonderful ignorance everywhere as to the properties of water.

Fig. 4.

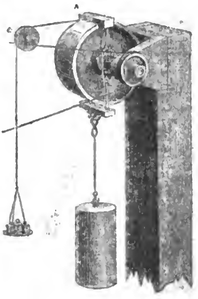


Fig. 5.

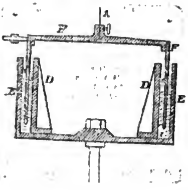
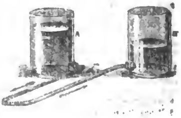


Fig. 6.



Just consider for an instant what is the condition of things before the labourers act on the lever of an hydraulic press. There is a ram which carries a heavy weight, the weight to be lifted. Now, the space between the vessel and the ram, and all the space in their tubes, is filled with water, which has no means of getting away. There is no escape for the water anywhere on the pump side, and there is just as little on the other side, for you see that the water if it escapes into the space N, Fig. 3, finds that it has still to get past the leather, which is, however, so placed and shaped that the greater the water pressure the tighter the leather fits the ram. There is, then, no escape for the water, and when this is the case, no matter what weight is placed on the top of the ram, it cannot fall. The falling of the ram would mean some escape for this water; but as there is no escape for the water, the ram will fall no more than if it were supported on some quite rigid material.

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

I have been supposing here that a certain quantity of water will absolutely refuse to occupy a smaller space, but this is not quite correct. You know that if it were air that filled this space, instead of water, and there were no escape for it, the ram would fall when a greater weight was placed on it; for, although the air cannot escape, it is contented to occupy a smaller bulk, I have been supposing that this does not occur in water, and that water will refuse to go into a smaller space, whatever the pressure. But, with a piezometer, it is easy to show that water and all other substances will submit to a diminution of their bulk when subjected to pressure; and we find that this diminution for water is 1-20,000th of its total bulk for a change of pressure of one atmosphere, or 1-70th of its volume for a pressure such as we find in hydraulic presses. Now, this diminution in bulk is far too insignificant to be of much practical importance in hydraulic machines, and we may take it for granted that whatever weight be placed on the ram, it will not perceptibly fall, because the water refuses to become smaller in bulk, and because it cannot escape anywhere.

Now the labourer acts on his lever, forcing down the plunger. The water here is just like the water in the press: it tries to escape, it tries to burst this pump barrel, it resists the motion of the plunger. The question is, then, what force on the plunger is sufficiently great to cause motion. There is a law which is found to be true in all machines—the law of work. The work done to any machine is exactly equal to the work done by the machine, unless it is stored in the machine or wasted. If a weight of 10lb. falls slowly 6ft., acting on a machine, then the machine has been given 60 foot-pounds of mechanical energy, and it will give this out again. The machine can lift 6lb. ten feet, or 60lb. one foot, or 120lb. half a foot. It can do this if there is no friction; it cannot do more than this; it, in all practical cases, does less than this. A machine can store energy by the coiling of springs, the lifting of weighty parts of its mechanism, and in other ways, and its main method of wasting is by friction at rubbing surfaces, which converts mechanical energy into heat. We knew, then, that the work given to this machine by the plunger is equal to the work done in lifting the ram, minus the work lost in friction, if we are quite sure that the water is just in the same average state of compression all the time. For you must regard the squeezing of the water and the elastic yielding of every part of the apparatus as you look upon the coiling of a spring—that is, as a store, although but a small store, of energy.

The hydraulic press, then, may be looked upon as we look at this block and tackle (Fig. 1), or the machine inside this wooden case (Fig. 2); a machine that will give out undiminished, except by friction, all the energy we give to it. Let me take this very simple machine (Fig. 2), to illustrate my meaning.

You see that when the weight A falls, the weight B is lifted. In considering such a machine, we first find out how many feet B will fall when A rises, say 1ft. Now, I find that B falls 20ft. when A rises 1ft. Suppose the weight of B to be 6lb., in falling 20ft. it gives to the machine 20 × 6, or 120 foot-pounds of energy, and if there is no friction in the machine, this same amount of energy is devoted to the lifting of A. Now, if A is 120lb., then in rising one foot, just 120 foot-pounds of energy will be consumed. We see, then, that if there is no friction in this machine, 6lb. at B ought to be just able to support 120lb. at A, the weights being inversely proportional to the speed with which they fall and rise. B falls twenty times as fast as A rises, and consequently B will balance twenty times its weight at A.

This machine is inside a box, and you know nothing of how the falling of A causes B to rise, but when you are told that there is no coiling of springs inside, and no friction, you feel sure, from all your experience of nature and machinery, that the above calculation is correct.

If we opened up this box we might find out how it is that when B falls twenty feet A only rises one foot. The connection may be through a million wheels and levers or only one axle; outside measurement is enough for us without an inside examination. Suppose now that very careful measurements have been made on the hydraulic press when it is in action, and it is found that the end of the lever falls 2,000 times as fast as the weight on the ram is lifted. You know that if there is no friction, a weight of 1lb. at the handle will balance a weight of 2,000lb. at the ram, and hence a weight of 180lb. will balance a weight of 360 000lb., or nearly 170 tons. This you can tell without examining the inside of the machine.

Different experimenters give different results as to the loss in friction. Rankine's results were about 20 per cent. of loss; but Mr. Hick, of Bolton, in 1867, found results which were less than one-tenth of Rankine's. It is, then, very probable that there is usually much less than 20 per cent. of loss in hand-worked hydraulic presses.

Let us now consider why it is that hydraulic machines have so much greater an efficiency than ordinary machines. In the hydraulic press, as in any other machine, the mechanical advantage, leaving friction out of account, simply depends on the relative velocities of the plunger and the ram. You are all well aware of how it is that wheels, screws, levers, and belts diminish or increase speed. How does the hydraulic press effect this object? Suppose that the plunger is one square inch in section, and that 1in. more of its length is forced into the pump, evidently the metal takes up the place of an equal bulk of water, or one cubic inch. For you know that 1in. of material, one square inch in section, contains one cubic inch. This cubic inch of space is now occupied by metal, and it used to be occupied by water, and the water has found one cubic inch of room for itself somewhere else. As we suppose no greater compression of the water, and no yielding of the sides of the press, it is evident that one cubic inch of the ram must leave the press to give the water the space it must have. Now, if the ram is 100 square inches in section, then 1-100th of an inch of its length contains one cubic inch in volume. If the ram lifts through the distance 1-100th of an inch, it will therefore leave one cubic inch of room behind it. We are not concerned with the shapes of the ends of the plunger and ram; we know that if one more inch of the plunger enters the water, 1-100th of an inch of the ram must leave the water; that is, the relative speeds of plunger and ram are as 1in. to 1-100th of an inch, or as 100 to 1. The plunger must move 100 times as quickly as the ram, and by the law of work, if there was no friction, a force of 1lb. on the plunger would balance a force of 100lb. on the ram. We know the mechanical advantage then, if there were no friction, in the portion of this machine from Plunger to ram, if we know how many times greater is the area of the ram than the area of the plunger.

So much, then, for the mechanical advantage if there were no friction. And now, where does friction occur in the hydraulic press? It occurs at 1. The rubbing surface at the fulcrum of the lever. This is the friction of solids. 2. The rubbing surfaces of the two glands: one that of the plunger, the other that of the ram. Here again we have friction, as if between solids. 3. Everywhere in the water where there is motion. This is fluid friction, which is quite different from that of solids.

You know the nature of the friction at the fulcrum of the lever, or any other mechanism required to move this plunger.

Here is a specimen (Fig. 3) of the leather collar used in presses. It is made from the best leather, softened in hot water, and pressed between cast-iron moulds to its present shape, the pressure gradually increasing. It is then left for several days under pressure in the mould. The water gets behind this leather, and presses it tightly against the ram. The friction seems mainly to occur at the part A, and increases as the pressure of the water increases Mr. Hick found that there does seem to be much friction at the portion between A and B, and the efficiency of the press is but little altered by making A B greater or less. It is, however, asserted by some makers of presses that the distance A B is of importance; but I rather think that this is on account of deterioration. The part B A is constantly being in states of tension and compression, and is liable to crack. When the leather deteriorates, much time is wasted in renewing it.

Hemp-packing is invariably used instead of the leather collar at low pressures; some manufacturers never use hemp or cotton when the water has a greater pressure than 700lb. per square inch, but Mr. Tweddell and others use hemp to 2,000lb. per square inch.

In Fig. 8 you will see the form of indiarubber cup used in hydraulic jacks and bears. It is moulded in this form, and is fastened to the end of this ram by means of a screwed bolt and metal washer, as shown in the figure. The water pressure keeps it tight against the cylinder at the point, and this is where the friction occurs. The friction between lubricated leather or hemp, or rubber and metal, follows the laws of solid friction, and we have now described what friction of this kind occurs in hydraulic presses. The remaining source of loss of energy is the fluid friction. In ordinary machines the friction occurs at the rubbing surfaces of solid bodies, and such friction is proportional to the load, and is almost altogether independent of speed. If anything, it is greatest at very slow speeds. Here is an apparatus (Fig. 4) which I designed in Japan to measure the friction between sliders, A, of all these different materials, and this cast-iron wheel, with very different loads on the sliders, and very different speeds of the wheel. You observe that the slider is at rest, and that its force of friction with the rim of the wheel is just balanced by the weight in this scale pan. The result is, that there is no great difference in the friction at different speeds, and that the friction is proportional to the load on the slider. What, then, is the explanation of the well-known curious fact about railway brakes? It is this—in experiments on railway brakes there is no true friction; the material of the brake block is rapidly worn away; thus, in one of Captain Galton's experiments, *several* inches in thickness were removed in a *few* minutes.

What, now, are the laws of fluid friction? One fact is well known to everybody, namely, that water is easily changed in shape. It takes the shape of any containing vessel. A bar of steel, if placed in a vessel, would probably remain a bar for ever; it would not flow over the bottom of the vessel as water does. Now we have every gradation in character between steel and water. Steel can certainly be made to flow. It is drawn out into pianoforte wire. Many of you are aware of M. Tresca's interesting observations on the flow of metals. You have all seen copper wires drawn, and you know that many metals can be beaten or squirted out into other shapes without melting them; but, as a rule, great pressures are needed to perform these operations. But the peculiarity of all substances which we call fluid is this, they will flow and change their shape, even when very small forces act upon them. Thus, you all observe this very rigid-looking bituminous material, which breaks with a glassy *fracture*. Now that material is a fluid. If I leave it piled up on this soup-plate, you will find that after some days it will have covered the bottom of the plate, and that, although it flows very slowly, it does flow, even under the influence of its own weight. Here, again, is a stick of sealing-wax. You see that I can use it like a piece of wood to push or pull other objects with. But if I support its two ends, and leave it to itself, even its own weight is sufficient to cause a gradual bending, which is quite perceptible after a few days. Now, between this rigid-looking black mass and this liquid-looking tar, I can obtain every gradation of fluidity, and all such substances are said to be viscous liquids. A liquid yields perhaps slowly, perhaps rapidly, but it yields to slight stresses tending to make it change its form. Of course, water yields much more rapidly than any of these substances, but there is a certain amount of viscidity, which is quite measurable, and which gives rise to what we usually term friction. If a man attempts to dive into water unskilfully, and falls prone, you know that the water offers a very considerable resistance to a change of shape. Now this resistance is not quite what I am talking about. This is mainly the resistance that any body offers to being rapidly set in motion. If you came colliding against the end of the most frictionless carriage you would also experience its resistance to suddenly being set in motion; whereas the constant steady resistance to motion which the carriage experiences when moving with a uniform velocity is called friction. What I am rather referring to is the resistance to the motion of water in a pipe, the resistance to the steady motion of a ship.

FIG. 7.

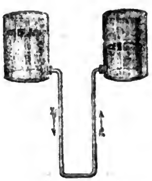

Fig. 5 shows a hollow cylindric body, F, supported so that it cannot move sidewise, and yet so that its only resistance to turning is due to the twist it would give this suspension wire A. C C is water or other liquid filling the space between the cylindric surfaces D D and E E, and wetting both sides of F. When the vessel D D E E is rotated, the water moving past the surfaces of F tends to make F turn round, and this frictional torque is resisted by the twist which is given to the wire. The amount of twist in the wire gives us, then, a measurement of the viscosity of liquids, and investigations may be made under very different conditions.

Fluid friction may be illustrated by similar and equal cylinders of brass, which you set hanging in air, water, and oil. You will observe that, when the suspension wires are twisted and let go, the bodies vibrate like the balance of a watch. But is only the one which vibrates in air that goes on vibrating for a long time; the one in water keeps up its motion longer, however, than the one in oil, showing that there is more frictional resistance in oil than in water, and in water than in air. The rate of diminution of swing tells us the viscous friction of the fluid. Similarly, the rate of diminution of swing of the vibrating fluids in two U tubes, one containing water and the other oil, tells us about the relative coefficients of viscosity of the liquids.

From experiment, it is found that the force of friction in water is proportional to the wetted surface where friction occurs; it is proportional to the speed, if the speed is small, but it increases much more quickly than the speed does. Thus, at the velocities of 1, 2, 3, &c., inches per second, the friction is proportional to the numbers 1, 2, 3, &c., whereas, at the velocities of 1, 2, 3 yards per second, the friction is proportional to the numbers 1, 4, 9, &c. At small velocities such as these cylinders experience, three times the speed means three times the friction; whereas, at great velocities, such as those of ships, three times the speed means nine or more times the friction. You see, then, that friction in fluids is proportional to the speed if the speed is small; to the square of the speed if the speed is greater; and at the greatest speeds the friction increases even more rapidly than the square of the speed. Even in such a fluid as air, the resistance to the motion of a bullet is proportional to the cube of the speed. That is, a bullet of twice the velocity meets with eight times the frictional resistance from the atmosphere.

Again, it has been found that the friction is much the same whatever be the pressure. Thus it is found that when this cylinder apparatus and water are placed in the receiver of an air pump there is exactly the same stilling of the vibrations. Here is an apparatus (Fig. 6) which illustrates the fact. Water tends to pass from vessel A to vessel B by means of this long tube. Whether the tube is in the position Fig. 6 or Fig. 7, we find the same flow through it, the same quantity of water passes through it per second; although, as you see, the pressure of the water in the tube in the position of Fig. 7 is very much greater than in Fig. 6.

Again, fluid friction, for even considerable velocities, does not seem to depend much on the roughness of the solid boundary.

You see now that in a hydraulic press, where the flow of water is everywhere slow, there cannot be much loss on account of fluid friction. Whatever loss there is must occur in the narrow passages, where the velocity is more considerable than in the press. But the grand distinction between it and other mechanisms lies in the fact that when the motion is extremely slow, the fluid friction is extremely small. The friction of the fulcrum of the lever we know about. The friction at the glands is simply due to the fact that metals rub on leather or hemp, and the pressure between the rubbing surfaces being proportional to the load, the quasi-solid friction is also proportional to the load. It is the friction at these two stuffing-boxes or glands which makes up the loss of power in all such machines as I am speaking about. For in all the machines which I am speaking about to-night the water velocity is small, and the water friction can be neglected.

So small indeed is the fluid velocity, that when oil is used, the loss would be much the same. Probably honey or tar would not give very different results; but the more viscous mixtures of tar and pitch would be unsuitable, because in these the fluid friction, at even such small velocities as we have to consider, would be considerable. I want you, however, to recognise the fact that even solid pitch would act as a fluid in the hydraulic press; but to obtain the same mechanical advantage as with water, you would require not to make more than one stroke of the plunger per month, and you would need to take exceptional precautions as to escape of the pitch by the joints.

(To be continued.)

FIREPROOF CEMENT.

A FIREPROOF cement is made from a material found in the Eifel Mountains. It is alleged by eminent professional men to be the only material of the kind which possesses besides its plastic qualities the virtue of being fireproof. Moistened with water, this cement forms an elastic mass, which can be exposed when dry to great heat without shrinking or showing any cracks. The mode of its preparation is as follows:—The cement is to be well mixed in a dry state, a small quantity of water is added and mixed well together. As a mortar, it can be used in the ordinary way. In lining furnaces, however, care must be taken to press the cement well into the walls, so as to leave a smooth, even surface, as when dried by the air the cement easily crumbles, and will not harden till ignited. Moreover, it must not be treated roughly until it has been well burnt. Cracks in furnaces, retorts, &c., should be well cleansed and scraped, and if possible roughed before applying the cement. The parts to be mended should be damped beforehand. An analysis by Dr. Bischof, of Wiesbaden, gives the following results:—The cement is a pale grey, gritty substance, consisting of a good deal of fine dust, with angular and round particles of quartz. When mixed with water it is very sticky, compact, and easily moulded. In 100 parts of the material dried at 120° C. there were—

Clay earth	10·18
Silica, chemically combined	11·03
Silica, mechanically mixed (sand)	73·58
Iron oxide	0·41
Lime	0·23
Magnesia	0·17
Potassium	0·99
Loss by heat	3·46
	100·05

As will be seen, the quantity of fusible matter, such as iron, &c., is very small indeed, if any. Under the fire treatment the cement showed the following results:—After being heated to silver, smelting heat, or about 1,000° C., the cement turned to a grey colour, speckled with a few black spots, the fracture being earthy and porous.

TESTS OF DOUBLE RAW HIDE BELTS.*

HAVING made some tests of new riveted double so-called "raw hide" (semi-tanned and fulled) belts on a 36in. new wooden pulley, with 180° arc of contact and tensions of 25lb. and 50lb. per inch of belt width, I find them as follows. With the grain-side next the pulley (both grain-sides were out, as is usual with tanned leather belts) the grip with 25lb. tension per inch was 200lb., and with 50lb., 460lb. It thus seems that in the case of this 4in. new double-fulled leather belt, on that new 36in. wooden pulley, with 180° arc of contact, doubling the tension more than double the grip, the latter being as 100 to 230.

Comparing the grip of the double belt with that of a single belt of the same material, under the same condition (grain-side to) we find as follows:

Tension per inch	Single.	Double.	Ratio showing influence of thickness.
25lb. ..	300	200	0·66⅔
50lb. ..	400	460	1·15
Ratio showing influence of tension.	1·33	2·30	....

These results are curious, and would indicate, without looking into the matter, that with new riveted double "fulled" belts on 36in. new wooden pulleys, with 180° contact and tensions of 25lb. and 50lb. per inch width—(1) With light tensions a double belt will not grip as well as a single one. (2) With heavy tensions a double belt will drive more than a single one. (3) Both single and double belts drive better with heavy than with light tensions. (4) The influence of tension is more marked with double than with single belts. In reference to "raw hide" belts there are some that get hard after running a while, while others remain pliable and elastic. By "elastic" I do not mean that they stretch so as to necessitate being taken up constantly; for a belt that needs taking up every little while is not elastic. If it were elastic, the local extension in length while in contact with the pulley would be counteracted in each portion as soon as it got round to slack side. I want to be particularly understood as repudiating, as yet, any general formulæ or statements covering the working of belts on pulleys where all the conditions are not stated. Some of my notes may seem to contain needless repetitions; but they are cautionary limitations. If, after making my tests of new single leather belts on new cast-iron pulleys, I had formulated the rule that new leather belts drive best flesh side to the pulley, I should have been badly "out" on the subject of semi-tanned leather belts.

NEW AUTOMATIC ADJUSTABLE EXPOSER.†

IN the days of wet plates, exposures of 5, 10, 15 seconds to a minute, or more, with large stops, were the rule, and could easily be regulated by the seconds-hand of a watch. With the advent of gelatine emulsions, however, conditions were changed; few plates now manufactured are less than ten times, and many twenty or more times, as rapid as wet collodion. These plates, admitting readily of exposures of a fraction of a second, brought quite a new range of subjects within the range of photographers, of which they were eager to avail themselves, and have led to the invention of innumerable appliances for opening and closing lenses rapidly, with the result of an indiscriminate shooting in all directions. Photographers are, however, now beginning to apply the same criterion to pictures of objects in motion as to others, and, consequently, there has arisen a want for a properly adjustable rapid shutter to meet varying conditions. In confirmation of these remarks, I pass round for inspection two photographs—one of the Khedive of Egypt's yacht passing up the Suez Canal at about seven miles per hour, taken with the third stop of a portable symmetrical; the second is a Sea View off Cape Bon, taken from the deck of a steamer going nine knots an hour, at six o'clock in the evening, with same lens, full aperture. Both were taken on Mr. Bennett's ordinary plates. I do not pass them round as good photographs, which they are not, but merely to confirm this statement, and to show that the plates were altogether ahead of my powers of exposure. Again, for ordinary landscape work, even the slowest lenses have now to be stopped down as far as possible to obtain a regulatable exposure, and some of my friends apparently think little of two seconds with the smallest stop of a landscape lens. Now I think I may affirm that, supposing two seconds to be a fair average exposure, unaided humanity, acting directly, is unable of itself to make the minute additions or subtractions from this which varying light and the exigencies of occasion demand, and that we may so account for many of the over and under exposed gelatine plates of which most photographers must have some stock. And, while on this topic, I may say that generally I do not think that photographers take sufficiently into consideration the effect produced by shutters opening from the centre, unless placed between the lenses. Since the advent of photography, one of the chief aims of opticians has been to devise lenses to give as equal illumination as possible; and this will be found in their catalogues advanced as one of the chief points in a good lens, as undoubtedly it is. But by using shutters opening from the centre we throw away this advantage.

Lastly, for purposes of comparison and testing plates, the need of some appliance which will always give correctly the same or any other exposure that may be desired is obvious. Having now glanced at some of the reasons which make it desirable that we should possess an easy means of obtaining, accurately, as short exposures as may be required, I will describe the method I have taken to accomplish this, and which I trust may meet with your favourable criticism and approval. After much consideration of the various means available for the correct regulation of short intervals of time, there ultimately appeared to be two methods only which promised any chance of success—a clockwork train controlled by a balance wheel, and one controlled by a revolving fan. This deduction has since been fully confirmed by others. Now a movement controlled by a balance wheel would be so complicated and expensive to construct as to put it out of the question altogether. There remains, therefore, only the clockwork train governed by a revolving fan. I had this theoretical fact in my mind, but could neither see nor devise a shutter to which it might be applied, and which at the same time seemed to fulfil other necessary conditions, until, at a technical meeting last autumn, Captain Abney stated that the shutter he found most successful was a drop-action with a long drop, and attached to the camera by a short bag, so as to avoid any chance of shake or vibration. He also added, that with this shutter, accelerated by elastic bands, he had been enabled to obtain exposures of 1-80th of a second. I perceived at once the excellence of his suggestion; but before using it as a regulatable shutter there were two objections to surmount—the length and the practical impossibility of arresting it halfway for purposes of regulation without soon straining the apparatus. The first was obviated by dividing it, so to speak, into two portions, and using two shutters, one to rise and one to fall, by which means the length was reduced to nearly half, and the foreground obtained a slightly longer exposure than the sky, while effectiveness was in no way sacrificed. The second objection was also removed by the same means, as the opening and closing slides were separate, and could be made to act quite independently of each other. To anyone desiring a simple, compact, and very radid shutter, correct in principle, but giving one length of exposure only, I can recommend this action. Both slides are held, when set, by catches; and the opening slide, after traversing its course, releases the closing one automatically. This is the form of shutter I prefer, and have adapted to my regulating apparatus, though I now see that several of the forms at present in vogue could be made to work with it.

It will be remembered that the two slides of the shutter are held in their places, when set, by two catches; these catches have each an arm projecting at right angles through the cover of the shutter. Now the problem is to withdraw these catches mechanically at any required interval of time. To do this, I fix a small brass case on the surface of the shutter, and projecting about half an inch; in the centre of this case is a long spring, with stop-work, to prevent its being turned more than once in winding, so as to secure as equal a pull as possible; geared to this spring is a train of two wheels and pinions rotating a small fan (which first made too large is snipped down until the apparatus revolves at the proper rate, or an adjustable fan may be used); on the opposite side of the spring-barrel to the fly there is another cog-wheel of rather less diameter than the spring, the arbor of which projects through the brass case; on this arbor, about ⅜in. above the surface of the case, a brass disc is fixed, which revolves at a steady and uniform rate when the fan is released.

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* By John E. Hilleary. A paper read at a meeting of the Franklin Institute.

† By G. L. Addenbrooke. Abstracted from his paper read before the Photographic Society.

To connect this disc with the catches of the shutter, on the underside of it is fixed a projecting pin, while a movable arm with a spring carries another pin, which can be placed in any one of a series of properly graduated holes round the edge of the disc. When the disc rotates, these two pins come in contact successively with two levers working on central pivots, the other ends of which are directly fastened to the two projecting arms of the catches, holding the shutters, when set, by light metal strips without the intervention of any other mechanism. Whenever, therefore, its pin moves one of these levers the corresponding shutter is released.

As at present made, the longest exposure obtainable is 2½ seconds, and the shortest 1-24th of a second. If, however, it were desired, the disc might easily be made to rotate in a minute, when all the exposures would be multiplied by twenty. Or, on the other hand, it might be made to move round in one-third of a second, when all the exposures would be divided by nine, and the shortest would be the 216th part of a second, provided the shutter could be made to act in so short a time, which there seems no difficulty in accomplishing, though I have not yet actually tried it. The graduation of the disc is, of course, quite arbitrary. I will now describe my own proposal, but shall nevertheless be glad to receive suggestions. I have made the disc to revolve in three seconds, because I think longer exposures can be regulated by the watch or by counting with sufficient accuracy, using the clockwork in this case only to open and close the exposer, by stopping it after the first shutter has risen until it is time to end the exposure by letting the second shutter fall. For a long time I was doubtful whether to graduate the disc decimally or not, but have come to the conclusion that the number twelve being so much more intimately connected with the measurement of time than the number ten, and also as it offered many more convenient fractions, that it was the better. I have therefore graduated as follows:—The first ½ second to 24ths, giving these convenient fractions, besides four others—1-24th, 1-12th, 1-8th, 1-6th, 1-5th, 1-4th, 1-3rd, and ½ of a second. The second ½ second to 12ths, giving amongst others the following—2-3rds, 3-4ths, 5-6ths, and 1 second. The third ½ second to 6ths. The fourth ½ second to 6ths. The fifth ½ second to 4ths. That is to say, twenty-seven progressive exposures within 2½ seconds.

The first drawing gives a front view of the exposer, with the outer covering taken off, to show the action of the catches.

The second figure explains the graduation of the dial.

FIG. 1.

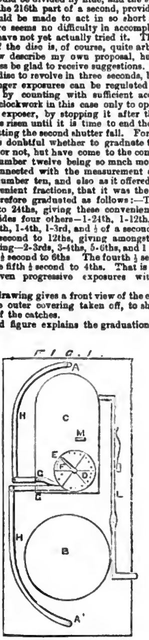
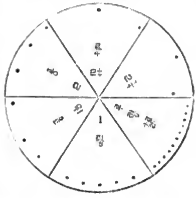


Figure 1.—A' A, arms of the two catches holding the sliding shutters when set; B, aperture; C. clockwork case; D, rotatory disc, with fixed projecting pin at E and movable arm, now placed at F; G G', two levers coming in contact with projecting pins on revolving disc: H H, metal strips connecting levers with catches; L, lever and spring which releases the clockwork when set; M, nut for winding spring.

The dimensions are—Length, 8¼in.; breadth, 4in.; thickness, ¾in., the clockwork projecting another ¼in.; aperture, 2¼in.

In order to show at a glance the fraction each graduation represents without unnecessary engraving, I divide the disc by radii into ½-second intervals. In the angle formed by the first two of these is placed the fraction 12-24th, 1-24th being the interval between the graduations, and twelve being the number of them in the ½-second space. This fraction is repeated below as 6-12ths, the denominator representing the space between the graduations in the second ½ second, and the numerator representing the value of the first ½ second in terms of the second ½ second, so as to continue the fraction on, and so on round the disc. Though this may seem a little complicated at first, yet I think a few minutes' study of its principle will enable anyone to place the movable arm in the graduation required at a glance. Messrs. Watson and Sons, High Holborn, are making the shutter for sale, and will no doubt show it to anyone interested.

FIG. 2.



SCIENTIFIC NEWS.

THE number of known small planets has been increased by Dr. J. Palisa to 229, making 36 of those bodies discovered by him. The last two were discovered by Dr. Palisa on August 19 and 22; they are equal to about 12½ mag. stars in brightness.

The Arctic meteorological observing party in Finland reached their station at Sodankyla in good time, and commenced their labours on August 15.

The new telescope for the Halsted Observatory, Princeton, New Jersey, is nearly ready for work. For the present it ranks as the second large telescope in the United States, the object-glass having an aperture of 23in. The lenses of the o.g. are nearly 7in. apart—an arrangement which has been adopted to allow of the free circulation of air, and thus obtain rapid equalisation of temperature, while preventing "ghosts"—i.e., reflections between the lenses. The telescope, which was constructed by Alvan Clark and Sons, is supplemented by a fine spectroscope similar to that at Greenwich, made by Hilger, so that Prof. Young is now fairly equipped with instruments suitable for his researches.

The intersessional field-day of the Liverpool Astronomical Society took place on Saturday last, when after a pleasant ramble around the sandhills of West Kirby and the neighbourhood of Thurston, where is an ancient monolith from which the village is supposed to be named, the members were hospitably entertained at the house of the Rev. T. E. Espin. Messrs. R. C. Johnson and Espin were nominated president and vice-president respectively. The executive of the Society has been strengthened by the co-operation of other Fellows of the R.A.S., several of whom have promised papers for the coming session, which opens on Monday, Oct. 9.

Considerable progress has been made with the collation of the vast amount of information collected by the Commissioners on Technical Instruction. Prof. Roscoe and Mr. Swire Smith are occupied in reporting on the industries and schools in the neighbourhood of Kendal and Barrow. Mr. Woodall, M.P., and Mr. Redgrave are travelling in the Black Forest, while Mr. Samuelson, M.P., and Mr. P. Magnus have been instituting inquiries as to the possibility of improving the material condition of the labouring classes in Ireland by the establishment of trade schools, and the introduction of new means of livelihood in the agricultural districts.

It is proposed to establish a first-class technical school in connection with University College, Nottingham. The Drapers' Company have offered £300 per annum for five years, with an additional £200 in the first year to purchase apparatus. The grant is dependent, to a certain extent, on the amount of local enterprise. A course of instruction in practical mechanics is to be given by a professor of physics and mechanics in the evenings, and practical instruction will be given in the construction of machinery and tools used in hosiery and lace manufacture.

Improvements in electric block signals have been patented by J. Radcliffe, of Retford. A tongue projects from the clip-lock of the lever, which is locked by a vertical bolt suspended over the tongue. A link attached to the armature of an electro-magnet is connected with the bolt. A current passes through the electro-magnet only when the block signal instrument at the box in advance stands at "line clear," and the signals and points are interlocked in the usual manner.

The admission of new pupils to the course of medical training for women at the Nicholas Military Hospital is to be discontinued after the present term, by order of the Emperor.

At the Vendeville, Boulevard Montmartre, an 11 horse-power gas-engine, with the assistance of Faure accumulators, is found capable of working 250 Swan lights and keeping them illuminated every night for six or seven hours.

At the Comptoir d'Escompte, Paris, a system of electric lighting by means of the lamps of Swan and the electric arc lights of Siemens and Gravier excited by a modification of the bichromate of soda battery, has been exhibited by MM. Jarriant and Grenet. Each battery employed consisted of 48 elements, in two sets of 24 each. The E.M.F. was 82 volts, and the intensity of current was 24 ampères. The constructors estimate that each battery in full working order is equivalent to a horse-power and a half of electric energy. M. Corroyer, the engineer, proposed the installation of this voltaic battery, as a steam-engine and its accessories is considered dangerous in a building full of valuable papers.

M. Serra-Carpi has described, in a paper to the Academy of Sciences of Paris, a new application of the microphone to determine the position of nodes in columns of vibrating air. The microphone is mounted on an elastic membrane stretched over a little drum, and then lowered into the sounding pipe. When the apparatus came to a node, the telephone in circuit with the microphone gave out a rumbling sound, similar to that caused by an induced current. On the other hand, when the microphone passed a belly, the sounds became very faint and rare, while at intermediate points they increased or diminished, according as the microphonic sounder was brought nearer to a node or a belly. It is believed that the microphone may thus be made useful as a detector of fire-damp in mines.

The use of high steam-pressures is increasing in the mercantile marine. The *Albertine*, a steamer recently fitted with engines by Messrs. Douglas and Grant, Kirkcaldy, has boilers which have been tested to a pressure of 300lb. per square inch, and which are intended to work at 150lb.

We have received *La Navigation Electrique*, by Georges Dary (Paris: J. Baudry), a pamphlet of about 65 pages, giving an account of the inventions of M. G. Trouvé, in connection with air and water navigation by electrical aids. It is freely illustrated, and is a popular and accurate description.

ANHYDRO-SULPHAMIN-BENZOIC acid, the recent addition to the list of chemical products, is described as a white crystalline substance, very soluble in alcohol, but sparingly soluble in water, and characterised by a sweetness so great that the merest trace of the alcoholic solution in water gives it a distinctly sweet taste. Its discoverer, Dr. Constantine Falberg, estimates that it has from twenty to thirty times the sweetness of cane sugar. Should it prove wholesome and producible in quantity with comparative cheapness, it may play an important part in the future social and industrial history of the world.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

ASTRONOMICAL.

[20490.]—During the late season, I have frequently observed η Coronæ, and compared it with μ² Bootis. Invariably I have found the last by far the easier object. If others have made the same comparisons, I shall be glad to hear of their results. With no power up to 1000 upon my 8½in. mirror have I been able to really split this now very difficult object; but invariably, when the air was fine, I have brought the two discs in contact. I had some hope to split it really when it passed at the meridian before dark; but during that time the air was not good enough. μ² Bootis has generally been divided with power 300 ±, and before dark, on July, 16, 1882, with power 150 and 260. With the last power, the division was easy. λ Ophiuchi divided with 3½in. side aperture, position 30° ±. O.Σ. 298. On focussing nicely on the distant companion, and then looking at A B, it was seen as a minute square, on July 4, 1882, power 400 to 900 ±. According to Perry, the distance is 0·31", Aug. 19, 1882, ζ Herculis, with power 900 ±. The small reddish companion was seen standing out beyond the ring, and the space between the stars was more than a full diameter of the large star. On July 4, 1882, this star was split with 3½in. side aperture. The following are a few double stars I have observed, and which I cannot identify either in Webb's or Gledhill's lists. The positions are roughly given:—

18h. 31m. + 27° 36', a suspected double at D, position 110°, mag. 8 and 5.

18h. 24m. + 24° 54' — 7·5 — 9 — 360° — 1·5". Is this Σ. 2320? Yellow, blue.

18h. 46m. + 21° 18' — 8 — 10 — 20° — 4", both yellow. Is this Σ. 2401? In this case, the companion has moved, and must be variable, as the difference in magnitude is greater than stated by Webb.

β Delphini, thought to be slightly elongated in direction 10° — 230°.

19h. 2m. + 32° 54' — 8 — 9 — 315° — 1".

19h. 15m. + 32° 54' — Triple 9 — 9 — 9·5. A B 340° — A C 350° — A B 1·3 — A C 6".

Positions and measures by estimation.

C. Gaudibert.

THE BLACK-DROP AND THE TRANSIT OF VENUS.

[20491.]—I would again ask you, now that the Transit is so near, and so much interest is felt in it and its results, to allow me a line on the subject of one at least of its difficulties—I refer to the difficulty of the *black-drop*, as it is termed. I have seen no hint even of a true solution of it away from the one I ventured to give in the English Mechanic of last year. It is due, as I take it, solely to the *size* or linear dimensions of the *eye-pupil*, as admitting of the crossing rays of light from the two objects looked at: the edges of either one *lapping over* (to the eye) the other. Thus both are seen together, and thus the "drop." But this confusion of outlines disappears if but the *eye-pupil* be practically *reduced in size* to a needle-point hole. A thin metal plate thus pierced does this; and by observing, with due care and precaution, the coming together of the sun and planet *through this reduced eye-pupil*, the "drop" difficulty disappears. I venture to trouble you with this in the hope that one or more of the many observers of the coming Transit will try it. It cannot, as I think, fail. It is a rare chance for the younger observers. **C. Bruce Allen.**

Sept. 11.

FOCAL IMAGES—CASSEGRAIN TELESCOPE—EYEPIECES.

[20492.]—Having previously said that I do not consider myself competent to give an opinion on two of the questions put by "Lens," I have, in this, my final notice of the matter, nothing further to add relating to them.

With regard to the other portion of your correspondent's letter, he will find that the rules given in letter 20022, are quite sufficient for practical purposes. I have no inclination to take up space with a useless explanation of what form the rule takes, when the point of convergence is a little behind the large mirror. A very slight variation in the position of the small mirror has very great influence on the convergence of the rays proceeding from it. If the two mirrors are placed at the difference (or for a Gregorian, at the sum) of the focal lengths apart, their exact separation for a particular position of the eyepiece, can readily be found experimentally. For the Cassegrain, if y be the distance of the focal point behind the large mirror, and x the distance apart of the mirrors, we have:—$x = (F - f) + f^2 / (F + y.)$. Now, as y is very small compared with F, this second term varies very little from f^2 / F given in my previous letter. In the Cassegrain form, increasing the separation lessens the convergence of the rays, but in the Gregorian construction the contrary effect is produced.

Your correspondent, "A. S. L." (letter 20411), is obviously quite correct in what he says respecting the unsuitableness of ordinary eyepieces for reflectors. There can be no doubt that achromatised eyepieces are the best for all instruments, and especially so for the reflector. The counter-correction, by means of positive and negative errors in o.g. and e.p., is not, I fancy, in favour with the best opticians; for, under this system, the same o.g. will perform very differently with different eyepieces of the same construction. Dr. Draper found the advantage of having an achromatised combination for use with the reflector. It was made on "Littrow's formula," but what this is I have never been able to learn. Littrow gave an article in one of the early volumes of the R.A.S. *Memoirs*, but I am told this does not relate to crown and flint combinations. I wish some of our American friends would prevail upon the Doctor to give us an account of this special eyepiece formula.

Achromatised combinations are made by various opticians; but I fancy they are mostly of the positive or Ramsden form. Steinheil has devised a peculiar construction, which is a development of the Coddington sphere. I am glad that "F.R.A.S." has supplied the diagrams, which I had not seen. Looking at the arrangement of curves, I am tempted to ask:—Can *aplanatism*, as well as *achromatism*, be obtained in this form, retaining the central primitive sphere?

I must refer "R. E. C." (query 47860), to some of our practical correspondents for a description of "the best and newest method of mounting the diagonal" of a Newtonian reflector.

Orderic Vital.

FOCAL IMAGES, &c.—To "F.R.A.S."

[20493.]—I am much obliged to "F.R.A.S." for his notice of this subject, but I am sorry to find my queries have been quite misunderstood, apparently because I used the word "light-spot," instead of focal image.

I am well acquainted with, and often use, the method of testing the powers of telescopes mentioned by "F.R.A.S.," and quite understand the theory of the process, but my queries have nothing to do with this.

Let me put it in another way. If I take an object-glass of focus F, I get an image of the sun of a diameter D. If I take an eye-lens (or eyepiece) of focus f, I get an image of diameter d. If I combine the two as a telescope, I get an image of diameter x. Then, supposing F and f are known, how can I determine D, d, and x?

As regards the two object-glasses of different foci, my query was intended to go a bit deeper than "F.R.A.S." takes it. The reduction of brightness as area is increased is of course evident; but this leaves out another consideration, viz., the length of the ray paths before the image is formed; thus, in the lens of 100in. focus the rays must travel twice as far as in the lens of 50in. focus; but in the case of rays from, say, a candle the intensity of the illumination varies inversely as the square of the distance between the candle and the object it illuminates.

It has been stated that object-glasses of unduly long focus are wanting in brilliancy, and that with the same magnification a short-focus telescope gives the brightest image, notwithstanding the thicker glass in the lenses of the o. g. and eyepiece.

If this be true, the photometer ought, I thought, to show and measure the difference *due to this cause* also. **Lens.**

CASSEGRAIN AND GREGORIAN TELESCOPES—TO "ORDERIC VITAL," "W. G. P.," AND OTHERS.

[20494.]—Every now and again the subject of these forms of reflectors crops up in our columns; but, whether from the difficulty of the optical questions involved or otherwise, no definite results seem to follow.

As they are again to the fore, may I appeal to the two correspondents above named to deal with the matter as they have dealt with the theory and construction of the object-glass, and bring their great skill in handling the mathematics of the telescope to the solution of the problems involved.

Let me make a beginning by quoting (from memory) a remark of Tulley's, that he wished mathematicians, instead of concerning themselves with imaginary parabolas and hyperbolas, would work out a pair of curves for the two mirrors which should give the least possible aberration.

This has never yet been done. The best results seem always to have been obtained in a kind of haphazard way by trying a lot of pairs in succession, and selecting those that were found to give the best results.

I shall be, doubtless, told that the "proper" curves for, say, the Cassegrain, are a parabola for the large mirror, and a hyperbola for the small one; but in practice the small mirror is spherical—so here comes in variation No. 1. Then, I believe, I am correct in saying that these two curves are only true for certain of the rays, and not for others, and that there is a limit in this respect even when considered theoretically.

I fancy I have seen it stated that the large mirror of the Melbourne Cassegrain is rather elliptical than parabolic; but I have seen nothing stated as to the curve of the small mirror. Will Mr. Calver kindly tell us this? Then comes the question of practical construction—viz., which mirror is the one to undergo the final corrections? Is the small mirror adjusted to the large one, or vice versâ? Also, how is the combination tested before being actually mounted? Next comes the question as to the best ratio of the foci of the two mirrors, in which a wide difference exists in instruments by different makers, so also as regards the due proportion of magnification between the mirrors and the eyepieces, which resolves itself into settling whether the small mirror should be of a deep curve, or the lenses of the eyepiece? Connected with this is the best diameter for small mirror, since its size depends on its focus, and distance from large mirror, it being of course assumed to receive *all* the rays from the *full* diameter of the large mirror.

Lastly, there is the hitherto unsolved problem of which the fig. and description on page 217 (May 12, 1882), is the non-practical form, and which requires to be modified so as to bring the conjugate focus of small mirror *to where it would be wanted*—viz., at some given distance behind the large mirror.

I have throughout referred to the Cassegrain as being the more perfect form (in theory at all events); but a similar investigation of the Gregorian would be also of interest.

Short, with his Gregorians, saw the divisions in Saturn's ring, so don't let us turn up our noses at this construction, because we can make better Newtonians than he could—*perhaps.*

L. L. L.

FLATS FOR REFLECTORS.

[20495.]—I think "Prismatique" (p. 16) could have thrown more light than he has on the question of perceptible effect on definition of the flat being slightly round or hollow. I think he knows enough of the matter to have settled it. I should regard the colour test as all that could be desired if one only had a reliable perfect plane surface to test upon. I am sure that a plane sufficiently good to stand a power of 300 pretty well will not stand the colour test at all well. But what I have principally learnt by trying pieces of plate glass is, the surface is so uneven. It is not that it is round or hollow. The defect is, it is of no regular curve or surface at all. There is not one piece in fifty which even approaches regularity; and whether or not there be few people who can grind a better flat than they can select out of plate glass, I am quite sure that any such selected flat would spoil the performance of the best mirror ever ground. Of course this is exactly what "Prismatique" corroborates me in. Allow me to ask him, if the so-called flat was a convex of, say, 10ft. radius, what would be the result on the definition?

Edwin Holmes.

NEWTONIAN FLAT.

[20496.]—I should think that if the plane mirror of a reflector had either an almost imperceptible convexity or concavity, the disturbance in the direction of the converging rays would not be noticeable; but this would only apply to a surface of perfectly regular curvature. The case would be far different with one of irregular or wavy outline, and this, I imagine, is most likely to occur in a piece taken at random from a sheet of plate-glass. I have no doubt our good friend "Prismatique" will say that it is a most difficult matter to work a surface perfectly regular, whether it be plane or curved.

I must thank "Prismatique" for answering my request about crown glass achromatism. His practice and my theory seem to agree that it is impossible to correct a deep convex lens by a shallow concave one.

How would the combination act if both lenses were of the same *description* of glass, but one much denser than the other? That is, if the o. g. were of light flint, say about specific gravity 320, and the concave corrector about 365 or higher, would the effect of irrationality be as marked as in a crown and flint combination?

Sept. 9th. **Orderic Vital.**

SATURN'S SATELLITES.

[20497.]—I THINK that if some kind correspondent would furnish us with a little diagram of the apparent paths of Saturn's satellites, with the positions in hours after eastern elongation marked thereon, with a little list of the times of the said elongations for the month, it would be a great boon to many subscribers, and would certainly take less space than Herr Marth's long tables, which take much time to reduce to position.

D. Smart.

TELESCOPICAL.

[20498.]—LAST year I had the privilege of seeing Jupiter through an achromatic, about 7ft. long and 5in. aperture, made by a leading maker. Subsequently looking through my own constructed telescope of 12ft. length and only 2in. aperture (o.g. by Wray), I thought I saw it more free from colour, and in fact better defined than in the former more expensive glass. Is this a delusion on my part, or which would or should show Jupiter best—viz., a 7ft. and 5in. aperture; or a 12ft. and 2in. aperture, both the o.g.'s and eyepieces being of good workmanship? Secondly: If we desire what Sir W. Herschel calls "unpardonable indulgence," otherwise "convenience, comfort," etc., I should like to know the objection to a 12ft. focus and 2in. aperture achromatic, especially for planetary and lunar observation. I exclude, of course, small double-stars and nebulæ, for which 2in. aperture is wholly insufficient in illuminating or penetrating power. **Padlock.**

AN ARTIFICIAL MOON.

[20499.]—YOUR note on p. 592 of last volume brings to my mind a paragraph, for which, however, I have hunted in vain. The process indicated in this paragraph was, as far as I recollect, to cover the bottom of a soup-plate with some effervescent salt—such as citrate of magnesia, for instance—and pour upon it plaster of Paris in a thick state. The bubbles produce the effect of lunar craters on the surface of the plaster; and it was stated that photographs of a surface prepared in this way presented similar effects of light and shade, &c., to those of the moon. **Glatton.**

CROWN-GLASS ACHROMATISM.

[20500.]—I SHALL be, at all times, glad to attend to the criticisms of such a correspondent as "Orderic Vital." I think I now begin to see where his difficulty arises. It seems to be thus: In the usual equation of condition for achromatism—viz., $d = \frac{1}{2}(f_1 + f_2)$, or in the other, which I proposed, if f_2 were negative, and greater than f_1, it would seem to give a negative value to d, and to imply that the concave glass must lie to the left of the convex, rays being supposed to travel from left to right, so that the concave must be, in reality, the first lens which the rays fall upon.

When I first undertook the problem some years ago, precisely the same difficulty occurred to myself, and seemed at first to be so great a one, that I abandoned the inquiry for a time; but, on looking at the matter again, I found that it implied that, for parallel rays entering at one end of a system of lenses, there would be achromatism, but not for those entering at the other; that is, that the condition of achromatism would depend upon the *order* in which the lenses are placed. Dr. Parkinson, however, "Optics," Art. 184, says:—"The conditions of achromatism depend only upon the *focal lengths* of the component lenses—not at all upon their *forms*, or the *order* in which they are placed," and, therefore, the conditions being independent of the forms of the lenses, are independent of whether one or both are concave.

We must, therefore, look out for another interpretation. Now when one or both of the quantities $f_1 f_2$ are negative, or if f_2 be negative and greater than f_1, it is manifest that the right side of the equation is negative; but all that this really shows is that d and $f_1 + f_2$ are measured in *opposite directions*.

Now, quantities being supposed to be positive when they are measured in the direction of the incident rays, f_2 will be measured in the *opposite* direction of the rays, because the focus of the concave lens is a *virtual* one; so, also, will the whole quantity $f_1 + f_2$ when f_2 is greater than f_1; but we have also seen that d is measured in the opposite direction to $f_1 + f_2$, therefore it is measured in the *same* direction as the rays; that is, the rays proceed from f_1 to f_2, and not *vice versâ*.

The same consideration applies to the other formula. I hope that the considerations which caused me to change my own opinion will suffice for the same purpose with "Orderic Vital" also.

One word more may be added. If the *first* lens were the concave one, and greater than the other, d and $f_1 + f_2$ would still be measured in opposite directions, and $f_1 + f_2$ is also still measured in the opposite directions of the rays; whence also d is measured in the direction of the rays; hence the condition of achromatism is satisfied, whichever of the lenses is in front, so that the case in question is no exception to what was said by Dr. Parkinson.

I may say to "O. V." that it was quite superfluous on his part to assure me that he did not speak from a spirit of contention. I believe him to be altogether a person who is incapable of anything of the kind. **W. G. P.**

CHEMISTRY FOR ENGINEERS.

[20501.]—I SEE Mr. Allen (p. 14), by way of helping me and others out of a real difficulty, shirks the task of supplying the needed information, and tries to laugh it off. Perhaps some other chemist will be more obliging.

No doubt, as Mr. Allen suggests, a stray note on analysis of one material may be found in one place, and books may be obtained which will (if the student likes to waste time in learning to analyse all sorts of things which he will never require to examine in his ordinary business), gradually lead him up to analysis of things *in general*. Now this is all very well, but few engineers could spare the time to go through a complete chemical education.

On the other hand, the substances which an engineer *does* require to analyse are so few that *specific*, instead of *general*, methods might surely be given for these substances. (See letter 20452, p. 597.) Would the blowpipe answer the required purpose?

Glatton.

[20502.]—NOTHING short of a complete analysis would answer the requirements of "Glatton" (letter 20452) in the case referred to. It is, therefore, of course, indispensable to provide a well-appointed laboratory, and to possess a thorough knowledge of chemistry, before undertaking, with any pretence to accuracy, such analyses as "Glatton" and his friends desire. For such a series of articles (as your correspondent suggests) to be of any value the above premises are essentialities; if such exist, I shall be happy to contribute my share towards such articles. **A. E. Robinson.**

NOTES ON DYNAMO MACHINES.—VIII.

[20503.]—60. CONSIDERED from a mechanical point of view the dynamo ought to be of exceptionally good workmanship. After all, the dynamo is a machine, and too much attention cannot be given to the details of its construction. Of the total work absorbed in turning the armature, only a part is converted into electrical energy; and the object of electrical engineers is to make this part as large as possible. The work disappearing in waste is partly due to mechanical friction of the bearings and commutator brushes, partly due to the heating of the iron in the armature, and partly due to the formation of extra currents. The reduction of the frictional waste is of course a mechanical problem, and the first step towards its realisation would be a slowly moving armature of large diameter. Hitherto, the chief object of those engaged in the manufacture of dynamo machines has been to obtain powerful effects from small machines, and it is needless to say that the friction in driving an armature, say, at 1,600 revolutions per minute, with a belt sufficiently stretched to prevent slip, must be excessive and constitute a considerable proportion of the total power absorbed in working the machine. I am not aware that there is any objection to winding the coils on an armature of large diameter, running at a slow speed. The circumferential velocity must of course be great, so that the coils can cut the magnetic field with sufficient rapidity—the field being formed by a number of magnets placed round the circumference of the armature, on each side of the coils. This means a comparatively large machine; but one, I believe, in which the electrical energy derived is large compared with the work absorbed in driving it. As our knowledge gets more extended, the dynamo will alter its shape accordingly, and instead of armatures revolving at 800 to 1,600 revolutions per minute, we shall have the armature probably forming the flywheel of a slowly-working engine. Excessive friction, heating of bearings, rapid wearing-out, and difficulty of lubrication are the usual concomitants of high speeds, which on this account are always to be avoided where possible. In addition to this, a somewhat serious difficulty is introduced by frequent slipping of belts. Perhaps the best way to cure this fault is to keep the belts soft and pliable by the application of dubbin.

60 (*a*). To render the dynamo steadier in its action, and to get rid of the difficulty of the belts slipping, some engineers have keyed on its spindle a heavy flywheel. The writer has proposed to drive the dynamo by two belts, the two pulleys being keyed one on each end of the spindle. This does away with the slip, or rather counteracts it; it also affords the additional security of creating no delay should a belt break. The rattle of the spindle caused by the wearing of the bearings would be prevented, since the spindle is kept hard up to the bearing on each end. Every effort should be made to render the slip as little as possible. The belts should always be wide, and the pulleys highly polished. Rubber belting is said to give less trouble from slipping than leather.

61. The framework of the dynamo ought to be strong and rigid, and all connections of parts made by turned bolts, tapped into rosebitted holes, which they accurately fit. The spindle should be of steel, so that it can be made of small diameter at the bearings. The bearings should be long, and of some anti-friction metal, such as Babbitt's or Kingston's; some makers prefer phosphor-bronze: and above all things it is necessary that the oil be fed into the bearings with precision, as a heated bearing and consequent stoppage is a very serious matter. It will be observed that in many machines of the Bürgin, Gramme, and Siemens type there is no provision made for taking up the wear of the brasses. The bearings are simply bushes driven into the frame. This is a structural fault. The brasses ought to be fitted into plummer blocks, so that they can be set up whenever the wear begins to show itself. Apart from all other considerations, the facility with which the bearings can be adjusted in the Brush and Edison machines is a point much in their favour. Moreover, in the Brush machine, as in some others, the sinking of the shaft through wearing down of the bearings can do no damage to the machine, as the magnets are placed at the sides of the ring armature; whereas, in the Siemens, Bürgin, or Gramme machines the wearing of the bearings may cause the bobbins to rub against the pole-pieces. This point is worthy of note. Machines ought to be constructed, whenever practicable, so that they can be driven from either end.

62. If the armature is of the "drum" form, that is a ring having its greatest dimension parallel to the shaft (Siemens, Gramme), the outside of the armature ought to be bound round in two or three places with thin brass wire, underlaid by thick varnished tape. The wire, when bound on, forms a ribbon about an inch wide, and it ought to be soldered here and there in its circumference to bind it all firmly together. This binding is for the purpose of counteracting the centrifugal force; in a ring armature, where the greatest dimension lies perpendicularly to the shaft, this precaution is unnecessary.

63. The commutator strips ought to be made of phosphor-bronze, and the commutator ought to be easily removable. The connection of the wires to the commutator ought *never* to be made by soldering, but always by clinching screws. The soldering in the Gramme machine has frequently given way through overheating, and disastrous failures have thereby resulted. Where soldering is inevitable, resin only should be used, and not spirits.

64. The copper wire for the rotating coils and field magnets must always be double-covered with cotton. Before winding the wire on the iron armature, the latter should be covered with varnished tape, the varnish consisting of shellac dissolved in spirits. The cores of the field magnets ought to be covered with thin sheet-rubber, varnished paper, or varnished calico; the cheeks of the magnets with well-varnished cardboard, vulcanised fibre, vulcanite, or other suitable material. In winding the coils one layer ought to be insulated from the other by sheets of calico, varnished paper, paraffin paper, or thin rubber. If the coils are painted, never start the dynamo until the paint is thoroughly dry.

65. The brush holders ought to be fixed in a position easy of access, and constructed so that the brushes can be quickly renewed and moved into any circumferential position on the commutator while the machine is at work. **E.**

VOSS'S ELECTRICAL MACHINE.

[20504.]—THE letter of your correspondent, "H. B. T. S." (No. 20613), in last week's "E. M." would lead your readers to suppose that the simple device I recommended the week before for increasing the length and frequency of the spark from these machines was of but small moment—merely adding ½in. to a 3in. spark. Now, if it would do no more than this, I should be ashamed of the authorship of such a worthless communication; but I maintain that it will do far more, in many instances often doubling the length of the spark. My machine, which, under the most favourable circumstances, gives a 3in. spark, will give one of 5½in. when I apply the thread. The maximum striking distance of any of these machines is limited to the distance between the inner ends of the horizontal combs, and 5½in. is the distance between mine. Let those of your readers who have these machines just try this simple device—it will not take more than a few minutes:—

Set the machine in action; draw the conductors apart to the utmost striking distance; take a piece of worsted-thread 8in. to 10in. long, hold it by one end, with the left-hand over the conductors, so that the other end may hang down between the knobs; now turn the machine with the right-hand, and they will be, or may be, surprised at the result, for the sparks will immediately increase in frequency and may be lengthened considerably by withdrawing the knobs. These machines, in ordinary weather do not give more than half, or even a quarter, of their maximum spark, all depending on the humid state of the atmosphere. It is at such times as these that the thread exerts its most surprising influence, often doubling the length and greatly increasing the frequency of the sparks.

If these machines are warmed they will work in any weather; but I have never found mine to work when "*bedewed with moisture*," as they have been said to do. To those of your readers who take an interest in this matter and are not acquainted with these machines, I refer them to Vol. XXXIII., page 335, of the English Mechanic, where they will find a full description and illustration.

John C. Frank.

INDUCTION COIL.

[20505.]—The scientific perspicuity, of the very interesting experiments of "Ernest" on condensers of varying capacity (letter 20457) shames us who have been in the habit of reckoning by so many sheets of tinfoil, of such a size. Our only excuse must be that a standard condenser is not often found in the amateur laboratory. Since describing my coil, I have become convinced that the proper position, for not only the secondary, but also the primary, is about the middle of the core. A set of extremely interesting experiments, on the inductive effect of the primary and core, have been made by a good friend of mine, whose acquaintance I was fortunate enough to make through the medium of these columns; I have repeatedly urged him to publish his results. Perhaps a query from "Ernest" addressed to "Ohm" would be more effectual. Some experiments of my own, as well as the older work of others, show that much greater magnetic strength is obtained from a current flowing round the core near its centre than when at either end—consequently it is found that simply lengthening the core increases the length of spark, though not to the extent that might be expected from the experiments referred to above—possibly owing to the mutual induction of the turns of the secondary on one another.

I should recommend "Ernest" to try a core 16in. or 18in long—it would be very interesting to hear of his result. With the platinum break and three Grove cells my coil would not give more than 1½in. spark, although with the kind help of "Sigma," "Sunlight," and others, I made several determined attempts at it. The mercury break gave 6in. spark with the same cells.

Belfast, Sep. 8th. **J. Brown.**

NEW FORM OF BICHROMATE BATTERY.

[20506.]—An ordinary bichromate battery—viz., a plate of zinc 4 × 3, a plate of carbon same size, charged with the following solution, worked without stopping a small Rhumkorff coil for two hours and a half:—

Bichromate solution	3 parts
Hydrochloric acid	2 „
Saturated solution chloride zinc	1 part.

After that time, by gently moving the cell for a few seconds and stirring the solution with a glass rod, I got it to work half an hour more.

Sema.

SMALL DYNAMOS.

[20507.]—As Mr. Chaster (p. 14), has given some interesting particulars about the above-named little contrivances, I should like to add a few particulars respecting the one described by Mr. W. H. Preece, at the British Association.

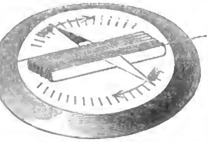
This little dynamo is 15in. by 15in., by 10in. high, and is constructed in the following manner; the four field magnets are fixed on a cast-iron cylinder, the inside of which is bored out to receive the armature, which is built on the De Meritens principle, consisting of a number of coils like the Gramme ring, but the coils are insulated with strips of cork. This machine, when running at 3,000 revolutions per minute, gives a current of 10 ampères, and an E.M.F. of 55 volts through a resistance of 6·15 ohms; at this speed, it will work a 600-candle arc light, or seven 20-candle Swan lamps. The internal resistance is 2·66 ohm—viz., 1·33 ohm for field magnets, and 1·33 ohm in armature. This little contrivance takes about ¾-h.p. to drive it, and weighs 54lb. In his machine I see M. de Meritens adopts self-lubricating plummer blocks or bearings, so that one supply of oil will last four or five days.

When worked by hand, this machine gives a current equal to 35 large Bunsens, each having an E.M.F. of 1·90 volt, with a resistance of 0·06 ohm. I have seen this machine working seven Swan lamps, and doubt if any machine would give a steadier current.

James Thame.

AN IMPROVED GALVANOMETER.

[20508.]—Let one end of needle (say the north) be marked with a little gilding. On the dial below, mark two arrow points as shown.



N.B.—The arrow points will be reversed if wire is wound in opposite direction. Now when a current passes through wire, its nominal direction is indicated by the arrow towards which the gilt point inclines.

Glatton.

PROBLEM IN DYNAMICS.

[20509.]—I beg to give a simple explanation as to how the weight E, in the apparatus illustrated in letter 20470, will descend. The strain on the cord which hangs the weights C and H will only be the weight of the lightest weight when they are made unequal, so the pull on point D will be twice said strain only. As an illustration, suppose two men of unequal weight stand on the ground and pull ends of rope, so soon as strain on rope equals weight of lightest man, up he goes, and although the other continues to pull, it is evident the rope will not be further strained.

Scotch Working Mechanic.

[20510.]—I think "A. S. L." (20470) must have forgotten the actual results of his experiments when "paradoxes and perpetual motions perplexed" him. If he subtracts from his weight H, and adds to his weight G, the results will be as he says; but if he decreased G, and added to H, the results would be exactly opposite—that is to say, the D end of the beam would descend instead of the C end. Since the axis of the pulley D is equidistant from fulcrum B, with the point C of the lever, it follows that the weights G and H being equal, their aggregate ponderance is suspended from the axis D, and hence the equilibrium of the bar A A. But if you "took" from the weight G, and added to H, you would increase the leverage of the D end of the beam, and that end would descend, contrary to "A. S. L.'s" assertion.

G. B. T.

EXAMINATION OF MALT.

[20511.]—Your valued correspondent, Mr. Allen, in his letter 20480, p. 14, calls attention to my reply to query 47651 on the above subject. Whilst acknowledging the kindly spirit in which he has criticised my reply, I must, in justice to myself, say that at the time I wrote the reply I was aware of the researches of Mr. O. Sullivan and others into the transformation products of starch when acted on by malt extract, which have appeared in the *Journal* of the Chemical Society; and there is no doubt that a body having the constitution $C_{12}H_{22}O_{11}$, to which the name of maltose has been given, has been isolated, and found to have a cupric-oxide reducing power of about that given by Mr. Allen; although even here it may be noted that the results of Brown and Heron, O. Sullivan, and the German chemists, Musculus and Gruber, all differ within not inconsiderable limits.

But it does *not* seem to me to be "conclusively proved" that the sugar constituent of ordinary malt wort (call it by what name you will) has *this* cupric-oxide reducing power. I believe that the sugar referred to was prepared by acting upon potato-starch with small quantities of malt extract; but here I may be in error as regards O. Sullivan's experiments, for I have not seen the papers published before 1876; but, at any rate, this was the case with Brown and Heron's experiments.

But the reason why I have myself kept to the factor ·05 as the equivalent of 10cc. of Fehling, is that I have invariably found in practice (and that in many determinations) that if the factor ·08 is used, the quantities of sugar and dextrine found *exceed* the total amount of the known solid extract.

I will give one illustration of this. I recently examined a strong-beer wort, having a gravity of 1,088, and a solid extract, therefore, of ·229gram. per cc. Diluted to 1 in 10, 5·75cc. were required for 10cc. of Fehling; and after boiling for two hours with acid, 2·4cc. were required. Now, this worked out with factor ·05, gives 38 per cent. sugar and 93 per cent. sugar and dextrine as sugar; but take factor ·08, and the amounts will be 61 per cent. sugar and 148½ per cent. sugar and dextrine as sugar, and after reducing the amount for dextrine, you still have 111 per cent. of the total extract, which is absurd. Moreover, the wort was brewed for a very full-bodied beer, and was certain to contain a large proportion of dextrine.

If Mr. Allen is in the habit of making estimations from actual wort, or if he would kindly take an opportunity of doing so, and give the results, I should be much obliged, as the subject is one in which I take particular interest.

With regard to the factor 3·85, for reducing gravity to terms of solid extract, I did not give it, as I was under the impression that the ratio varied with different densities; but I find on consulting Bates's (not Bale's, as misprinted in my reply) tables, that, although there is a variation, it is not sufficient to practically affect the result.

E. S. Beaven.

STRAIGHTENING CROOKED CASTINGS.

[20512.]—As "Patternmaker" (p. 573) has thought fit to criticise the article of T. D. W., which you have been pleased to produce on page 515 of the last vol., I consider it my duty not to allow it to go unchallenged in the pages of the English Mechanic. T. D. W. gives in his article two reasons for castings warping—first, ill-proportioned thickness; second, allowing some parts to cool before others. Now, then, "Patternmaker" says, "this is very misleading; for what he states as the first reason, is only the cause of the second." I say this is not the case, for ill-proportioned thickness is not the cause of some parts cooling before others in castings of uniformity in thickness, such as runs, gutters, &c. Therefore, "Patternmaker" is wrong in saying that the first reason is the cause of the second.

Here, again, "Patternmaker" says, "In an unequal column the thin side in cooling becomes rigid, while the thick side being still plastic . . . is not liable to bend by the contraction of the thin side." Now, the very fact of a column being bent and not broken proves that one side cannot be rigid while the other is plastic; and that bending takes place when the column is hot and all parts liable to bend. Therefore, "Patternmaker's" rigid and plastic theory falls to the ground. Again, he says that "contraction in all parts of a casting (thick and thin) is alike in amount." He would have been as correct had he said that 12 = 1728. It is true that the lineal contraction is the same in amount for thick and thin castings; but the coefficient of cubical contraction is three times that of the former. Therefore, contraction is greater in amount in the thick than in the thin parts of a casting. Here, again, "Patternmaker" draws on his seemingly inexhaustible store of ignorance, and contradicts what every moulder knows to be an undeniable fact—viz., what T. D. W. asserts in his article, that "cooling the middle on the top side of a casting causes the ends to come up." "Patternmaker" adds "for the under side being still plastic will compress by the action of the cooling side." The reverse of this is the case, for the contracting caused by the cooling of the top side will compress the particles of the top side, thereby overcoming the cohesive force of the under, rendering it less dense. I think from the above that the readers of the English Mechanic will see that "Patternmaker" is void of both theory and practice.

Moulder.

SIEMENS'S THEORY OF SOLAR REGENERATION.

[20513.]—A theory of recuperation for the solar heat has been, as is well known, put forth by Dr. Siemens. This consists of many hypotheses—namely, that the space containing the solar system is not a vacuum, but may be considered as a medium, gaseous or otherwise. This may, of course, be the case. Also that the action of the Sun is able to dissociate such of these substances as are products of combustion, just as a plant leaf is able to separate the carbonic acid of the atmosphere into carbon and oxygen. This has not been shown to be possible in any way.

But the most objectionable part of the theory is that the dissociated substances are continually streaming throughout space with enormous velocity towards the polar regions of the Sun, are burnt, and attain the region of the polar equator, from whence the products of combustion stream out into space. Dr. Siemens can scarcely be said to give any information as to the mechanical agency which produces this stream. He, indeed, says that the Sun acts as a fan, which is as much as saying that the streams are produced by the solar rotation, but how this can be is left unexplained. Two particles are supposed, placed at equal distances from the centre of the Sun, one in the neighbourhood of the pole, the other in that of the equator. Then, in consequence of the solar rotation diminishing the equatorial gravity, the polar particle is supposed to be compelled to stream towards the Sun. This is totally incomprehensible, to me at least. Both particles would stream towards the Sun, unless they are prevented by the elasticity of the subjacent material. We might begin with two particles so placed that the equatorial and polar gravity were precisely equal, or any other position, in fact, any result might be proved by such reasoning.

The equatorial out-stream is still more incomprehensible if possible. The only way in which particles on the solar equator can be projected into space beyond the reach of the solar gravity would be by a violent explosion, which is not postulated by Dr. Siemens, and, indeed, could not be in that case. Further, the action of the Sun in dissociating the matter of space must be supposed to take place almost entirely in the regions beyond the Earth: otherwise the waste of heat, calculated from the quantity which falls upon the Earth, would still remain, for which the theory was intended to account. The above considerations are so simple that it is difficult to suppose Dr. Siemens was not aware of them when he projected his theory. If so, it is to be regretted that he has not shown how such objections are to be met. **W. C. Evans.**

MOON AND WEATHER.

[20514.]—"If there is any dependence of the weather on the phases of the moon, it is only to a degree quite imperceptible to ordinary observation." (Sir W. Thomson, Meeting of British Association, August 25th, 1882.) That is the scientist's answer to an old question. It may be that the scientists are right, and that old weather adages are altogether wrong. Here in Northamptonshire is a very old saying—viz., "Saturday's change was never good, and Sunday's change is sure to bring a flood." Surely such a saying was not coined until after long years of experience. Let us, then, see if there be any truth in it. But stay, there is yet another saying, and probably it is older still. It is as follows:—"Saturday's change and Sunday's full, All'us did bring bad weather and alt'us wull." Saturday, January 15th, 1881, full moon—terrible snowstorm on the 18th. January, Sunday 30th, new moon—fine aurora borealis on February 1st, rain on 2nd, 3rd, and 4th, storm on the 7th, and again on the 10th. Sunday, June 26th, new moon, apogee—rain 27th; severe thunderstorm, July 6th. October, Sunday 23rd, new moon hastening to perigee, and rain fell on 22nd to 27th. November, Sunday 6th, full moon ascending to apogee—rough weather until 27th. Let us now try 1882:—February, Saturday, 18th, new moon perigee—the barometer commenced falling on the 20th, attained a minimum on 26th, and the total fall was 160°, and rough weather prevailed to March 5th, when we had a Sunday's full moon. And a Sunday's new moon came March 19th; the moon was near perigee—the barometer had begun falling on the 18th, and stormy weather prevailed to the 26th. Saturday, July 1st, full moon hastening to perigee. Saturday, July 15th, new moon going apogee—wind and rain with thunder at intervals to the 30th, when we had a Sunday's full moon. Full moon, Saturday, November 25th—stormy weather will probably set in some little time previous. New moon, Sunday, December 10th; full moon, December 24th, Sunday—rough weather, probably wind and rain, about 7th and 27th. **W. M. Gardner.**

THE PRESSURE OF WIND.

[20515.] — I ACCEPT the explanation which "F.M.S." gives with regard to "storm" and "rate" in reference to Mr. Simmons' balloon voyage, though it must be confessed that, at first, his meaning was ambiguous. In quoting my letter, "F.M.S." ignores the condition I make, "supposing the anemometer to be accurate." Omitting this, my statement appears as self-contradiction.

I do not think it is so much that engineers and meteorologists are at loggerheads, to use "F.M.S.'s" expression, as that the way in which they regard the motion of the atmosphere differs. The engineer is mainly concerned with the effect of the wind, while the actual motion and transference of the air more engages the attention of the meteorologist. But allow me to correct "F.M.S." when he says that engineers calculate the pressure of wind from the velocity, for no practice could be more absurd and objectionable, and this I indicate with the reason in the second paragraph of my last letter.

The connection between pressure and velocity varies, as stated by different authorities, but I venture to assert that the formula of Daubuisson is more accurate than any proposed. As "F.M.S." points out, the velocity increases with the height. Mr. Thomas Stevenson gives the following formula connecting the two, $V = v\sqrt{\frac{H - 72}{h - 72}}$, where H and h represent respectively the heights in feet of the high and low-level stations above the ground, and V and v the respective velocities at those levels. What the rolling burden and pressure of wind upon the Tay Bridge was at the time of its collapse of course is not known; but the vast venture undertaken by Messrs. Fowler and Baker, the Forth Bridge, is to be allowed a maximum wind pressure of 56lb. on the square foot, and it is the opinion of Mr. Baker that their bridge will withstand the "strongest hurricane yet known." This implies that the engineers of the Forth Bridge consider 56lb. on the square foot a greater pressure than has ever yet been known in this country. After this, "Khoda Bux" can use his own judgment with regard to his tower. If he thinks it necessary to allow such a maximum pressure he can, but he may remember that his tower can never receive such a strain as the Forth Bridge will. I suppose "Khoda Bux" has calculated the pressure above each bed-joint of his square tower, and is therefore aware that the total pressure on the area of the side—if he allows 52lb. as the maximum—above the top bed-joint will be rather more than 21 tons. Considering this, together with the size of the tower, it is no small weight.

Something more than mere mechanical accuracy in our anemometers is necessary if we would desire to gain a knowledge of the ways of the wind. We need more of such researches as those of Mr. Thomas Stevenson before we can pronounce definitely upon such a perplexing topic as wind-pressure. From the window where I now sit I can see a little square-shaped, steeple-roofed pinnacle on a building, and as I consider how the "wind fiend" sometimes lets out upon that little pinnacle, and how I have seen the slates stripped from its roof without that little pinnacle collapsing, I feel bound to reiterate what I have already said—that the wind can never exert such a force as even 40lb. on the square foot.

Worthing, Sept. 11th. **C. H. Romanes.**

NEW METHOD OF HANGING A GUIDING-WHEEL.

[20516.]—I SEND you an illustrated description of a new method of hanging a turning front-wheel for vehicles having three wheels, such as wheel-chairs, tricycles, perambulators, &c. The axle on which the wheel revolves is turned to right or left by means of a handle, and is yet kept in place otherwise, by two metal straps, each attached both to the axle and to the shaft by pivots or otherwise, but so as to be movable. Fig. 1 represents the wheel thus inclined to the left. At B, in Fig. 2, is seen an attached piece, which keeps the wheel and its axle from falling down when those parts are raised from the ground. As the axle and the checking-straps work *below* the shafts, Fig. 1 represents the *underside* of the apparatus. There is no need of further explanation. The point of attachment of the straps to the axle should be as near as possible to the wheel, in order to avoid a slight displacement of the wheel on the ground at turning. The shafts may be broad and strong springs. Several hints as to manufacturing details could be given, but are here left to the ingenuity of the mechanic. The advantages are great. The bath-chair plan necessitates a very small, jarring wheel. It is complicated, soon strained and "ram-shackled," and expensive to repair. Mine is the contrary of all this. I have used a chair with a larger front wheel for 20 years, though not the same as the one here described, but with springs as shafts. I have only to add that the arc through which the wheel may be made to turn is greater than what is practically required.

FIG. 1.

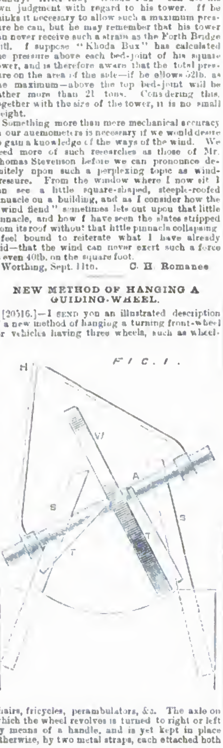
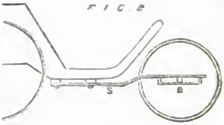


FIG. 2

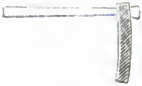


If the shafts are springs, it is necessary that they should be so affixed to the body that when the vehicle has its load they may be in a right position—i.e., the extremities must point more downwards; also, the rim of the wheel must be at such a distance from the footboard that it may not scrape it on pushing up hill, or at any other great resistance.

Fig. 1. A, axle; W, wheel; S, shafts; T, metal straps; H, handle. Fig. 2. Spring shaft; B, attachment to keep axle in its place. **X.**

INDIAN WORKMEN: THE BLACKSMITH.

[20517.]—THE mental capabilities of the blacksmith are just about on a par with his brother the carpenter; but as he often combines a little of the brass-founder, and generally knows something of brazing-work, he must, I think, be considered as of a slightly superior education. In country places, if bullocks require to be shod, an idea which may perhaps be strange to some of "our's," this work generally falls to his lot. Although if the place happens to be large enough to support a farrier (nalbund) the shoeing of cattle of all kinds is taken by him. The blacksmith's tools are, if possible, fewer and more rude than those of the carpenter. They are usually a sledge-hammer, a curiously shaped hand-hammer with a short handle, something of this shape.



The hammers are usually handled like pickaxes are in England, a knob being left on the end of the hammer to prevent the hammer flying off. Two sheepskin bags are used for bellows. Smithy fire, tuyère, and water-chamber are quite unknown. A hole in the ground, about six inches deep, serves for a receptacle for charcoal; a wall about six inches thick, one foot six inches wide and a foot high, serves to screen the bellows from the heat, and a piece of thin sheet-iron, shaped funnel-like, passes through the wall to convey the blast. Behind the wall squats a boy, or occasionally a woman. The neck of each of two sheepskins has a small sheet-iron pipe tied to it, and these two pipes pass into the funnel; the hinder-ends of the sheepskins have the large hole (where the body of the sheep has been passed through) fitted with two strips of wood, one on each side; to each strip is fixed, in the centre, a small leather loop, and the bellows boy holds the two strips in his hand, passing the thumb through one loop and the third finger through the other. In this manner, by pressing with his hand on the skin, he forces the air through the nozzle; then by opening his thumb and third finger end rapidly drawing the hand back, the skin is again filled with air, to be again forced out as soon as the band is closed and the bag pressed upon. The only fuel being charcoal, two of these skins, one being worked by each hand, form a very efficient bellows, and have the advantage of cheapness and portability, besides being procurable all over the country. In the smelting of iron from the ore, the natives always use similar appliances, but the skins are usually those of buffalo or bullock, and more of them are used to obtain a greater pressure of air. I must apologise for having taken up so much space in endeavouring to describe the bellows, but its importance to the smith must be my excuse. Most country blacksmiths are not lucky enough to possess an anvil, and a large stone often does duty instead. A few pairs of very indifferent tongs, a bit of steel for a chisel, and an old file or two, are sufficient to complete his kit. Ordinary blacksmiths find considerable difficulty in even welding common brands of iron, and will always work with Swedish iron if they can get it. The tempering of any spring is usually quite beyond their capabilities. They use the husk of rice, in large quantities, as fuel; it is first wetted and then placed over the charcoal fire; the effect is to keep in the heat, and it is almost impossible to work any large job with charcoal, unless some such thing as rice-husk is used. The charcoal alone ignites so readily in a blast that it is impossible to keep the fire within bounds, if a large quantity of charcoal is put on at one time. For heating the tires of wheels cow-dung cakes are, I believe, invariably used throughout the country, as they give an excellent heat without any chance of burning the iron. Blacksmiths are, as a rule, very careless as to saving up money; as long as they can make enough to find them rice to eat and something to drink, the latter being the first necessity, they never seem to be ambitious to make more. I fear there is little to be said as to how they work; what they turn out is usually very rough, and they quite fail in welding their iron, the reason, I fancy, being that they never try if they can help it, but always braze their work.

Melting Mechanic.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47004.]—**Bread.**—As some queries and replies have appeared on this important subject, I think it proper to state some conclusions and matters of fact with regard to it which may be worth knowing. It seems to me very strange that the common loaf bread should be so generally used as it is, for, to my taste, it is the most unpalatable of all kinds of flour-bread, and has a crust so hard as not to be masticated by elderly persons, or such as have bad teeth. This is also an opinion that is shared in by many persons with whom I have come in contact. The loaves known as "crown loaves," and those called "turnovers," which differ from the common loaves only in the manner of baking, and are of the very same price, are, to my taste, far superior, and of much greater flavour. Pan-bread I do not much care for, for, though very delicate, its flavour is not very grateful to my taste, and it becomes quite stale in a very short time. But the fact is, I am quite fond enough of bread in which no substance has been introduced to raise the flour (unvesiculated bread). The spongy texture of vesiculated bread, and the lightness thereby acquired, are not, in my opinion, so essential as other conditions, and I can well enjoy the domestic griddle-baked bread, or the unleavened bread of the shops. Leavened bread is at present in general use in Paris, but, in the English bakehouses, barm or yeast is generally used instead of the leaven. The spongy texture of bread is caused altogether by the action of carbonic acid, either generated by various means in the baking, or else introduced dissolved in the water used in making the dough, as in the aërated bread. In the leavened bread this is effected by the seemingly-unsavoury process of the putrefactive agencies of the leaven, and, in another case, by the use of the corrosive poison, hydrochloric acid (spirits of salt), and the bichromate of soda (bread soda).—DU PAIN.

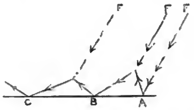
[47213.]—**Camel's Hair Brushes (U.Q.)**—I have never seen these made, but I believe the process to be somewhat as follows:—The hairs are tied tightly together and driven into a quill previously softened in hot water. In cooling, this contracts and binds the whole in place. The pointing is done on a grindstone running from the workman.—GLATTON.

[47239.]—**Deafness and Vegetarianism.**—The "deafness" for some time past has altogether been lost sight of in the correspondence in this query; surely someone can suggest something that would prove beneficial. I have been anxiously waiting to see if anything useful should appear; but the pith of the whole has been to advise Mr. Ollard to be thankful that his case is not so bad as others. I myself am suffering from slight deafness of three or four years' standing, caused, so I have been told, by a swelling of the aural tract on both sides, and so far as I can judge, my case is similar in character to Mr. Ollard's, hence my anxiety in the query. Shall I further appeal to any of our medical subscribers to come forward?—POLITZER.

[47239.]—**Vegetarianism.**—I am afraid Mr. C. L. Hart has been trying some second-rate cafés. I think he would alter his opinion as to the oppressive fulness, &c., if he lunched where I do. My lunch generally consists of lentils and haricots, and certainly I never feel anything of unpleasant fulness, and my appetite is appeased until the next meal. Vegetarians drink little. Personally, I take half a tumbler of cold water when dressing, ditto at luncheon, coffee at about 4 o'clock, and about half a glass of cold water at dinner, and half a glass at night. I will send the addresses if applied for privately.—JOHN ALEX OLLARD, F.R.M.S., Enfield.

[47239.]—**Vegetarianism.**—An experience of both systems for a lengthened period, I think, proves that vegetarianism, or the reverse, proving satisfactory, is not a question of which is the best, but of individual peculiarity, and also of a proper selection of food. Some of my own children have grown up of their own choice as strict vegetarians, others with a decided craving for a meat diet. I could myself live in perfect comfort on either vegetarian or mixed diet; but, on the average, the mixed diet has proved the most satisfactory. It is certain that, with myself, any illness or upset is accompanied by a strong craving for an almost exclusive fruit diet, and an objection to meat. On recovery the desire for meat returns. If we examine our supposed immediate ancestors in a state of nature, *i.e.*, the monkeys, we find them thriving on a mixed diet; and if we examine our own neighbours we find great personal differences; food which is satisfactory to one being disgusting and uneatable to another. The fact that one man is a vegetarian, teetotaller, and anti-tobaccoite, is no reason why he, having certain ideas, should seek or expect to make the world choose him as a leader. He might as reasonably expect his clothes to supply the pattern and size for all creation. We are put in the world, as I take it, to live a reasonably happy life, enjoying ourselves and making a pleasure of our lives day by day, in addition to filling our places and doing our daily labour. The use of animal food, and the death of one animal to provide food for another, is as old as creation. If it is not right, we must blame the Creator for making one half the animals in the world prey on the other half, the destruction of animals as food for others being part of the scheme of creation. The vegetarians are no more infallible or inspired than the meat-eaters; let each one elect his own way, according to the best of his judgment, without seeking to lead others, who are possibly quite as able to judge between right and wrong as himself. Many who have adopted one special system which happens to suit themselves, persist in airing their ideas, and laying down laws which they consider should guide the world; yet they refuse to adopt the systems of others who are at least as capable of judging as themselves. I myself cannot live in comfort and health without a very large proportion of fresh, ripe fruit, but others are not bound or expected to follow my example; let them select their own diet by their own experience, and if they find a system, vegetarian or not, which suits them, by all means stick to it. For a man who will listen to no argument or reason except his own, I have found none to compare with an average vegetarian, teetotaller, or anti-tobaccoite. Listen to his arguments for five minutes, and you cannot doubt that he considers he has found the right thing. The most delightful argument I ever heard in favour of total abstinence was a leader in the blue-ribbon army, who, after stating he had not tasted or desired to taste fermented liquors for seventeen years, wound up with, "and besides, I find it does not agree with me." The roar with which this argument was received no doubt will effectually prevent its use again; it "filled the bill," and settled the matter completely. Although strictly temperate myself for exactly the same reason, I do not seek to lay down my necessity as a rule for other people's guidance.—F. T.

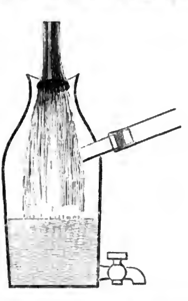
[47248.]—**Wind Pressure (U.Q.)**—I do not think anyone can answer such a question in figures. If the plate is very thin the pressure on the edges may be neglected, and the pressure of the wind then acts everywhere in a direction normal to the surface of plate. To take a simpler case in which the wind strikes a plane at an angle to surface, but in a direction parallel (in plan) with side of plate. Let *f f f* represent streams of air-molecules flying towards plate in direction indicated. The molecules striking plate at *a* give plate a blow, and rebound at the same angle as that at which they approached. As they recede they will come in contact with the other molecules, and deflect them from their original direction to *b*. Another blow (rather less than the first, owing to difference of angle of incidence) is given to plate; they again rebound, and deflect another stream to *c*, when a still smaller blow is given to plate. The effect of all this is that the end *a* of plate is depressed with an appreciably greater force than end *c*. I do not see how I can help the querist further, but will do so if I can.—GLATTON.



[47254.]—**Electric Commutator for Intermittent Action (U.Q.)**—Sir Wm. Thomson's patent magnetic break seems to be exactly what is wanted.—J. BROWN, Belfast.

[47315.]—**Boomerang.**—The throw described by Mr. Philip Valiance (p. 13) would be considered by a native a bad throw, as it would very probably result in breaking the weapon: coming down, as it does, straight into the ground. The flat surface of the weapon should, of course, if possible, be underneath as it flies on the air; the boomerang may be thrown concave or convex edge forward; shot out straight in the air, leaving the hand it is almost perpendicular, and it gradually becomes horizontal; the *surface* which is to float undermost is to be held to the right in throwing with right-hand, to left if with left-hand. The relation which the plane of the longer end has to the general plane of the weapon influences to a great extent its movements—why, I do not know, as I am not a mathematician. If this long end be bent very much above the flat, the boomerang will rise higher, turn from perpendicular to flat sooner, and make far smaller circles than it would if the two ends were almost or quite on a level. These few notes may perhaps interest those who have read "Umbra's" excellent reply to the boomerang query.—DRAREG.

[47356.]—**Cold Air (U.Q.)**—I do not know the arrangement referred to, but probably a modification of hydraulic blowpipe would suit you. A vessel is fitted up, as shown in sketch; water at high pressure enters by rose at top, and draws air after it into vessel. The level of water inside is kept constant with the help of a tap, and the cool air is carried off by the pipe on side. The proper position of rose would be ascertained by experiment.—GLATTON.



[47437.]—**Whitworth's Standard.**—Pitch for screws for all sizes of wrought-iron piping more than 1in. diameter is eleven threads per inch.—A MELTING MECHANIC.

[47444.]—**Boiler Corrosion.**—I would suggest to "E. M." that before he goes in for trying to filter the feed-water for his boiler, he might try the following:—Every week, after cleaning out the boiler and well washing away any loose deposit, let him put in two quarts of ordinary kerosene oil with the cold water when refilling his boiler. I and several other steam-using friends have been trying kerosene as a remedy for boiler incrustation, and comparing notes. The result is very favourable, and we are all continuing its use. It does not actually prevent any deposit forming, but it seems to prevent the fur from caking hard on the plates or tubes, and leaves it as mud on the bottom of the boiler, so that, when cleaned out, this mud all comes away and leaves the boiler clean. No ordinary filter will, so far as I know, remove the salts of lime from water. The only way I have heard of to do this is to pass the water through an intermediate sort of boiler, which is kept full of scrap-iron. The water being passed through this vessel at boiling-point deposits largely on the scrap-iron, and so is made comparatively pure before being allowed to go into the boiler, the scrap-iron being occasionally thrown away, and new scrap put in.—A MELTING MECHANIC.

[47459.]—**Silvering Looking-Glasses.**—Will Mr. Holmes give a description of the new processes to which he refers, and, if possible, state what is the charge for mercurial coating? Does he mean in actual cost or in charge made? I assure him I am asking for information.—J. T. M.

[47461.]—**Black Transfer-Paper.** — Black transfer-paper may be made by rubbing white paper with a composition of 2oz. tallow, ½oz. powdered blacklead, ¼ pint linseed oil, and enough lampblack to make it the consistence of cream. All to be melted together and rubbed on hot. When dry, the paper is fit for use.—A MELTING MECHANIC.

[47486.]—**Euclid's Axioms.**—It seems too hard that Mr. Smith should accuse me of ignorance of Latin in addition to not being able to prove that which I had set myself. I put axiom (2) into the form of an equation A + C = B + D—not as Mr. Smith has it, which I presume is quite eligible—but the step which is taken to deduce A − C = B − D Mr. Smith considers "simply an application of axiom (3), which we have to prove." But since we do not know the truth of axiom (3), how can it be applied? The equation follows from simple algebra.—C. H. ROMANES.

[47495.]—**Gun-Barrels.**—The gun will not require to be kept warm while the browning solution is on. The gun should be well polished before the solution is applied. After browning, it should be washed in an alkaline water to prevent any further action of acid, and then burnished with a piece of hard wood. After once polishing with hard wood, it may be varnished with varnish composed of 2oz shellac, dissolved in four pints methylated spirit, a little dragon's blood being added if the colour requires heightening. The gun should be slightly warmed before this is applied, and, when dry, another good rubbing with the polishing wood will do all that is necessary.—A MELTING MECHANIC.

[47553.] — **Problem in Dynamics.** — The monkey climbs rope by a series of expansions and contractions of its own muscles. Now, whether these muscles be expanded or contracted, or in the act of expanding or contracting, the weight of the monkey is a constant quantity, and such weight being all that in the circumstances it can bring to bear on rope, the ball will not move. Mr. Romanes gives a theoretical solution, which I think is incorrect, as he says for every s feet in descent of ball, monkey will traverse $2s$ feet. Suppose ball begins to descend when monkey begins to climb, then they become bodies of unequal weight, one getting heavier the other lighter, consequently the motion of ball is accelerating; therefore, it will pull monkey through one foot of space in less time at end of its fall than at the beginning. Now, monkey climbing with uniform velocity, the distances traversed by them will not be in the constant ratio of 1 to 2. The illustration given by "Dubliniensis" is not a parallel case. To make them so the strength of occupant of one boat ought to be taxed to the very utmost to keep the boats in position, as it requires all the monkey's weight to keep ball in position; and the strength in one case, and weight in the other, is all the force available in the circumstances. The first law of motion merely asserts the inertia of inanimate matter; that is, its inability of itself to move, or if in motion to cease moving; but the monkey is a mass of animated matter, with the power of moving or ceasing to move as it wills, without the application of external force; and I think "Vesuvius," on a little reflection, will see that he errs in applying this law to it in this case.—SCOTCH WORKING MECHANIC.

[47573.]—**Model Locomotive Boiler.**—I am much obliged to "E. L. P." for his sketches and suggestions; but I think he does not quite understand what I want. The top of my outside firebox is flat, and I am told here that I must bend the plate of outside firebox to meet the end of barrel. That I think I can do if it was not for the flat top which is 1¾in. wide. I have made one boiler, but could not make the bends, and it will not go into the frame, as the wheels being inside the frames the firebox comes in contact with them. I am afraid I cannot use ⅜in. tubes as in this town (Dresden), that size would be about 1-16in. or more in thickness. How would 7-16in. or ½in. do, and 25 or 30? My inside firebox is 1½in. from centre line. The engine is being made to scale, and is of Austrian design. Similar drawings appeared in *Engineering*, October 4, 1878.—SHAKESPEAR.

[47574.]—**Pressure.**—Quite possible. Why not? The temperature would be rather high, and it would not be easy to use the steam at such a pressure; but Perkins's engine comes very near it.—ESSAR.

[47585.]—**Electro-motor for Tricycles.**—This query is on a par with the suggestion to drive tricycles by means of gas-engines. Does not Mr. W. L. Ollard see that if there is so much "anxiety felt by thousands for the application of electricity as a motor-power for tricycles," electricians must be very sleepy not to take advantage of the demand! The fact is, that although it is quite possible to drive a trike by means of electricity, the game is not worth the candle, so long as the trike has to carry the generator with it. Trouvé actually fitted up a machine, which ran along some of the Paris asphalte roads at a good speed; but I guess very few wheelmen would be bothered with a battery and motor on a country trip.—NUN. DOR.

[47620.] — **Plumbing.** — The difficulties mentioned in this query exist only in the workman.—T. P.

[47621.]—**Faded Cloth Cushions.**—Rub them over with a weak solution of carbonate of ammonia.—C. K. M.

[47623.]—**Electro-Motor.**—I apologise to Mr. F. W. Ball for so long deferring my answer. I have not yet made the motor of sufficient size for the purpose he mentions, but shall probably do so shortly, when I will give result.—CONRAD.

[47631.]— **Polarity.**—No answers being given up to September 7th, I forward a definition, which though not to my mind quite satisfactory, might possibly be made so by a reasonable amount of fair criticism. General definition of term "Polarity in Electricity." Such induced or changed condition of current in fixed matter as gives an altered result—i.e., whereby the normal ratios of gravity, cohesion, or stratification, become altered not only in force and direction, but also in quantity and quality, dependent on the known laws of electro-dynamics.—J. HUSSEY WILLIAMS.

[47682.]—**Electro-Magnetism and Magneto-Electricity.**—Your query, in the form you now put it, is altogether different. No proof can be given that Oersted could deduce Faraday's discovery to be a necessary consequence of his own discovery, even if acquainted with the present theory of the conservation of energy. He might, perhaps, think that, as a magnet was moved by an electric current, the movement of the magnet back to its former position would produce an electric current. But Faraday discovered that when a conductor was moved under the influence of a magnet, an electric current was caused in that conductor, and this discovery was made during an experimental investigation, which had no connection with the discovery by Oersted of an isolated and previously unknown fact, unless through the historical sequence traced in my former reply.—J. SUTCLIFFE.

[47683.]—**To Electricians and to Mr. Sutcliffe.**—You do not need to join every two zincs and every two carbons to set your battery as one of 25 cells; it is sufficient to set up two batteries of 25 cells, and join the end zincs and carbons. See page 331, No. 899, where in the illustration to Ohm's Laws, the figure at the right shows how six cells can be joined as one battery of three cells. You might even find it best to use your battery in four series of 12 cells, and leave out the two odd ones; it is a matter for experiment. In each cell put the carbon into your outside jar at the right, and the porous cell at the left hand, then fill the space between with broken carbon; place the amalgamated zinc in the porous cell, and make the connections. Empty the cells with a glass siphon; you need not then take the battery to pieces to recharge it. You will gain no advantage by mercury in the porous cells unless they have to stand for a long time before use.—J. SUTCLIFFE.

[47756.]—**Electro-Plating.**—"Galvanometer" asks for description of instrument for measuring the E.M.F. of an electric current used for plating. In answer to which "Edwin" says it may be done with an ordinary current detector. Will he kindly explain how? as I want to measure the E.M.F. of an electro-plating current from a dynamo machine. Also, would he kindly explain construction of Profs. Ayrton and Perry's volt-meter, as well as the thickness and length of wires of which the coil of volt-meter is composed?—W. BARTON.

[47757.]—**Manganese.**—The reply of C. Harris is thoroughly misleading, and at variance with facts. C. Harris is evidently not aware that MnO_2 is the highest, and Mn_3O_4 the lowest mineral oxide. The MnO_2 on heating is reduced to Mn_3O_4, and not Mn_3O_4 to MnO_2. I doubt whether metallic manganese can be produced in the manner given, and more than one chemist would be glad to know the actual reactions that would take place. C. Harris takes it for granted that the pyrolusite and hausmannite and braunite, as produced, are pure oxides; but as this is not a fact. "Chlorine" has not been correctly answered, because each contains a considerable amount of impurities in the form of silica SiO_2, iron Fe_2O_3, $CaCO_3$, MgO, and phosphorus and sulphur in small quantities, besides other oxides of manganese in small proportion to the dominant one.—M.

[47766.]—**G. N. Engines.**—I give a list of the 8ft. singles:—King's-cross, 53, 94, 544, 547, 666; Peterboro', 7, 8, 22, 48, 69, 98, 221, 545, 549, 663, 668; Grantham, 2, 3, 5, 60, 62, 93, 95, 665; Doncaster, 1, 33, 34, 47, 546, 548, 550, 662, 664, 667.—ALARIC.

[47768.]—**G. N. Engines.**—I wish to make an addition. "Iron Horse" has omitted Nos. 668 and 669, eight-footers, the latter of which came out only a few days ago. I do not know their stations. The goods engines mentioned by "Iron Horse" are very fine engines. The cylinders are 17½ by 26, and six-coupled wheels 5ft. 1in. diameter. More of the same class are being built by the Vulcan Foundry Co., numbered 716, 730. In a former letter I stated that 610—649 had cylinders 19 by 28. This was a mistake; the cylinders are 17½ by 26. The G. N. Co. are building a great number of coupled engines. Some have been ordered from Kitson and Co. Nos. 78, 88, 224, 202 are the latest out from the Doncaster shops.—METEOR.

[47822.]—**Tempering.**—I think that the best way would be to get the steel as hot as you can without burning it; then dip it in mercury. If it does not stand well, then the steel has lost its substance, or the lathe runs too many revolutions per minute.—ACCRINGTON.

[47823.]—**Drink.**—A few drops of sal-volatile in water is often recommended.—T. P.

[47823.] — **Drink.** — Dr. Sydney Ringer, in "Manual of Therapeutics," 1880, says:—"I can endorse Dr. Lyon's strong recommendation of capsicum in dipsomania. Ten-minim doses of the tincture obviate the morning vomiting, remove the sinking at the pit of the stomach, the intense craving for stimulants, and promote appetite and digestion. It should be taken shortly before meals, or whenever there is depression and craving for alcohol. Capsicum also induces sleep, especially in the early stages of delirium tremens. Dr. Lyons sometimes gives twenty, or even thirty, grains, made into a bolus with honey, and repeats the dose in three hours if the first fails to induce sleep. He says this quantity does not disturb the stomach. Capsicum is often useful to dipsomaniacs to enable them to overcome their pernicious habit. By removing the sinking at the pit of the stomach, it often enables the drunkard to resist the drink-crave. A draught composed of ten minims of tincture of capsicum, ten grains of bromide of potassium, a drachm of spirits of ammonia, taken several times daily, is very serviceable, or the bromide of potassium may be omitted, and replaced with two minims of liquor arsenicalis, or by a few drops of tincture of nux-vomica, or tincture of orange-peel."—JAMES FOSTER, M.P.S., Carlisle.

[47827.]—**Grist Mills.**—By all means have a small pair of Derbyshire stones. I have never seen anything to beat them yet. Several farmers round the part of Leicestershire where I live have them, and I have recut, or, as we call it, "dressed," them for these farmers for the last twenty years. This kind of grist-mill gives great satisfaction everywhere as to size, price, &c. I will give "Amateur Farmer," free, all information, if he likes to advertise his address in the "Address" column; and if he lives anywhere near me, I would rig a mill up for him, and teach him how to work it; but be it understood I am not a maker of them.—HINCKLEY.

[47828.]—**Microphone.**—The Blake transmitter is the best. You will find it fully described and illustrated in a back number of the "E. M."; but should you experience any difficulty in getting the exact copy, I shall be happy to give you all the information I can, if you will give your name and address, so that I may write you direct.—AMATEUR.

[47831.]—**Milk Analysis.**—The percentage of water may be arrived at as follows:—About 10grm. of the sample is weighed out, transferred to a small porcelain dish, and evaporated to dryness on the water-bath. A little benzoline is now added to the dry residue, which should be allowed to boil for a few minutes, and then decanted, taking care not to lose any of the residue. This treatment with benzoline should be repeated about six times; when the dish and contents are dried in the water oven, allowed to cool in a desiccator and weighed. The weight of the residue multiplied by 100 and divided by the weight of milk taken, equals the percentage of solids not fat. This should be 9·0 per cent.; should it be less, the milk may be considered as watered. The following calculation will show how to calculate the percentage of water:—

$$\text{If } \underbrace{\text{of solids not fat}}_{9 \text{ parts}} \text{ are contained in } \underbrace{\text{of genuine milk}}_{100 \text{ parts}}$$

what is

$$\underbrace{\text{Percentage of solids, not fat, found in analysis}}_{x \text{ parts}} \text{ contained in?}$$

The quotient equals the quantity of genuine milk contained in the sample, while the quantity required to make up the "100" is water. Example: Suppose solids not fat to be 7·991 per cent., then

$$\text{If } \underbrace{\text{of solids not fat}}_{9} \text{ is contained in } \underbrace{\text{of genuine milk}}_{100}$$

$$\text{what is } \underbrace{\text{of solids not fat}}_{7{\cdot}991} \text{ contained in}$$

7·991
100

9) 799·100

88·788

Therefore, 7·991 of solids not fat would be contained in 88·788 of milk; consequently, that which is deficient to add up to 100 is water thus—

88·788 milk.
11·212 added water.

100·000

Therefore, this milk would contain 11 per cent. of added water. *Unhealthy and Abnormal Milk.*—One of the chief symptoms of "lacteal albuminuria," an affection from which cattle suffer, is a viscid, stringy condition of the milk a little while after it has been drawn. Such milk is highly albuminous, containing from 8 to 10 per cent. of albumen; when in this state, it generally enters rapidly into lactic fermentation, and is apt to cause diarrhœa in young children. The milk in anthrax and anthracoid diseases is said to be of a dirty bluish colour, streaked with blood, and soon becoming putrid. The milk of cattle suffering from pleuro-pneumonia has been drunk with impunity, and the same may be said of that from cattle suffering from cattle plague. In such diseases, however, there is nearly always early suppression of the secretion, and but little is known of the chemical qualities of the fluid. *Milk from Cattle affected by Foot and Mouth Disease.*—If milk be taken on the first day of the disease and microscopically examined no abnormal elements whatever may be discovered in it; but on the other hand, instead of the globules remaining free and separate, as is usually the case, they show a tendency to aggregate into groups. About the third day some new bodies (first observed and described by Mr. A. W. Blyth) make their appearance. These consist of elongated, flattened, highly refractive bodies, ranging in length from 1-800 to 1-1,000 of an inch. In some there are divisions at intervals, which appear to be rather the contraction of a sarcode than an indication of cells. By the fourth day they are fewer in number and rather larger. In the latter stages they are absent. If, as frequently happens, there are ulcers on the teats themselves, pus-cells, epithelium, and blood will be found in the milk. These are, of course, accidental products, and not secreted by the gland; frequently there is a circular ulcer, not very evident unless looked for, just within the teat, and this ulcer contaminates the milk. The chemical investigation should be specially directed to the determination of the relative quantity of albumen to caseine proper, to the amount of chlorine in the ash, and to the presence and amount of urea. Dr. Beale was the first to observe that in pneumonic patients, practically the whole of the chlorine was withdrawn from the urine. It is, therefore, probable that in some internal inflammatory diseases of the cow, attended with exudation, the chlorides in the milk would disappear. Certain diseases of the kidney cause in milk an increase of urea, and though the presence of the latter may be found in minute traces in normal milk, any quantity, capable of determination, would be evidence of ill health.—J. C. Belcher.

[47835.]—**Cheap Tent or Workshop.**—For a cheap tent or workshop either a building of timber covered with stout grooved and tongued boarding, or covered with good galvanised iron, would be the cheapest. Any carpenter could erect the wood building; but iron would be the most durable.—G. S.

[47842.]—**Electric Light for Workshop.**—There can be no doubt about the advantages "Ironfounder" would receive by the employment of the electric light in his foundry. If it is possible it would be best to suspend two electric lamps, about 20ft. or 25ft. from each end of the foundry, and if they cannot be suspended the next best plan would be to place each lamp on the top of a post about 12ft. high. It would not be impossible to construct your own dynamo, if you have a thorough knowledge so necessary for this work; if not, you had better not attempt it, unless you wish to undertake a lot of trouble. Dynamo-machines can now be obtained for a very moderate sum, also arc lamps. A shunt machine would suit you the best. A particular system can scarcely be advised; but if you care to communicate with me at my address, in this week's front page advertisement, I may, perhaps, be able to give you a little further assistance.—A. J. Jarman.

[47842.]—**Electric Light for Workshop.**—Can "Iron Founder" fix his electric lamp above the beam—say to the roof, so as to avoid the travelling crane? I fixed a set like this in an iron foundry a short time ago, and the moulders and others found the light, although high up, an immense advantage. I should not advise "Iron Founder" to attempt to make his own dynamo: it requires some electrical knowledge to do that. It is all very well for amateurs to make small ones, such as we have lately described; but the efficiency of these, if made to the size required, would not equal the latest and best make. As to advice about which machine would be the most suitable, the following remarks may be useful. The Brush machine for small installations, is excessively dear, being from two to three hundred pounds. Siemens's and Crompton's (Bürgin) are the next; but for rough workshop wear, and moderation in price he will find the latter best all in the market. The price of a three-light (3,000 c. each) machine is £90.—Tried.

[47846.]—**Electro-plating.**—The nitrate of mercury is injurious to the health; it should be avoided as much as possible. Do not hold your mouth too near it. There is no danger with the articles which have been dipped into it, so long as they are properly plated, and are not allowed to wear too long. Plate them without the nitrate. Get the articles perfectly clean, and you will be able in most cases to do without it. Be careful with it.—W. R. Hicks.

[47847.]—**Electro-plating.**—I think you have too much silver in your bath; put more cyanide of potassium and try again (see my answer to your other query about cleanliness.) Be particular about the proportions of the chemicals.—W. R. Hicks.

[47848.]—**Replating Worn Steel Pickle-Fork.**—Strip all the silver off, then if the steel is perfectly clean plate it with copper first, then try the silvering. Use a strong current for the coppering, a weaker one for the silver. Be sure it is clean, and do not handle more than can be helped after it is clean.—W. R. Hicks.

[47851.]—**Sewing-Machine.**—Probably your Weir machine does not make perfect stitches, and in consequence of cotton accumulating under, prevents forward motion; place a piece of calico, two or three times doubled, in machine, and work round without putting cotton on; if it moves forward now, it shows that it is out of adjustment, and should be put in the hands of a practical man; but if the feed-teeth do not move at all, but remain stationery while turning wheel, then first turn the thumb-screw for regulating stitch just under needle-plate in front; sometimes these thumb-screws are screwed back so far by the operator that they fail to produce any movement of feed. I have seen many instances where people have thought their machine to be out of order because the feed would not move; but by my simply giving the thumb-screw a few turns in the direction of a longer stitch, the machine has worked all right; if working the thumb-screw up has no effect on feed, then a piece of steel, upon which the end of thumb-screw bears, and which is situated under surface-plate, has got shifted out of place. If this is the case the surface-plate will have to be taken off before the piece of steel (which is somewhat similar in size and shape to a small iron door button) can be placed in position; first take the machine off the iron base or stand, by means of central screw at bottom, then you can unscrew the cast-iron surface-plate by means of two screws underneath, when it will come off—an easy matter to take off, but not a very easy matter to put on again correctly, except by an experienced hand.—E. Martin.

[47857.]—**Defective Sewing Machine.**—"F. E. T." did not give name of machine but I will presume it to be on Howe system. Put a drop of oil on centre pin of the feed-wheel, but the hub of wheel must be kept quite free from oil: should any accidentally get on hub, wipe dry again, as any oil on hub diminishes lifting power of the two grips attached thereon. Attached to these grips, and within the circle of wheel, are two small spiral springs which are intended to keep the grips firmly in position. These spiral springs frequently weaken—i.e., get longer, and thus lose the power they should have. If this is the case, they should either be renewed, or the old springs may be made more powerful by cutting off a portion of each and fixing on again. The long piece of steel, one end of which presses on hub of wheel to prevent the wheel from retreating backwards, should be so adjusted as to be just sufficient to keep wheel from going back, and no more; any extra pressure beyond this prevents the wheel from going easily forward; also the pressure of foot should be so adjusted as to be just sufficient to hold work down firmly, and no more, as any over-pressure in this direction bearing down on wheel considerably interferes with the free working of wheel. Are you sure that wheel does not revolve regular when work appears to halt? You can tell this by looking at the under-side of a piece of leather after working, as if the teeth-marks of wheel are imprinted quite distinct on leather this proves that wheel stops, but if the wheel leaves a dragging mark on leather, this proves that wheel goes round without carrying leather with it; in this case either raise wheel a little higher or have the teeth cut sharper; the wheel should only be just a shade higher than needle plate, just the difference of a thin piece of cardboard.—E. Martin.

[47863.]—**Aniline Dyes.**—Violet is the least fugitive. Magenta and fuchsine are the same dye; eosine would be better than either for dyeing paper pulp.—Amido.

[47864.]—**Chemistry Examinations.**—Armstrong's "Organic Chemistry," published by Longmans, 3s. 6d.; Roscoe and Schorlemmer's "Chemistry: Organic," Vol. III., Part I.; Fownes' "Organic Chemistry."—R.

[47865.]—**Utilisation of By-Products.**—"Puzzled" has been misinformed as to the value of his ammoniacal liquor. It is, on the contrary, a very valuable manure, but is far too strong to be applied to the land without dilution. It should be diluted with from 5 to 10 times its bulk of water, and applied to grass lands with the liquid manure cart in the early spring before the grass has begun to grow, or powdered gypsum might be added to the liquor in the proportion of 1lb. to the gallon, with frequent stirring, which would combine with the ammonia and prevent its volatilisation in hot weather, or preferably sulphuric acid, until the liquor is neutralised.—Gas Manager.

[47875.]—**Concrete Floor.**—"W. L. P. P." has appealed to me on the subject of support for his galvanised iron tank. I do not understand his question. Is he in doubt whether his wall will stand the crushing weight of the tank filled with water? or does he fear the rigidity of the tank supported as he says? He forgets to give the three dimensions of his tank, so its contents and weight cannot be dealt with. On the data given, I could give him no safe information. I may tell him I have a tank, made entirely of concrete, to receive the rainfall of close on to 5,000ft. of surface, the inner dimensions of which are 14ft. by 10ft. by 3ft., holding about eleven tons of water, the bottom of which is 34ft. from the ground, and which supplies the w.c.'s top and bottom, and also a considerable amount of bath water in ordinary seasons. I should think if there is no doubt about the strength of his walls and their ability to bear the weight of his tank when full, the cheapest plan for him would be to put a couple of girders of 4in. by ½in. T-iron, web downwards, across his wall. This would not only form a support for his tank, but if he let his girders lap over the wall and bent the ends downward (first cutting off the web of the part that laps), he would get an efficient tie for the wall if weak. If his walls are too weak to stand a tank 10ft. by 6ft. and, say, 4ft., they would not do to spring a concrete arch from. The concrete for tank work should be 1 volume Portland cement, 1 vol. sharp sand, and 4 vol. good hard aggregate of either clean flint stones, broken brick, or clinkers, mixed and manipulated as described in "E. M.," No. 910. If "W. L. P. P." really wants information, he can advertise in the "E. M." for my address; I will give it, and appoint a meeting some day when I am in town. As Jack says, "My jawing tackle are in good order." I wish I could say as much for my hands. Writing is, to a certain extent, an effort, and I have quite as much as I can get through.—Khoda Bux.

[47878.]—**Electro-Gilding.**—To "O. S."—Will he kindly say whether a hot solution will melt the shellac varnish, and how would you clean the varnish off when gilded?—An Amateur.

[47879.]—**Silversmith Work.**—Will George Eversley be a little more explicit? Are the facets regular, or simply hammer-marks left rough on the under side of work. If "G. E." will state what he wants to hammer, I will send size, shape, and weight of hammer used.—Silversmith.

[47881.]—**Tricycle Making.**—The machine with the large back driving-wheel works pretty well, owing to the connecting levers necessary to drive it, the lever being better, in my opinion, than the rotary action. I should not, however, advise you to make that kind, your 18in. wheel being rather small. I should get another 50in., and make a machine with the small wheel behind, and the large wheels driven either by cogs or chains. The small back wheel is supposed to be superior to those machines having the small wheel in front, owing to the better action of the brake; the brake on the front wheel, if applied hard, has the same effect as on a bicycle—i.e., throwing the rider off in front, a quality not to be recommended. There are several good patterns now in the market; you should notice them and take your choice. If you live in London you will see dozens of different machines; if in the country, you should write for illustrated price-lists from the different makers. As to your getting it in a doorway 27in. wide, I am afraid you will not be able to manage that unless you are a good mechanic in that way, and possessed of the tools which you will require. However, if I can assist you in any way, I shall only be too glad to do so.—W. R. Hicks.

[47882.]—**Amateur Engraving.**—You cannot learn this art from printed instructions alone. You would not be able to do anything in the monogram line that you would like to put on your album-covers under twelve months' hard and diligent application, and at the expense of considerable damage to your left hand. The tools are very numerous, and though not costly, they are very difficult to whet. In fact, you would sooner learn to engrave than to whet the tools properly: but if you will advertise your address in "E. M." I will do the best I can to set you going (or any other reader who may fancy trying his hand) gratis.—Practical Metal Engraver.

[47883.]—**"The Vicar of Bray."**—See "Bray, the Vicar of," in Davenport Adams's "Dictionary of English Literature." The story told in the song is not literally correct, as the famous vicar is said to have lived in the reigns of Henry VIII. to Elizabeth, so that he was first a Papist then a Protestant, then a Papist, then a Protestant again. But if he changed his religion he kept true to his own principle, which was to live and die the vicar of Bray. His name, by some authorities, is said to have been Symon Symonds; by others, Pendleton; by others, again, Simon Alleyn. The story, however, is not confined to the church records of Bray. (Extracted from source named above.)—Ploni Almoni.

[47893.]—**Cement for Gas-Stove.**—Either of the following may be used with perfect satisfaction. Ordinary white-lead mixed with powdered red-lead until it becomes a stiff paste. A strong solution of silicate of soda mixed with dry powdered clay to the consistency of mortar. This requires to be thoroughly mixed, and worked into a smooth mass, or it is liable to crack. Both the above should be mixed fresh as required, and both are difficult to remove when set; they stand a red-heat without damage.—Thos. Fletcher.

[47897.]—**Cleaning Engravings.**—It is not a bad plan to rub them carefully over with a few moist, clean breadcrumbs. When thoroughly cleaned, size over the engravings with vellum size. When dry, give them one or two coats of good paper-varnish. If treated in this way, any dirt, dust, or flyspits can easily be removed by carefully rubbing over with a clean rag or sponge slightly damped.—G. Fryer.

[47897.] — **Cleaning Engravings.** — If the engravings are very dirty, take two parts of common salt and one part common soda, and pound them together until very fine. Lay the engraving on a board, and fasten it with drawing-pins, and then spread the mixture dry equally over the surface to be cleaned. Moisten the whole with warm water and a little lemon-juice, and, after it has remained about a minute, or even less, tilt the board up on its end, and pour over it a kettleful of boiling water, being careful to remove all the mixture, and avoid rubbing. If the engraving is not very dirty the less soda used the better, as it has a tendency to give the engraving a yellow hue.—Eleph.

[47900.]—**Weather-Glass.**—If too much alcohol be present the flocculi subsides; if too much water it all rises to the top. "J. C. B." does not say that his chemical glass contains camphor: it should. I have made a good many such weather-glasses, and experimented therewith. A drop of nitric acid will sometimes make the solution very sensitive; a drop of formic acid will sometimes make an improvement; so will acetic acid, while a drop of a solution of carbonate of potash will destroy all sensitiveness. I have a chemical glass at the present time in which the flocculi slowly rises from the bottom of the glass, and but very little remains at the bottom, and a day or two before a storm of wind and rain comes over us the mass of flocculi falls from the top to the bottom, and so the rise and fall goes on from one storm to another. I cannot give its component parts—it has been doctored so much in order to make it work to my satisfaction. Methylated spirit will do as well as pure alcohol.—W. M. Gardner.

[47904.]—**Thorough Bass.**—There are many elementary books on this subject, but to my mind the simplest and clearest of all for an absolute beginner is "Rudiments of Harmony," by Prof. G. A. Macfarren, published by J. B. Cramer and Co., Regent-street. The name of the author is sufficient guarantee for the accuracy of the teaching.—Blackwater.

[47904.]—**Thorough Bass.**—If "Musician" will get Hiles's "Catechism of Harmony and Thorough Bass," with key to same, he will find it just the work he requires. Each book is one shilling, and it is published by Brewer and Co., 23, Bishopsgate-street Within.—Henry Chapman, Kneller, Hull.

[47904.]—**Thorough Bass.**—The simplest and best introduction to the study of harmony that I have met with is a series of "Lessons in Harmony," by "E. J. P.," given in the English Mechanic, Vols. XIX. and XX., in which the science is divested as far as possible of the technicalities that bewilder a beginner. It was proposed to publish the series of lessons in a separate form, of which they were fully worthy; but I am not aware that it was ever done. If those volumes are not accessible, or if "Musician" desires a fuller treatment of the subject, let him procure "Logier's System of the Science of Music," published by Boosey and Co., Regent-street, upon which the "lessons" are based—decidedly the best work I know on the subject.—Organist.

[47905.]—**Legal.**—Here the legatee clearly obtains an advantage under his stepmother's will to the amount of £1,500, for if she had not bequeathed the mortgage debt to him, he would have had to pay the money to the executor as a portion of the estate belonging to the deceased. He is, therefore, liable to pay legacy duty upon the sum of £1,500, which he really receives under the will; and being a stranger in blood, that duty must be reckoned at the rate of 10 per cent. upon this amount.—Fred. Wetherfield, Solicitor, 2, Gresham-buildings, Guildhall.

[47907.]—**Problem in Co-ordinate Geometry.**—Let the radii r, s, and the rod, of length $l + m$, make angles θ, ϕ, χ respectively with the line, of length $2d$, joining the centres; then

$$\begin{aligned} r\cos\theta + l\cos\chi &= d + x \\ r\sin\theta + l\sin\chi &= y \\ s\cos\phi + m\cos\chi &= d - x \\ s\sin\phi - m\sin\chi &= y \end{aligned}$$

The first two equations give

$$(d + x)\cos\chi + y\sin\chi = \frac{(d + x)^2 + y^2 + l^2 - r^2}{2l}$$

$= 2\text{H}$, and the last two give

$$(d - x)\cos\chi - y\sin\chi = \frac{(d - x)^2 + y^2 + m^2 - s^2}{2m}$$

$= 2\text{K}$; whence

$$\begin{aligned} d\cos\chi &= \text{H} + \text{K} \\ d\,y\sin\chi &= \text{H}(d - x) + \text{K}(d + x), \end{aligned}$$

so that the required locus is

$$d^2y^2 = (\text{H}y + \text{K}y)^2 + (\text{H}\,\overline{d - x} + \text{K}\,\overline{d + x})^2,$$

in which the above values of H, K must be taken. The origin is taken at the middle point of the line joining the centres. The point suggested by A. J. Smith can be found only by solving an equation of the third degree.—R. E. B.

[47907.]—**Problem in Co-ordinate Geometry.**—In this problem there are several points in which P meets OO′, as Mr. Smith will find from his own equation by putting $y = 0$. Indeed, the equation requires that the origin should be the middle point of the line OO′. Assuming then this point as the origin and the line OO′ as the axis of x, the general equation to the curve will be

$$\Big[\, l\,(x + d)\,(r'^2 - l'^2) + l'\,(x - d)\,(r^2 - l^2) - (x^2 + y^2 - d^2)\Big\{ l\,(x + d) + l'\,(x - d)\Big\}\Big]^2 + y^2\Big[(l + l')\,(x^2 + y^2 + d^2 + l\,l') + 2\,(l - l')\,dx - l'r^2 - lr'^2\Big]^2 = 16l^2l'^2d^2y^2$$

If we make in this equation $l = l'$ and $r = r'$, as in the particular case given by Mr. Smith, we shall have, after reduction, the equation

$$x^2(x^2 + y^2 + l^2 - r^2 - d^2)^2 + y^2(x^2 + y^2 + l^2 - r^2 + d^2)^2 = 4l^2d^2y^2$$

which is identical with Mr. Smith's equation. The curve is interesting as being that described by a point in a link joining the extremities of two cranks. The investigation is perhaps rather long for the columns of the English Mechanic; but, if desired, I shall be glad to give it in full.—Milverton.

[47907.]—**Problem in Co-ordinate Geometry.**—Although the problem presents no very great difficulty, yet I find that in working it out it becomes very tedious, and although I did not complete it, yet I could see that, after all the trouble, the result would be unsatisfactory; it would be a very long equation, involving implicit functions of x and y up to the eighth powers of each, and would take up two or three columns of the "E. M." Any problem where two circles are concerned, together with a number of arbitrary constants, becomes insufferably tedious when worked by algebra.—M.I.C.E.

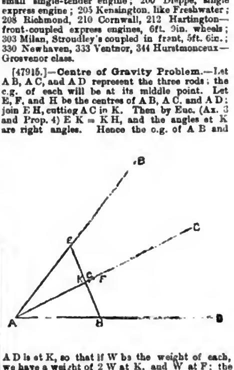
[47908.]—**Tricycle.**—To "Benedict"—Why not do as I have just done—sell your Coventry Rotary, and buy a Coventry Convertible? I presume the "eight or nine stone" you wish to carry is "live weight." You could thus utilise the weight in the propulsion of the machine, instead of turning your back on it in the ungallant fashion you propose; and your machine will be just as useful as a "Sulky" when you feel so disposed.—Fal.

[47913.]—**Electric Bath.**—Having been working-electrician at Dr. Caplin's establishment for some considerable time, I am able to supply the information required by "Au Revoir":—1. The bath must be of copper. 2. The battery employed was a zinc-carbon, the latter being really platinised graphite, size 7in. by 5in. Each zinc was mounted between two graphites, after the fashion of a Smee cell. Twelve such cells were usually employed, and put into action by a mixture of 1 part of oil of vitriol to 8 parts of water. The elements were withdrawn from the cells when not in use by a windlass arrangement. 3. The acid employed along with the water in the bath was hydrochloric; in the proportion of 1 quart of acid to 40 gallons of water. 4. The bath itself was attached to the negative pole of the battery (so as to constitute the cathode), while the patient was, by means of the suspended handle of metal (not bar), connected with the positive pole, and hence became the anode. 5. The cost of the bath, exclusive of battery, will vary with the thickness of the copper employed. It may be anything between £5 and £20. If home made, the cost of a 12-celled battery will be about £3. N.B.—The patient must be prevented from touching the bath at any point by means of a wooden trellis under the body, and a strong band under the head; otherwise the electrolytic action of the current will be nullified. If "Au Revoir" lives anywhere near London, and cares to advertise his address, I shall be happy to give him the benefit of my experience.—S. Bottone.

[47914.]—**L. B. and S. C. Engines.**—Wimbledon, No. 6, 4-coupled wing tank; Bramber, No. 246, 4-coupled wing tank; Ashburnham, No. 248, 4-coupled wing tank; Buckhurst, No. 252, 4-coupled wing tank; Pelham, No. 253, 4-coupled wing tank; Tunbridge Wells, No. 279, 4-coupled wing tank; Richmond, No. 208, 6ft. 6in. leading and driving coupled; Ventnor, 333, single inside bearings.—Alaric.

[47914.]—**L. B. and S.C. Engines.**—Replies to this query, more or less complete, have been received from several correspondents. We have amalgamated those from D. Smart, "Genoa," "E. W.," "W. B. P.," "Clyde," and "Surrey." 3 Battersea, 6 Wimbledon, 7 Bermondsey, 17 Dulwich, 28 Isfield, 246 Bramber, 248 Ashurst, 252 Buckhurst, 253 Pelham, 255 Withdean, 259 Telford, 260 Lavington, 273 Dornden, 279 Tonbridge Wells, 285 Holmwood, 286 Ranmore, 288 Effingham, 289 Holmbury, 291 Deepdene, 293 Norbury, 294 Rosebery, 298 Southwark—four-coupled tank engines, like Bury Hill, given in a recent number. 44 Fulham, 45 Merton, 73 Deptford, 75 Blackwall—Terriers. 101 Orleans, 102 Cherbourg, 104 Brittany—six-coupled tank goods engines; 231, tank engine with trailing-bogie; 233 Horsham, small single-tender engine; 200 Dieppe, single express engine; 205 Kensington, like Freshwater; 208 Richmond, 210 Cornwall, 212 Hartington—front-coupled express engines, 6ft. 9in. wheels; 303 Milan, Stroudley's coupled in front, 5ft. 6in.; 330 Newhaven, 333 Ventnor, 344 Hurstmonceux—Grosvenor class.

[47915.]—**Centre of Gravity Problem.**—Let A B, A C, and A D represent the three rods; the c.g. of each will be at its middle point. Let E, F, and H be the centres of A B, A C, and A D; join E H, cutting A C in K. Then by Euc. (Ax. 3 and Prop. 4) E K = K H, and the angles at K are right angles. Hence the c.g. of A B and



A D is at K, so that if W be the weight of each, we have a weight of 2 W at K, and W at F; the c.g. of the whole, therefore, will be at G, distant from K, ⅓ of KF. Now $AK = AH\cos. 30^\circ = AD\sqrt{3}/4$, and $AF = AC/2 = AD/2$ ∴ $KF = AD(2-\sqrt{3})/4$ ∴ $KG = AD(2-\sqrt{3})/12$ ∴ $AG = AD(1+\sqrt{3})/6$. Hence c.g. is distant from A $1+\sqrt{3}/6$ of the length A C.—TAM O'SHANTER.

[47915.]—**Centre of Gravity Problem.**—The centre of gravity of each of the rods will, of course, be in the middle of each. Join these points by straight lines, and we get a triangle. The common centre of gravity will be in the middle rod of the three. If the portion of the middle rod between the apex of the triangle and its base be divided into three, and two of these parts be measured from the apex, we get the required centre.—M.I.C.E.

[47915.]—**Centre of Gravity Problem.**—Draw equal lines at the proper angles representing rods, bisect the lines, draw a line from middle point of A B to middle of A D. Divide the distance from the point where this line intersects A C to the middle of A C into three equal parts; the first point of division from where the line intersects A C is the centre of gravity of the three rods. This mode will do for any three equal rods, provided the angles the other two make with the middle one are equal.—SCOTCH WORKING MECHANIC.

[47916.]—**Midland Tank-Engines.**—The tank-engines which I mentioned are fitted with brakes as follows:—1532 to 1546 are fitted with steam brakes only; 1547 to 1551 are with steam, also Saunders and Bolitho's vacuum; 1552 to 1561 are fitted with steam only; the 780 class, built by Dubs and Co., Glasgow, are fitted with steam, also Saunders and Bolitho's vacuum; 1252 class, built by Neilson and Co., Glasgow, are fitted with steam only. There are 46 engines, called the 800 class; I will give you the numbers: 3, 22, 23, 60, 61, 62, 63, 64, 65, 66, 93, 167, 168, 169, 138, 139 (there is a little difference between these and the 800 class; they are 3in. shorter between the centre of driving and trailing-wheels, but in the shop they are termed the 800 class), 800 to 829. There are 20 890 class, built by Neilson and Co., Glasgow, 890 to 909.—CAMOMILE.

[47917.]—**Voss Electrical Machine.**—"W. J." will find a full description and illustration of this machine in a back number of the ENGLISH MECHANIC, Vol. XXXIII., p. 335.—JOHN C. FRANK.

[47918.]—**Maclaurin's Theorem.**—The fifth differential coefficient of the given function is

$$4e^{x}(4e^{x}-5)-4xe^{x}(8e^{x}+1),$$

which is equal to -4 when $x=0$; hence the given result.—R. E. B.

[47918.]—**Maclaurin's Theorem.**—If e^{2x} be expanded, it becomes $1+2x+4x^2/2+8x^3/2\cdot3+$, &c. Multiply this series by $(3-x)$ and we get $3+5x+4x^2+2x^3+2/3x^4+2/15x^5+$ &c. In the original expression we have $-x-3$ to be added. The first term will, therefore, disappear, and the second becomes $4x$, the others remaining the same. Again expand e^x, and multiply by $4x$, and we have $4x+4x^2+2x^3+2/3x^4+x^5/6+$ &c. Subtract this series from the one first obtained (after dealing with the first two terms as explained). All the terms disappear except the last, and we have $(2/15-1/6)x^5$, or $-x^5/30$, which is the same as $-4x^5/120$, or $-4x^5/2.3.4.5$.—M.I.C.E.

[47918.—**Maclaurin's Theorem.**—

Let $e^{2x}(3-x)-4xe^{x}-x-3=f(x)$

Then $f^{1}(x)=2e^{2x}(3-x)-e^{2x}-4(1+x)e^{x}-1$

∴ $f^{11}(x)=12e^{2x}-2e^{2x}(2x+1)-2e^{2x}-4e^{x}-4e^{x}(1+x)$.

i.e., $f^{11}(x)=fe^{2x}-4xe^{2x}-4xe^{x}-fe^{x}$

∴ $f^{111}(x)=16e^{2x}-4e^{2x}(2x+1)-4e^{x}(1+x)-fe^{x}$

i.e., $f^{111}(x)=12e^{2x}-8xe^{2x}-12e^{x}-4xe^{x}$

∴ $f^{1111}(x)=24e^{2x}-fe^{2x}(2x+1)-12e^{x}-4e^{x}(1+x)$

i.e., $f^{1111}(x)=16e^{2x}-16xe^{2x}-16e^{x}-4xe^{x}$

∴ $f^{11111}(x)=32e^{2x}-16e^{2x}-(2x+1)-16e^{x}-4e^{x}(1+x)$

i.e., $f^{11111}(x)=16e^{2x}-32xe^{2x}-20e^{x}-4xe^{x}$.

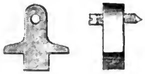
From these results it will be seen that $f(O)=0$; $f^{1}(O)=0$; $f^{11}(O)=0$; $f^{111}(O)=0$; $f^{1111}(O)=-4$. Hence the first term is $-\frac{4x^5}{15}$. Mr. Romanes must have made a slip in his sign.—AN ENGINEER'S SON.

[47930.]—**Raising Water.**—If the pipe through which the water is to be raised 30ft. be a short one, and not less than 4in. diameter, a quantity equal to 66 gallons per minute may be raised by a turbine. To proceed with the construction of the turbine, the best way by far is to consult an engineer, or apply to a maker of turbines. There are so many little things to be attended to, if success is to be insured, that they could not all be stated in the ENGLISH MECHANIC, unless the editor would withdraw his general order of brevity.—C. S.

[47931.]—**Making Miner's Boots Waterproof.**—A solution composed of indiarubber (small pieces), 1oz.; boiled oil, 1 pint. Apply heat until dissolved, then add 1 pint hot boiled oil, stir thoroughly, and cool. Apply hot.—ALEX. MCDONALD.

[47931.]—**Making Miner's Boots Waterproof.**—I send a good recipe for the above. Melt over a gentle fire, and stir together till thoroughly mixed, 1 pint of neat's-foot oil, ½lb. of mutton suet, 6oz. of beeswax, and 4oz. of rosin. Clean the boots and rub some of the above well in before a fire, repeating occasionally.—W. R. HICKS.

[47932.]—**Looped Figures by Gearing.**—In reply to "Amateur," I should have stated that if the turn of the headstock is a close fit between the bed, it may need a slice planed off to give it freedom of oscillation, especially if a deep one. This will not interfere with its general accuracy, if, when not meant to oscillate, the side not thus planed is pressed back against the bed, as this will place it in its true position, as it was before it was planed. A great many small headstocks have, however, very short tenons, which will be sufficiently free without planing. These can be raised till the bottom of the tenon is almost out from between the bearers; but I would never raise the headstock further than absolutely necessary, and prefer to plane the tenon thinner on that account. The ornamental slide-rest is easily raised to match the new position of the centre. The ordinary metal-turning rest cannot be so raised, but the tool can be packed up, as is frequently done in ordinary turning. The tool, as a rule, is to be level with the lathe-centre, but the pattern is varied by placing it above or below; and this is often desirable. The second mandrel is necessary—the eccentric disc placed upon it is acted on directly by the rubber; the gear-wheel is on the same mandrel as the disc—the eccentricity may be great or otherwise. I have shown the mode of increasing or reducing it. It is by varying the eccentricity that the patterns are so readily modified. The centre screws on which the poppet oscillates are often fixed in a pair of little poppets, which fit between the bearers like this,



which thus raises the tenon of the oscillating headstock quite clear of the top of the bed. For experiments on the effects producible by a rocking headstock these may be made of beech or any tough wood; but for permanent use should be of iron with steel screws. If not sufficiently raised, the base of the poppet will strike the bed.—J. L.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Glatton" has replied to 47213, 47248, 47356; J. Brown, 47254.

47320. Portable Target, p. 411.
47332. Engine and Boiler for Small Boat, 412.
47336. L.B. and S.C. Locos., 412.
47342. Dialyte Telescope, 412.
47344. Small Dynamo-Machines, 412.
47345. Indelible Stain for Stone, 412.
47358. Cold Air, 412.
47370. Dynamo-Machine, 413.
47374. Ulcerated Varicose Veins, 413.

47569. Barrel Piano, p. 508.
47575. Electric Pendulum, 508.
47581. Coil. To Mr. Tolmen, 508.
47582. To Mr. Lancaster, 508.
47593. Paper-Making, 508.
47594. Chemical, 508.
47601. G.W.R. Engines, 509.
47602. Turkey Red, 509.
47605. Probable Errors, 509.
47614. Gas Analysis, 509.
47616. Abyssinian Tube-wells, 509.
47617. Logarithms, 509.
47619. Universal Joint, 509.
47621. Heberlein Brake, 509.
47626. Warping, 509.
47627. Pneumatic Bellows, 509.

A NEW explosive compound, to which the name of Panclastite is given, has been invented by Mr. E. Turpin; it is composed of two liquids which are harmless before being mixed. It is said to be less liable to spontaneous combustion than dynamite, and to produce far more striking results.

QUERIES.

[47935.]—**Ventilation of Room.**—Will some of your readers advise me in the following matter? A large room, about 25ft. by 16ft., is lighted with gas—five burners hung from ceiling. The ornament over the gas in the ceiling is perforated, and has, or is supposed to have, communication with outer air by gratings in side of house; but the hot air never seems to go out at the perforations: rather there is a draught in, and the heat of the room is unbearable. I saw last year at the Agricultural Hall, Islington, a chimney-top or ventilator, called the "Eclipse," which was said always to produce a steady updraught. I want to know whether a small pipe carried up the side of the house with one of these ventilators on the top, and communication below with the space between the floors over the room, would affect the desired purpose of carrying off the hot air without any other inconvenience resulting from the draught in the room?—F. R. C. S.

[47936.]—**Machine for making Jack Chain.**—Can any of "ours" oblige by giving a description of the above, with diagrams, if possible? The chain required is that used for certain kinds of spurs.—C. G. W.

[47937.]—**Electro-Motor.**—To "CONRAD."—Will "Conrad" (p. 554) kindly give sketch of commutator of his electro-motor? Also, state what terminals of wire are to be connected together? What gauge of wire, and how much, should be used on the armature and on the field-magnets, supposing the motor were 3½in. long?—A BEGINNER.

[47938.]—**Photography.**—Can I photo the interior of a room at night (40 by 25ft.) by magnesium light in sufficiently short a time to take a few people sitting in it? If so, what length of ribbon must I burn, and should the gas be lit or not? I use a Ross symmetrical lens and Miall's instantaneous dry plates. I also find a difficulty in developing these to get the right intensity, some being too thin, while others with the same apparent development take hours to print. Any hints on the above will greatly oblige.—SEMPERVIVO.

[47939.]—**Grinding Sawdust.**—Will some one please describe a machine or a process for grinding or reducing sawdust to a fine powder? What I want is to reduce the dust from circular sawbenches to the same fineness as that from bandsaws.—SAWYER.

[47940.]—**Mathematical.**—(1) Show by means of the exponential values of the trigonometrical functions, that if—

$$u = \log._e \tan.\left(\tfrac{1}{4}\pi + \tfrac{1}{2}x\right)$$
$$= Ax + Bx^3 + Cx^5 + Dx^7 +$$
$$\text{then } x = Au - Bu^3 + Cu^5 - Dx^7 +$$

Show also that $A = 1$, and that there are no even powers in the expansion.—(Hon., 1879.)

(2) If $u = \log.\tan.\left(\tfrac{1}{4}\pi + \tfrac{1}{2}x\right)$ show by the use of exponential forms that—

$$\text{if } u = ax + bx^3 + cx^5 + dx^7$$
$$\text{then } x = au - bu^3 + cu^5 - du^7$$

—(Hon., 1882.)

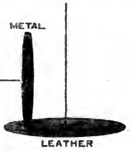
(3) A B C is a great circle of a sphere: AA′, BB′, CC′, are arcs of great circles drawn at right angles to A B C, and reckoned positive when they lie on the same side of it. Show that the condition of A′, B′, C′, lying in a great circle is

tan. A A′ sin. B C and tan. B B′ sin. C A + tan. C C sin. A B = 0.

(4) Prove that $\log._e x = \frac{1}{n}\;{}^{\infty}S_m\left(\frac{x^{mn}-1}{m(x^n+1)^m}\right)$

Where ${}^{r}S_m . f(m)$ denotes the sum of (r) terms of the series whose mth term is $f(m)$.—DUBIOUS.

[47941.]—**Coating for Leather Disc.**—"Jack of All Trades" must have misunderstood my query on the above. I do not want a substitute for leather, as he supposes, but a substance with which to coat it so as to protect it from wearing. The discs are neither grooved nor coned-driver iron. See sketch.—A DOWN MECHANIC.



[47942.]—**Bought or Not?**—To MR. WETHERFIELD.—A. advertises a piece of machinery for sale at a fixed price in a local paper. B. applies personally, inspects the machine, and agrees to have it at that price, and wishes it to remain on A.'s premises until the following week, telling A. he can have the cash any time. Two days after the purchase B. writes to A. declining to have the machine. Consequently, A. writes to B., incloses bill of machine, and saying that B., having bought the machine (thus causing A. to refuse other applications), must remove and pay for it by the end of the following week, or he will be sued for the same. B. not complying, A. wishes to know what course he is to take, and if it would be a good case for the County Court?—AN OLD READER.

[47943.]—**Locomotive Engines.**—Would any of our readers kindly give me information as to what railway the peculiarly-designed engines Lioness, Tartar, and Avon belong, and the difference in the value between one of Mr. Johnson's fourteen forties on the M.R., and one of Mr. Webbe's twenty-three seventies on L. and N.W.R.?—F. E.

[47944.]—**Legal.**—Can Mr. Wetherfield kindly aid by informing as follows?—Suppose I purchase a photographic likeness of any public character, say of the Premier, and reproduce this likeness for sale, not in photo, but in litho, or copper or steel plate, say, shall I, in so doing, be infringing the law of copyright?—Delta.

[47945.]—**Cotton v. Leather Belting.**—Will someone kindly give his experience on cotton belting in distinction to leather?—A. B.

[47946.]—**Failing Sight.**—From opacity of sight ("blurring of the disc") for 3½ years I was unable to follow my calling of clerk, draughtsman, and surveyor. I then (18 months ago) ceased smoking tobacco, and my sight slowly improved till three months ago. It is again slowly becoming worse. I have not smoked since. Can any reader kindly suggest how to prevent its becoming worse, or how to improve it? Would a field-glass aid me in ranging by poles lines in the field? Health has been feeble for some months and I am constantly taking debilitating colds, spite of precaution.—Age 53.

[47947.]—**Land Reclamation.**—In this connection what does the term "warping" mean, as applied to raising the level of land reclaimed from the sea?—J. Brown, Belfast.

[47948.]—**Cold-Air Machinery.**—Will some brother-reader who is conversant with the theory and working of cold-air producing machines kindly give me some information as to the following? What is the lowest temperature which it is possible to attain in those machines? Can 40° below zero be reached? If so, please say what pressure per sq. in. the air would have to be compressed to in the first instance, and to what temperature would such compressed air be raised during the compression?—W. Ainsworth.

[47949.]—**Power Wanted.**—What size of engine or engines shall I require to work one of those firewood-chopping machines and a circular saw 18in. diam., with a sawbench 20ft. long, 3ft. broad, and 3ft. deep, and also a small chaff-cutter, and what size of boiler, and which is best—vertical or horizontal—and what pressure shall I need: and last, but not least, what will the cost be?—Piston-Rod.

[47950.]—**G.W. Engines.**—Can any one inform me whether the G.W. B.-gauge and N.G. engines are numbered separately, and if not, what is the highest number to which they run?—R. H.

[47951.]—**Wheel Barometer.**—Would some kind brother-reader tell me how to fill a barometer-tube—what quantity of quantity of quicksilver and cost of same, &c.?—Engine Fitter.

[47952.]—**Agricultural Chemistry.**—I intend commencing the study of this science, and would like to know of a book suitable for self-instruction. Could any of your readers enlighten me?—J. D. B.

[47953.]—**Geological.**—I found a piece of rock (about a cubic foot) in the sand and gravel pits at Newton-road, near Wednesbury, Staffordshire, about 50ft. from the surface. In breaking through it is apparently composed of some porous material and numerous shells. The place abounds in what appear to be fossil fruits, from the size of a small bean to that of a large cocoanut, inclosed in a strong shell of ironstone. I think it is Mr. Howell in his "Geology of Warwickshire" who says the conglomerate of the Keuper bed crops out in the above district. Perhaps some of your correspondents can give me information or will say where I can find it?—Jno. Dawson.

[47954.]—**Seashore.**—On the sands at Paignton, Devonshire, last spring, there were a number of objects exactly resembling the casts in sand of the high heel of a lady's shoe. They could be handled, but were very fragile, and showed what appeared to be an organic structure upon breaking them. Can any one give the name and the nature of these objects?—F. B. A.

[47955.]—**Solar Eclipses.**—Can any one inform me as to the maximum duration of totality in the solar eclipses from 1851 to 1878?—F. B. A.

[47956.]—**Matches.**—I want some matches which will ignite on being slightly pressed against a box without rubbing them on it. Are such matches made? If not, are any chemicals known by which such might be made?—J. B. Dunn.

[47957.]—**Measuring Heights of Mountains.**—To "F.R.A.S."—Will you kindly tell me if there is any method of measuring the heights of mountains (roughly) without special instruments? There is a mountain about a mile from my window over 3,000ft. high, I believe. It is not precipitous, so I cannot get under the summit, or I could measure it easily.—Glen.

[47958.]—**Chloride of Silver Batteries.**—I should feel greatly obliged for plain instructions how to make chloride of silver batteries for medical purposes? Also, other kinds of pocket batteries suitable for a person travelling in China?—W. H.

[47959.]—**Gauges of Continental Railways.**—Can some reader tell me the exact measurement of the gauges of the railways on the Continent of Europe? Are they all the same as the French with the exception of the Spanish?—F. B. M.

[47960.]—**Bright Boots.**—I want a liquid blacking for private use, something like Hanthaway's peerless gloss. Can anyone give me a recipe? Would that do given in the issue of Sept. 1?—R. M.

[47961.]—**Eels in Vinegar.**—To what are these owing? Do they indicate the purity of vinegar, as I am told they never occur in the low-class article?—Acid.

[47962.]—**Liquidation.**—I place an order with a firm for some articles, the materials for which I place in their hands and obtain a receipt for them, they undertaking to make up the articles and return them to me. The order is partly executed, when they fail and go into liquidation. In a case like this, is there any reason to fear for the balance of my materials in their hands, or could I safely leave them there until a settlement is effected? I understood a receiver had been appointed, and the works are to be carried on as usual. Will Mr. Wetherfield kindly enlighten me?—Sefton.

[47963.]—**Legal.**—A. makes a will in which is found the following:—"I give &c. to my dear wife Jane for and during the term of her natural life the rents &c. of all those four newly-erected houses situated &c. and immediately after her decease I give and devise the whole of the said four houses &c. aforesaid to my son B. to hold to him his heirs and assigns for ever." B. dies 18 months after, and leaves a will wherein is found: "I give devise and bequeath all my real and personal estate in possession and expectancy to my dear wife Mary her heirs executors administrators and assigns." Mary dies 14 years after without issue, while A.'s widow, Jane, is still alive, as is also A.'s elder son. The questions are, now, Have Mary's heirs any claim on the above-named property? Can B. give away what neither he nor his wife ever possessed? Will the property go back to Jane as A.'s widow and heir? In short, to whom will the property come?—Anglo-Dane.

[47964.]—**Coloured Stars.**—Is a coloured star composed of a single body or of several bodies? If of one, sometimes such stars change their colour and magnitude. Do their matter and volume also change? If of two bodies are both of the same colour? What are their respective positions? Suppose one is red and the other yellow, will not their light be orange? If blue and white, will not the light be pale blue? Does any reader know of a means of detecting all this without incurring the expense of large optical instruments? If so, will he say how?—S. St. Croix.

[47965.]—**Glaze for Fireclay.**—Can any reader tell me what to use for blue or black glaze for ridge tiles?—R. S.

[47966.]—**Concrete.**—Would "Khoda Bux" (letter 20456) kindly give exact size of the vessels he uses for measuring the ingredients for concrete, and say if sea-sand is equally good? What is "finely-ground quicklime"? Slacking fresh-burnt lime with water and covering up in sand will leave it in fine flour. No need for grinding.—Amateur Builder.

[47967.]—**Pattern-making.**—Will "Cast Iron" oblige us with a description of the way patterns must be made for small work such as lathes and engines; particularly such pieces as slide-rests which have undercut V-channels and engine-cylinders? How must the lugs or feet be arranged when the pattern divides through centre of steam-port's face?—O.V.

[47968.]—**Dynamo.**—Will "E.," or some other competent electrician, kindly state whether a Siemens armature 5in. by 2½in., with 2lb. of c.c. wire No. 20, would light a five-candle Swan lamp satisfactorily? The field-magnet is a good one.—Conrad.

[47969.]—**Liability for Injury.**—To Mr. Wetherfield.—Would you be so kind as to tell me what to do in the following case?—On the 3rd of August last the firm by which I am employed hired a van from contractor to send some cases to the docks and sent me with them to see them shipped, &c. While on the road to the docks, and about five minutes after we started, the near front wheel came off and pitched me out, and while on the ground the corner of the van came down on me and injured my right leg, so that I have been unable to work since, and am still unable. I think I can put what I want to know in four questions: 1. Can compensation be had, and about what amount can be claimed in the case? 2. Is it to be claimed from my employers, and let them recover it from contractor, or am I to claim it direct from the contractor myself? 3. Will it come under the Employers' Liability Act? 4. Is there any limited time after the accident for giving notice or bringing an action against the responsible party?—J. R. E.

[47970.]—**Rating Club-house.**—To Mr. Wetherfield.—Will you kindly inform me whether a club-house can be legally rated for Poor-rates, &c.? The club-house was presented to the members for their use free of rent. It consists of two rooms, and no one lives on the premises. The rooms are only opened for three hours of an evening. It is used entirely as a club and institute. Refreshments are on the premises, and the members pay a weekly subscription, paying for their refreshments as they require them. The club has been opened nearly seven years, and never been charged with a rate before.—Sec. P.C.H.I.

[47971.]—**Gas-lighting Spark Coil.**—Would "Sigma," or some other reader, kindly give length of wire and sizes of same for a small coil to give a ½ spark for gas-lighting; to work with chloride of silver battery? Should I use one or two cells, and what surface of silver?—A. L.

[47972.]—**Metal-work.**—Can any one tell me how the new work in copper and brass is done? It is called, I believe, "repoussé work," and consists of designs in relief on copper or brass ornaments in imitation of old metal-work. It appears to be done with some sort of punch. What should the gauge of the metal be? Is anything used as a backing, and what tools are used? Is any book published on it?—Pat.

[47973.]—**Barium Compounds.**—Would any of your readers favour me with information and sketch of plant required to make barium chloride and nitrate direct from the sulphate? I mean the process of turning the sulphate into sulphide by reduction with coal, on a practical scale.—Amateur.

[47974.]—**Question in Dynamics.**—Suppose a conical body of 6in. in length, the diameters of whose extremities are 3in. and 1in. respectively, be propelled through a point above its centre of gravity on a plane superficies, and by inertia continue to roll on. What figure would it describe, and what would be the dimensions of the figure? Now, suppose the diameter of the thick end of the body be lessened by 1in., and the operation repeated. What would be the difference between the two figures, what proportion would the difference bear to each figure, and what would be the reasons of the results?—G. B. T.

[47975.]—**Testing Lightning-conductor.**—How can a lightning-conductor fixed many years ago to a lofty chimney stalk, be tested as to whether it continues in good working order?—No Sig.

[47976.]—**Firing Guns.**—Will P. Vallance kindly oblige with further information as to the system mentioned on p. 13? Is it applicable to a breechloading system, and how was the powder inserted, ditto the bullet, was there any decrease as to range, and how about elevation?—B. E. W.

[47977.]—**Water-power.**—Given a waterfall with a varying quantity of water always flowing over it, what horse-power could be obtained from it by means of a turbine wheel under the following conditions?—Height of fall, 10ft.; width of overflow (an even surface of cement), 72in.; minimum depth, ½in. (equal to what would pass through a conduit 6in. square), and a maximum depth of 2in. (equal to 12in. square).—What power would the minimum and maximum falls of water respectively give with either a turbine or common water-wheel, and which of the two would produce the better result, and which the cheaper and least likely to get out of order?—H. H.

[47978.]—**Violin.**—I have a violin labelled "Mansuy à Paris." Can some one kindly give me particulars as to the date and characteristics of this maker, and state what rank his instruments take?—A. E. T.

[47979.]—**Locomotives on Various Lines.**—L.N.W. Engines.—Wanted principal dimensions of Princess Alexandra and Nos. 531, 770, 1877, 1906, 2049, 2064, 2101, 2240. M.R. Engines.—Wanted principal dimensions of 60, 132, 204, 402, 695, 761, 799, 890, 1125, 1272, 1304, 1398, 1441. G. W. Engines.—Wanted principal dimensions of Swallow and Nos. 385, 520, 716, 866, 913, 990, 1271, 1401, 1577. G.E. Engines.—Wanted principal dimensions of 104, 155, 176, 212, 339, 488, 528. S.E. Engines.—Wanted principal dimensions of 56, 63, 149, 150, 181, 203, 214, 229, 236, 273, 287, 300, 310. S.W. Engines.—Wanted principal dimensions of Firebrand, Zephyr, and Nos. 21, 133, 135, 252, 319.—Alaric.

[47980.]—**Pressure.**—Would any of "ours" be good enough to explain by diagram the fitting up and working of a hydraulic press? I want a pressure that I can either crack a nut or press up to 20 tons per sq. in. My plates will be 14 by 12in. square. There will be 12 plates altogether, one above the other. Would malleable iron plates stand the pressure and retain their shape? They will be hollow or grooved, because I will require them to be heated by steam up to 300° Fahr. or more. Show how the under part is constructed with valves, &c.—A. B. C.

[47981.]—**Steam Plough Engines.**—Can any of our readers give me some of the leading dimensions of an 8-h.p. ploughing engine with drum under boiler-barrel?—H. S.

[47982.]—**Field-glass.**—I have recently bought a binocular field-glass with revolving lenses styled field, marine, and theatre. Would any reader of ours kindly inform me what the difference of the three lenses consists of, how could I practically test them, and say whether I could put them to any such use as taking photos?—F. W. J.

[47983.]—**Reasonable Wear.**—In some leases one of the covenants is substantially that the house shall be given up, &c., together with all fixtures, &c., in good repair (reasonable wear excepted), but it reads to me very ambiguously, as generally worded. Does the reasonable wear refer to the house and fixtures, or to fixtures only in the received acceptation? As usually expressed (see Woodfall) it may mean either; and an experienced solicitor whom I have asked holds to one version, while an experienced surveyor holds to the other.—Posconal.

[47984.]—**Dry Plate Transparencies.**—Will Mr. W. J. Lancaster kindly give dry process for taking and developing transparencies for the lantern?—A. B. Y.

[47985.]—**Measuring Atmospheric Pressure.**—I have a 6in. tube inserted in the ground, reaching the water-bearing strata, which fluctuates from 20ft. to 30ft. from the surface. In this tube floats a hollow sphere of copper, to which is attached a fine wire, passing over a pulley fixed 7ft. high on the inside of the wall of a building, and balanced by a plummet of lead. By the rise and fall of this plummet I am able to measure the varying depth of the water-line in feet and in inches; but I am wishful to discover, if possible, any atmospheric influence on the rise and fall of this water-line. Will any one kindly oblige me by describing a simple arrangement by which any variation, as small as the one or two-thousand part of an inch, could be readily detected?—Aqueous.

[47986.]—**Parrot.**—Can any reader of "ours" kindly assist me in the following?—I have a parrot who is astonishingly tame, even with perfect strangers, but who has the bad habit of pulling her feathers out. Her red tail, left wing, and sometimes her breast attract her special attention, and no sooner one appears a little longer than she particularly cares about, than out it comes. Her principal food is as follows: Hemp-seed and bread-and-butter daily; raw potato and meat (cooked) frequently; biscuit, sop, and oatmeal porridge occasionally. In fine weather she is put out of doors, and sometimes when the sun is out sprinkled with cold water. She has a way of holding her head lower than the perch she stands on, and shaking her wings, apparently straining every nerve. What would be the best diet and treatment? Can any one assist me from experience?—Polly Parrot.

[47987.]—**Carpenter's Bench.**—Will any reader kindly give me the proper dimensions for making a carpenter's bench?—Amateur Carpenter.

[47988.]—**Violin Making.**—Will any one oblige by describing the kind of tool used by violin makers for cutting out the *f* holes of their instruments? I find cutting out with the pen-knife a rather tedious operation.—Tyro.

[47989.]—**Scroll Chuck.**—I want to make a four-jaw scroll chuck about 3½in. diam. Can any reader tell me how to cut the teeth on bottom of jaws which engage in the scroll, so as to be of a curved shape?—A. F. Shakespear.

[47990.]—**Asphaltum.**—Is this soluble in spirits of wine or meth. spirits? I intend to mix the the solution with a spirit varnish.—Tyro.

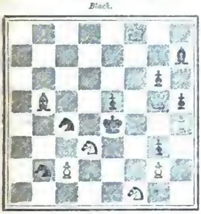
Since June 1st Mr. Edison has filed fifty-one applications for patents upon electric lighting devices, and has recently received twenty-eight patents, making 109 in all upon his system of electric lighting.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXXI.—By [illegible]

Black.



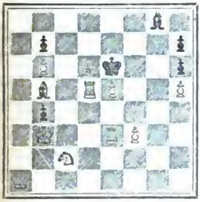
White.

White to play and mate in three moves.

PROBLEM DCCLXXXII.—By J. P. Taylor.

From the first number of [illegible]

Black.



White.

White to play and mate in two moves.

Solution to 777.

White.	*Black.*
1. B to K B 8.	1. P to K 4 (a)
2. B to Q 6.	2. P takes K
3. Kt to Q 2.	3. K takes Kt
4. B takes P mate.	
	(a) 2. P to K 5
3. R to B 6.	3. Anything
4. Mates.	

If 1. —— / P to K 3, 2. B to Q Kt 4 / ——, 3. R or B mates accordingly.

If 1. —— / P to Q 3, 2. B takes P / ——, 3. R mates.

Solution to 778.

White.	*Black.*
1. R to Q 7.	1. Anything
2. Mates accordingly.	

Game between two amateurs:—

(Ruy Lopez.)

White.	*Black.*
P. F. B.	H.
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. B to Kt 5	3. P to Q R 3
4. B to R 4	4. B to B 4
5. P to Q 4	5. P takes P
6. P to K 5	6. P to R 3
7. Castles	7. K Kt to K 2
8. R to K sq	8. Castles
9. B to B 4	9. P to Q 4
10. B takes Kt	10. Kt takes B
11. Q to Q 3	11. P to B 3
12. P to K 6	12. Q to K 2
13. Q to B 5	13. Kt to Q sq
14. Q Kt to Q 2	14. B takes P
15. Q to R 5	15. Q to Q 2
16. Kt to Kt 3	16. B to K 3
17. Kt takes P	17. B takes Kt
18. Kt takes B	18. B to Kt 5
19. Q to Kt 6	19. Kt to B 2

The game was continued a few more moves when Black succumbed.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 776 by J. Clegg, junr., to 778 by Schmucke.

W. E. K.—Thanks for the problem; but where is the mate if 1. —— / R to K Kt? What is the use of all Black's pieces?

A. E. S[illegible].—Your name is entered on tourney-list.

Mr. F. F. Barcuss intends to publish by the close of the year, should sufficient subscribers be obtained, a book entitled "Chess Blossoms," containing forty two-move and a few three-move Chess problems, with hints on the solving and construction of two-movers, poems, acrostics, and, if space permits, the prize problems in British tourneys of 1892. Price to subscribers, 2s. 6d.; after publication, 3s. 6d.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 13, and unacknowledged elsewhere:—

E. Bentley.—W. G. P.—A Fellow of the Royal Astronomical Society.—W. H. Hicks.—W. McGhee.—Tyro. —J. T. S., Sheffield.—J. H.—J. L. W.—P. H.—H. G. Minty.—T. N. Andrews.—T. R. Atkinson.—One in a Fix. —J. W. Bond.—Julia.—Paterfamilias.—Optical.—R. A., Cantab.—C. W. H.—Rushallite.—James Reynolds.—Alltop.—T. W. S.—Alexander.—Amateur.—W. Pugh. —Wallington.—W. S. Brown.—Prismatique.

A NEW VOLUME.

The last number was the first of volume XXXVI. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXV. will be published next week, and the bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the past volume are recommended to do so at once, as the back numbers soon run out of print.

A. E. H[illegible].—Thanks. The question was about free phosphorus in connection with a well-known advertisement. See pp. 323, 351, [illegible], Vol. XX., for a series of experiments.—Kittiwake. You can obtain answers to your questions at any of the registry offices or of the clerks at the churches.—W. Nunn, Ealing. (How can he say why, unless he is in the secrets of the directors. There have been plenty of "failures" reported, but nothing serious. The last account is published in the report.—Clyde. (To what does it refer? The engine seems to possess no peculiar features, and we are compelled to be careful of space.)—J. M. L. (The best plan would be to have a boiler adapted to the stove, which is burning all day. 2. We should think a rope of the dimensions named would be strong enough, but it would be liable to decay rapidly if wetted by rain.—Anti Corrosive. (Do you mean incrustation or corrosion?—A. B. (The difficulty is that so few people know of the machine. Cannot the makers explain?)—Stick-in-the-Mud. (Put into a solution of dilute sulphuric acid for a few minutes, and then with a wisp of tow brush mercury over them. If the zinc is dirty it should previously be cleaned with hot solution of soda aided by a brush.)—M. W. (Tallow alone, or tallow after plaster or whiting coloured to suit. Cheap work is simply sized.)—R. H. (You had better procure the situation first, for you will certainly have to go as junior. You do not say whether you mean as corresponding clerk or costs' clerk. The latter must, of course, understand the prices and brands of various materials.—Amateur Gardener. (Hurd[illegible]'s tables, published by Lockwood and Co., Stationers' Hall-court, may suit you; but there are several works of the kind, and any bookseller will give you their titles, and possibly may be able to show you one.—H[illegible]. (See p. 35[illegible], No. 795, and p. 3[illegible]1, No. 7[illegible].—Stellar. (Motors of the kind are to be had, and we have frequently described small ones. If you have water-power free, a turbine would be cheapest, otherwise a gas-engine would be the most economical. As to the steam-engine, any of our advertisers who make them will supply you.)—Nemo. (Scarcely an answer. How can stationmaster know when train is other side of box, and approaching him?—Young Engineer. (Cannot be done at low pressure. Must have high pressure and great piston speed, or the weights would be very heavy. See many places in back numbers.—St[illegible]. (Look through recent back numbers "Calculating Size and Power of Boilers," also sundry other replies. —A Subscriber. (The definitions were given so recently as p. 561, No. for Aug. 25.)—Anxiety. (Take open-air exercise, abstain from alcohol and tobacco, and if the symptoms do not subside, consult a medical man. There is nothing alarming in what you describe.) —Novice. (You must consult recent back numbers. Slate, earthenware, or wood properly prepared will do; anything not acted upon by the solutions, in fact. Mr. Elmore makes a special form of battery for nickel-plating.)—Hammer. (Question answered and illustrated by a diagram on p. 391, No. for June 2 last.)—Glen. (Yes, the so-called electric fluid. So-called thunderbolts are probably aerolites.)—Zeno. (We replied once for all, in No. 836, p. 160. You must have been to sea in the engine-room for at least twelve months before you can sit.—Stuffing-box. (See the indices of recent volumes.)—Loco. (Such drawings are sometimes published in the engineering papers. The question is too much of the nature of an advertisement for insertion in Query column.)—F. N. H. (Common washing soda is a favourite remedy, but see many replies in back volumes.)—J. F. (We believe they are generally "smoked" with a piece of burning camphor. 2. No, the expense would be too great, out of all proportion to the advantage.—A. E. Moore. (Sufficiently answered already.)—H. H. (Several instruments of the kind are advertised in this paper.)—C. H. Romaine. (The pamphlet alluded to can be had, we understand, of the secretary to the Institution of Civil Engineers.—Jack of All Trades. (Why adopt the signature of a well-known contributor? Better varnish it as it is. If you must have a stain, try Stephens'. See many replies in back volumes.—M. A. C. (Yes, from plumbago; the best cut out of the solid. Others are made by calcining the plumbago, grinding it to a paste with the addition of clay, and pressing into moulds. You will find articles on the subject in most encyclopædias.)—J. Hartridge. (You want a deflector to throw them to the sides of the chimney, and a wire netting over that, just as in woodburning locomotives.)

L. M., Gravesend.—Estaminet.—Your queries can only appear in the "Sixpenny Sale Column."

USEFUL AND SCIENTIFIC NOTES.

The Food of Fishes.—The Rev. W. Houghton is engaged on the examination of the stomachs of various sea-fishes, with the view of determining the food of the respective species in connection with their distribution and migrations. With this object he has recently been out in the North Sea in a steam-trawler and taken notes of the contents of the stomachs of several fish. He thinks it probable that the search for food is one of the chief causes of the migrations of certain fish, and that the nature of the food consumed influences the quality of the flesh as an article of diet. *Crustacea* appear to enter largely into the food-list of many fishes, the smaller kinds, such as the *Entomostraca*, being the favourite food of whitebait (young herrings), whose little stomachs are often full of these minute creatures. Mackerel are also very fond of small *crustacea*, a microscopic examination of their stomachs frequently revealing their presence, as also that of quantities of the larval forms (*zoea*) of crabs; the rich quality of their flesh, like that of herrings, is perhaps mainly attributable to the nutritious properties of an abundant crustacean supply. The examination of the contents of the stomachs of fish in connection with their distribution and migrations is probably the best way of obtaining reliable data, and an investigation of this nature is not unlikely to lead to some practical results. Mr. Houghton obtained in a surface-net large quantities of crab-larvæ in the North Sea, and numbers of *Sagitta* and *Tomopteris*, two aberrant forms of annelid life.

The Sanitary Committee of the Hanley Town Council have decided upon a new departure in the efforts which they have been making to minimise the smoke nuisance. They have determined that in future both masters and workmen shall be summoned—not, it is explained, with a view of pressing the penalties against both, but in order to find out which party is really responsible.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols XXIV., XXVI., XXVII., XXVIII., XXIX., XXX., XXXI., XXXII., XXXIII., and XXXIV., bound in cloth, 7s. each.

(Vol. XXXV. Ready shortly.)

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 4d. each, or post-free, 4½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive. 2d. each. Post free 2½d each. Indexes to subsequent vols., 3d. each, or post-free, 3½d. Cases for binding, 1s. 6d. each.

. Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post

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. It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements must reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Lathes. 1 3ft. 6in., with chucks, and two drawers, £7 One 4ft. back-geared, £8. Both in good order.—C. N., 15, Oxford-street, Reading. What in exchange?

Quantity of new **Plumber's Castings** and Finished Work, very cheap.—W., 1, Catherine-terrace, Ashton-under-Lyne.

"**Cassell's Popular Educator,**" in 32 shilling numbers, quite new. Best offer taken. Owner going abroad.—W. Gibbs, 1, Lorne Cottages, Ramsgate.

One **Brass Boiler,** 6 by 3½, two Fans, 9 and 11 dia. Exchange anything useful.—Banks, Bolton-lane, Pudsey.

Set of Vertical **Engine Castings,** 2 by 4 cylinders, bored and turned. Also Wooden Bicycle, complete. Exchange anything useful.—Samuel Banks, Robin-lane, Pudsey.

Three very fine **Model Engines,** inverted cylinders, £3 each, or offers in photo. apparatus.—W., 82, Bayham-street, Camden Town, London, N.W.

Six 2½in. **Lathe Heads,** each fitted with 2 chucks, quite new. What offers, singly or together?—W., 82, Bayham-street, London, N.W.

Horizontal **Engine,** all brass, cylinder 1¼in. by 2½in., drive sewing machine. Exchange bicycle, value £3.—A. Grace, Collegiate School, Irwell-lane, Runcorn, Cheshire.

Wanted, Morse Sounders and **Single Needle Telegraphs,** Batteries, &c. Exchange new scientific books. No cash.—L., Fair Bank, Oaklands-grove, Uxbridge-road, London, W.

Wanted, 4in. or 4½in. back-geared **Lathe,** for 5½in. hollow mandril ditto, 1¼in. hole, with dog chuck.—J. Ball, Milford Works, Queen's-road, Battersea.

Model **Feed Pump** and Check Valve, Water Gauge, and Wheel Lubricator, new. What in exchange?—C. Blanchard, 3a, Little Church-street, Edgware-road, London.

What offers for 4½ back-geared **Lathe** and Tools? Also a bench Vertical Drilling Machine—both good articles.—Apply, F. Underwood, Beverley.

Flagstaff, with wire stays. What offers in exchange?—C. Moran, 16, Orchard-street, Dartford, Kent.

Good **Poultry House,** with glass sides. What offers in exchange?—C. Moore, 16, Orchard-street, Dartford.

Will exchange my **Violin,** bow, and case, and tutor, in perfect order, for complete set of Bicycle or Tricycle fittings.—J. L., 73, Catherine-street, Warrington.

Bird Cages.—Three large breeding mahogany cages, two show cages. Exchange for Lens View, 5 to 6in., in good order, or offers.—For sizes and particulars apply Greenway, Ardlei Station, Meigle.

Fret-Cutting Circular Saw, Turning and Drilling Machine, cost £4s. What offers in exchange?—Watson, 34, Arundel-street, Strand.

Violin case and bow. The latter cost a guinea. What offers in exchange, value 15s.?—Watson, 34, Arundel-street, Strand.

I will exchange a good ¼-plate **Portrait Lens,** for a set of Lathe Castings, 3in. heads, back geared, gap beds and heads planed.—David Gillies, Junior, Bonnybridge, Stirlingshire.

Photography.—Amateur wishes to dispose of his complete set. Write for list. What offers? Canoe wanted.—Simms, 60, Albert-street, Crewe.

For exchange, an excellent **Harmonium,** rosewood, 7 stops, cost 14 guineas in exchange for back geared Lathe.—Mr. J. Brown, Windmill-lane, Longford, Coventry.

"**English Mechanic,**" volumes XXIV. to XXIX. and part XXX., inclusive, with indexes, unbound, clean; for Fern Case, or offers.—Woodburn, 62, Alvey-street, S.E.

Good Woollen **Bed Flocks.** Exchange; wanted, Gas Stocks, Dies, and Taps, Whitworth gauge. Drilling machine and lathe. Cash or exchange.—11, Silver-street, Huddersfield.

Engineer's Spare Tools.—Bellows, Fan, Boiler, Engine, Lathe, &c.; for Screw-cutting Lathe or other useful engineer's tools.—Newcombe, Northcote House, Sydenham-road, Croydon.

Engineer's Spare Tools.—Forge Back, heavy Lathe, Grinding Machine, &c., for screw-cutting Lathe, or other tools likely to be useful.—Newcombe, as above.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

Electric Machines. Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. (List Twopence.)

Paints.—Armstrong's full instructions for making Paints is now sold by Stevens and Co., 322, Old-street, London Price 1s. 6d.

Cyclists.—Challis's **Stop Bell,** with patent vibrating bracket, is best, 2s. 6d., 3s. 3d.—E. M. Challis Bros., Homerton.

American Organ Actions, complete. Any ingenious mechanic or amateur can construct cases.—Farrar and Harris, Plymouth.

Electrical Depot and Manufactory.—Millar's, 126 Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Bells. 5s.; Batteries, 2s. Telescopes, Microscopes, Field Glasses, Spectacles. None better or cheaper.—Millar, as above.

Fretwork.—For Catalogue of Machines, Tools, and Miniature Designs, send two stamps.—Harger Bros., Settle.

Inventions put into practice, Models made, wheel-cutting.—Oreenham Bros., 41, Old-street, Goswell-road, E.C.

"Fiddler's" improved **Violin,** no back or soundpost, 15s., 30s., by Fiddler, 19, Edward-street, Burdett-road.

Micro. Photos—List of 350 one penny stamp.—E. and A. Dancer, 124, Stockport-road, Manchester.

Tricycles, Bicycles; also sets of wheels, good and strong, at moderate prices. Send for list.—W. Gainsbury and Co., Alma-street, Wolverhampton.

10,000 **Lantern Slides,** 6d. plain, 1s. coloured. New Lists and Readings, 1882-3.—Pearsons, Henry-street, Birmingham.

Slide Rules.—Straight Triple Radius, double slide, 20s., 10s. Treatise, 6s. Combined circular, spiral, multi-index, and four figures. Logarithmic, 21s.—Author, Thomas Dixon, Engineer, Buttershaw, near Bradford, Yorkshire.

Lathes! Lathes!! Lathes!!! Cheap and good. Screw-cutting from £10. Maker to Government.—Martin, Cupola, Sheffield.

Dynamo for general experimental use, with incandescent lamps, storage batteries, electroplating, &c.; driven by hand or power.—Fawcett, 15a, White Lion-street, Chelsea, London.

Science and Art Exhibition, Falmouth.—The Britannia Company's Lathes and Fret Saws will be exhibited. These Lathes won the Prize Medal at Christchurch, N.Z., Exhibition.—Britannia Works, Colchester, England. Circular one stamp.

Violin for Sale, magnificent solo tone, copy of grand master, labelled "Antonius Stradivarius, Cremona, 1690," with good case and bow, 25s. Sent on approval. Cash needed.—Miss Strange, 54, Campana-road, Poole Park, Fulham.

Brassfounding.—Challis Brothers, Homerton, Brass, Gun, Bell, and Special Alloy Founders, &c. Mill Brasses. Model work.

Theobald's 15s. 6d. **Acme Telescope,** price only 9s. Wanting cash.—H. Fisher, Lime Tree-place, Stowmarket, Suffolk.

Stammering effectually Cured by Correspondence, and Manual of instruction, or personally. Guarantees.—Vox M., Aubert Park Library, Highbury, N.

Surveyor's Dial (Mining) for £6, cost £18. Very cheap, good order, accurate.—Arthur Thomas, C.E., 20, High-street, Newport, Mon.

The "Essex" Three-jawed **Chuck,** holds drills ⅛in. to 0, 10s. 6d. Larger size, holds up to ⅝in., 25s. Hold either straight or taper drills.—Britannia Company, Makers, Colchester.

Screws! Screws!! Screws!!! Britannia Co. have improved Machinery for screw making, and are open to estimate for quantities. Send two patterns or drawing.

Bicycle Nipples. Sample dozen on receipt of 13 stamps.—Britannia Co., Colchester, Makers of Bicycles, &c.

Metallic "A" and "E" **Violin Strings.** Acknowledged success. Six, post free, 1s.—John Blanco, 36, Kelvin-grove, Liverpool.

Artistic **Photographs** of Celebrities, Actresses, Statuary, Paintings, Classic studies for Artists, &c. Packets sent for selection. Catalogue and specimens, post free six stamps.—M. Williams and Co., Photographic Publishers, Bridgnorth. Agents wanted.

Telephones.—"The Simplex." The loudest and cheapest are on view for trial at the Alexandra Palace and "Simplex" Manufacturing Co., 15, Camden-street, Birmingham.

Three sets of **Engine Castings,** part finished, 3 by 1½. Also small Boiler.—Smith, Lower-street, Tutbury, Staffordshire.

50in. **Bicycle,** in good condition, cost £8, will take £3 10s., a bargain.—John Crabtree, Jun., Clarendon-street, Stockport.

Something Wonderful.—**Pocket Coil** and Battery, with handles, sent for 2s. 6d.—Jukes, 13, Fashion-on street, London.

Mortising Machine, by Haigh, in thorough good order, with all necessary tools, price £7 10s.; cost £12; also pair Joiner's Bench Cramps (Matthew's Patent), nearly new, £3 10s.—Alexander and Son, Engineers, Salisbury.

Lantern Slides. Egyptian War. Six dozen now ready, 3¼in., painted in best style, 1s. each. Large stock of other subjects. Artists and designers on the premises. Special subjects to order. Plain photographs coloured.—F. W. Thomas, 7, Woodstock-road, Shepherd's Bush, London, W. N.B.—See following testimonials.

Testimonial from Rev. Mr. Spurgin, Gresham Rectory, Norwich:—"I inclose 12s. for a dozen slides. I like the one you sent me very much; it is a perfect gem.—To F. W. Thomas."

Testimonial from G. A. Brookes, 88, Derby-street, Manchester:—"I am highly pleased with the curtain slide.—To F. W. Thomas."

Testimonial from Edward Davis, South-terrace, Mansfield, Linc.:—"Slides safely to hand. They are exceedingly good and well finished. The Curtain Slide of Egyptian War is so good that it puts my poor curtain into the shade.—To F. W. Thomas."

Testimonial from Rev. W. J. Wingate, 27, Harrogate-street, Sunderland. "The slides have arrived, and I am very well pleased with them indeed.—To F. W. Thomas."

Testimonial from P. T. Ewart, Guernsey-street, Portland. "The 36 slides to hand. I am much pleased with them.—To F. W. Thomas."

Testimonial from D. Wright, 7, Bunkers-hill, Nottingham. "I am pleased with the slides you sent me in every way.—To F. W. Thomas."

Great bargains in **Bicycles,** Tricycles. Price for immediate purchasers see below. 25 to 40 per cent. under maker's lists.—H. M. Pashley, 160, London-road, Sheffield

Two **Tricycles,** sacrifice at £9 and £8, nearly new, one with Ball Bearings.—Pashley, as above.

50in. and 54in. **Bicycles,** 8 and 10 guineas, hollow forks, latest improvements.—Pashley, as above.

Excelsior Pet **Tricycle,** new, £12. Excelsior Double, £16, only ridden few times.—Pashley, as above.

New Humber **Tricycle,** nett £21. Imperial Club, nett, £20. Lists and full particulars free.—Pashley, as above.

Finished parts of **Model Engine,** 1in. stroke, 10s. the lot.—G. Thomas, 69, Montague-terrace, Sheerness.

Vertical Boiler, new, 2ft. 11in. high, 1ft. 8in. dia., with firebox and cross tube, stand firebars, fittings complete; pair back-geared Lathe Heads, 7in. centres, portable slide rest, tools £15.—Hudson, Hairdresser, Pocklington.

Electric Lamp, complete, on stand, with a five-cell Bunsen battery, in varnished box, quite new, used once, £1.—"Electric," 16, Broadway, London Fields.

Medical Galvanism.—Professor Didier attends Patients at Home from 8 till 5.—10, Berkeley Gardens, Kensington.

Magneto Electric **Apparatus,** for Scientific or Curative purposes, only 42s.—Professor Didier, 10, Berkeley Gardens, Kensington.

A Pamphlet "On Animal Magnetism and its Healing Power," 1s.—Professor Didier, 10, Berkeley Gardens, Kensington.

"**English Mechanic,**" fifteen Vols., part of Vol. XX. in date, perfect condition.—J. Stephens, Treforest, Glamorgan.

Clothing, ladies' wear, from 1s. yard broad, also Jacket and Coating Worsteds.—Hawley, 57a, Winfield, Leeds.

Britannia combined **Lathe** and Fretsaw, splendid machine, perfect order; cash.—F., 41, Hankton-road, Brixton, London.

Cornish **Minerals,** 100 sorts, 2d. each, always on sale; also Fossils.—H. Wearnoth, Penzance.

The 15 varieties of Cornish **Ferns** always on sale, 1s. a dozen.—H. Wearnoth, Penzance.

"**Kitchener's Experiments with 51 Telescopes,**" out of print and scarce.—Arthur Shane, Mining surveyor, Bilston, Staffordshire.

Stocks and Dies. Some stock samples for sale at reduced rates.—F. M. Holmes, 21, Finsbury-pavement, E.C.

For Sale, half horse-power **Table Engine,** £5. Ducomet's Patent Steam Gauge up to 2 cwt. pressure, £1.—Nation, 183, Upper Kennington-lane, Vauxhall, S.E.

3in. centre Bench **Lathe,** 4 chucks, all iron, price 45s. 3in. slide Rest, 35s.—Tracey, Osborne-street, Colchester.

Oxford and White Long Cloth **Shirts** at manufacturer's prices.—J. Smith, No. 1, Hudson's-square, Corporation-street, Manchester.

Ladies' **Underclothing,** &c., at Manufacturer's prices.—J. Smith, No. 1, Hudson's-square, Corporation-street, Manchester.

Calicoes, Smallwares, Sheets, Blankets. Patterns post free. Any length cut. Carriage paid on £1 orders.—J. Smith, No. 1 Hudson's-square, Corporation street, Manchester.

Bargain, two-man **Gas Engine** and Launch Horizontal Boiler, 41 by 24.—Ant, Tib lane, Manchester.

New **Launch Engine,** double, cylinders 4in. by 6in. reversing gear, brass pump.—John Middleton, 16, Hope-street, Glasgow.

Back-geared treadle **Lathe,** wooden frame, only £3 5s.—John Middleton, 16, Hope-street, Glasgow.

Two McNaught's **Indicators,** nearly finished, all gun-metal. Tracing to complete sent. Price 40s. each, or 75s. the two.—Martin, Priory-terrace, Bedford.

Balance Wheel Cutting and Repairing Engine, in good condition, with cutters, 35s.—6, Hadley street, Birkenhead.

Dynamo Machines to light six 16 candle-power Swan lamps, finished complete, or Castings separate.—Fellows.

Siemens **H Armatures,** 3 by 1, turned and fitted with commutator and wound with wire, 7s. 6d.—Fellows, Blockhouse, Wolverhampton.

Half-plate bellows **Camera** and Changing Box for 12 plates, price 30s.—Clarke, Bradford-road, Huddersfield.

Send for specimen of **Boiler Scale** for quotation for prevention.—Clarke, Bradford-road, Huddersfield.

Remove Grease and Paint from iron and woodwork with our "Special" Detergent.—Clarke, Bradford-road, Huddersfield.

Jigger Saw for steam power, capital working order, £3, bargain.—D. Mead, Ladybellegate-street, Gloucester.

Vertical **Drilling Machine,** hand or power, drill to ½in., 30s.—D. Mead, Ladybellegate-street, Gloucester.

[*For remainder of Sixpenny Sale Column see p. VI.*]

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

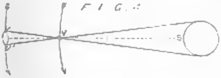
FRIDAY, SEPTEMBER 22, 1882.

THE COMING TRANSIT OF VENUS.

By "A Fellow of the Royal Astronomical Society."

(Continued from page 2.)

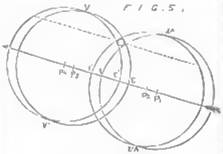
SO far, for simplicity of explanation, I have supposed that the Equator, Ecliptic, and the orbit of Venus were all in one plane. Notoriously, however, this is not the case; and, furthermore, the observation of the Transit is complicated by the rotation of the Earth, which I have, so far, tacitly assumed not to turn on her axis during the time occupied by Venus in passing across the Sun's face. It now becomes necessary to consider the effect which these modifying influences exert upon the Transit as it is really observable. In much that follows, I am largely indebted to Mr. Proctor's admirable book the "Transits of Venus," in which the matter is much more exhaustively discussed than would be possible within the prescribed limits of an article like this, and which everyone should read who wishes to obtain a thorough grasp of the subject. Probably the most easily apprehensible method of dealing with the phenomenon as actually visible, will be to treat it as it would be seen from the Sun himself. It is in this way that the preliminary determinations of the fittest stations for observation are always made.



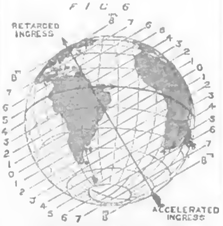
In the above figure S represents the Sun, V Venus. By drawing the lines *s*V, *s′*V as tangents to the Sun, and producing them behind Venus, to the proper proportional distance, we obtain a representation of the relative size of the shadow cone beyond Venus at the Earth's distance. *e* V *e′* represents this cone in the diagram. Its circular base, upwards of 300,000 miles in diameter, will, on the 6th of next December, travel onwards by the excess of the motion of Venus over the Earth; and, as seen from the Sun, will overtake our world in such wise that the *upper* part of the circle will envelop the Earth. A glance at the figure will show that, this being so, Venus, to a terrestrial spectator, will seem to cross the *lower* part of the Sun's disc.

In Fig. 5 (copied from Proctor's Plate X.) *v* I *v′* represents the circular base of the cone in the previous figure on a much enlarged scale, at the moment when the edge of the advancing shadow first touches the point *i* of the Earth *e e′*. As this instant, obviously, an observer at *i* will see Venus just touching the Sun's limb. At the centre of the circle advances from P^1 to P^{II}, its left-hand top portion will have reached the portion *v*I*v′*, touching the Earth at *i′*. Evidently between *i* (where the Transit was at first alone visible) and *i′*, the edge of the shadow has been moving practically parallel to itself, and bringing Venus successively into view at the places it crosses. When it gets to *i′* the Transit has begun for every part of the Earth where the Sun is above the horizon. Obviously, too, *i′* is the place where it has begun the latest of all, or where ingress is most retarded; *i* being the point where it is most accelerated. Observe here that the points *i* and *i′* are not exactly opposite to each other on the Earth, which is turning on its axis, while the centre of the shadow-cone of Venus travels from P^1 to P^{II} (a period of 17 minutes in the approaching Transit). Well, the circular base of the shadow-cone *vv′* continues to travel on, and ultimately arrives at the position V*e*V′ touching the Earth at *e*. Then the observer at that point will see Venus just going off the

F I G. 5.

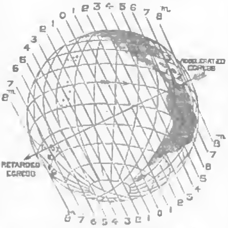


F I G. 6



Illuminated Side of the Earth at Ingress, Dec. 6th, 2h. 15m. 56s. (G.M.T.).

F I G. 7.



Illuminated Side of the Earth at Egress, Dec. 6th, 8h. 0m. 32s. (G.M.T.).

Sun's edge. Still passing on, *vv′* arrives at the position V*e′*V′, at which it is about finally to quit the Earth: and its last contact with the Earth takes place at *e′*. As before the edge of VV′ has been passing over *ee′* in a direction approximately parallel to itself. Then *e* is the pole of accelerated egress, and *e′* that of retarded egress. Figs. 6 and 7 (also copied from Proctor's Figs. 38 and 39, with my own addition of the stations selected for our observers) show on an enlarged scale the way in which the edge of the shadow-cone will cross the Earth on the 6th of next December.

The parallel lines represent, of course, a small portion of the edge of the circular base of the Shadow Cone of Venus (*vide sup.* VeV′ Vee′, in Fig. 5). The numbers affixed to them externally indicate the number of minutes by which the Ingress (or Egress) of Venus will be retarded or accelerated at all places lying along the line to which they belong, as compared with the instant of the occurrence of the given phenomenon, as viewed from the Earth's centre. Fig. 6 represents the illuminated side of Earth at Ingress, as viewed from the Sun on Dec. 6th, 2h. 15m. 56s. G. M. T; and Fig. 7 her illuminated side at Egress, as similarly seen, Dec. 6th, 8h. 0m. 32s. G. M. T. The little figures I have put upon the maps are intended to point out the localities of our British Observing Stations:—(1) Represents Jamaica, where Dr. Copeland, Captain Mackinlay, R.A., and Mr. Maxwell Hall will be stationed; (2), Barbadoes, where Mr. Talmage and Lieut. Thomson, R.A., will observe; and (3), Bermuda, where Mr. Plummer and Lieut. Neate, R.N. will be posted. A study of the two figures above will show that Ingress will be retarded and Egress accelerated at all three of these stations. For accelerated Ingress only, (4) stands for the Cape of Good Hope, and one or two points in the Cape Colony. In this region, Her Majesty's Astronomer Mr. Gill, Mr. Maclean, and his assistant Mr. Finlay, Mr. Pett, Herr Marth, and Mr. C. M. Stevens will be the observers. Father Perry, Father Sidgreaves, and Mr. Carlisle go to Madagascar; (5), Mr. Meldrum will be at the Mauritius; (6), and at Durban (not marked), the Colonists provide a telescope for some astronomer unknown. Observations of retarded Egress are to be made in New Zealand (7), by Col. Tupman, R.M.A., and Lieut. Coke, R.N.; Captain Morris, R.E., Lieut. Darwin, R.E., and Mr. Peck will be at Brisbane (8); Mr. Ellery and his staff at Melbourne (9); and Mr. Russell and his staff at Sydney (10).

Into the minutiæ of corrections of the Observations, it would be, as I began by saying, wholly foreign to my purpose to enter. All I dare hope is that I may, perhaps, have rendered the leading principles intelligible, on which the observations of the coming Transit will be made, and the Solar Parallax deduced from them. Any little difficulty which may be experienced on a first reading will, I would fain hope, disappear upon a second perusal. It may serve to test the student's comprehension of what I have written, if he will take two such points as, say (3) and (4), in Fig. 6, and having determined their linear distance asunder (say 4,960 miles), revert to Figs. 2 and 3, and the description of them. Then let him calculate from the number of minutes at the ends of the lines representing the edge of the base of Venus's shadow cone, the interval in time which will elapse after Venus has entered on to the Sun at (4) before she appears on his disc at (3), and from these data, on the principles explained above, let him try to deduce the angle subtended at the Sun by the line joining (3) and (4). He will not obtain the Solar parallax with any very astonishing accuracy, but the exercise can hardly fail to quicken his appreciation of the nature of the investigation, and to enable him to form a much more vivid mental picture of it.

Speaking for myself, I can scarcely regard Transits of Venus as supplying absolutely the most accurate method of determining the Solar parallax. But, at the same time, they do furnish a most valuable check upon other modes of ascertaining definitely the Scale on which the Solar system is built; and hence, to neglect their utilisation to the utmost, would be thoroughly indefensible. It is most earnestly to be hoped that the 6th of December may be fine in this country, inasmuch as no one who reads these lines can, by any possibility, hope ever to witness another Transit. The next one will occur on June 8th, 2004. I wonder who will describe it in the ENGLISH MECHANIC of that date?

On line 4, column 2, page 1, "Photographing results" should be "Photographic results." In connection with the proportion sin. V W S : sin. V S W : : V S (723) : V E (277) (p. 2, col. 2, lines 11 and 12), it will, of course, be noted that V W = V E.

A CROWN-GLASS ACHROMATIC TELESCOPE.—IV.

THE remaining two or three papers will be mainly occupied in speaking of the mode of action of the eyepieces that may be used, which may be somewhat modified by the fact that the image formed by the o.g. somewhat differs in each case from what it usually is.

To begin, then, with that form of instrument which makes the coloured rays emerge parallel, but does not bring them to a common focal point. Now, the points where the red and blue rays meet the axis are much too distant to allow of the use of a positive eyepiece; but if we use a negative one, we shall find that the distance is reduced to very tractable proportions, for if we suppose the points where they meet the axis after refraction to lie within the principal focal length, each of the rays, red and blue, is brought to a focus nearer than the principal focal lengths, and the difference will be very nearly equal to, but a little greater than, the difference of the focal lengths for the field-lens. After refraction through the second lens, virtual images will be formed at the conjugate foci of the points above named, and if these images are near enough to each other to fall simultaneously within the limits of distinct vision, there will be good definition.

On account, therefore, of the distance between the two points above spoken of being shortened by the field lens till it becomes but very little greater than the distance between the points at which red and blue rays, having a common focus, would be resolved by the first lens, so that the disadvantage arising from the not inconsiderable interval that intervenes is not near so great as might have been imagined.

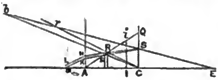
Achromatism of Eyspiece.

What is wanted in a telescope is that coloured rays, after passing through all its lenses at each end, should enter the eye parallel. The first condition is that they should emerge from the o.g. parallel, or very nearly so, and next that they must be so transmitted by the eyepiece as to enter the eye parallel. The explanation which I am going to offer of how this may be effected by a negative e.p. is so different from the usually-received one, that I am afraid many of our readers will scarcely think it worth examining. There is one at least of our correspondents, however, and he one of our best, who, partly from the interest which he takes in the question, and partly from feeling, as I do myself very strongly, that "the mathematic treatment of achromatics in the textbooks is not in a very satisfactory state" (see the letter of "Orderic Vital," 20438), may be induced to give attention to what follows.

The explanation usually given is this: "That by properly choosing the distance between the two lenses, they may be made to destroy each other's dispersion." One thing, however, is obvious, though generally ignored: that the achromatism of a proposed pair depends upon the *manner* in which the rays enter, and the position of the point to which they converge. All that we are here concerned with is the case when the eyepiece is in *adjustment*—that is, when the rays pass nearly through the focus of the eye-lens; and there is a very simple method of determining whether the lens is, under such circumstances, correct, or exaggerate each other's dispersions. Suppose, first, that the axis of the pencil incident upon the first lens coincides with the common axis of the lenses. Then, if the geometrical focus for blue rays to which a ray is brought by the first lens coincides with the principal focus for the same rays of the other lens, the blue rays will emerge parallel to the axis, and the same may be said of the red rays; and when they are both parallel to the axis they are so to each other. In order that this may happen, the focus for blue rays must be *nearer* to the eye-lens than that for red. When the foci are so situated, and are at this distance, they correct each other's dispersions; if they are at a less distance, they do so only partially; and if they were to coincide, the whole of the dispersion would be due to the second lens also; while, if they were on the wrong side of each other, they exaggerate instead of correct. Now, this latter is just the position which the foci have in the case of a negative eyepiece.

If, then, a negative e.p. is achromatic, as experience certainly, to some extent, shows it to be, we must look out for some other explanation. The real fact is this: *that it is not the geometrical but the visible image which is free from colour.* This means, that an eye, properly placed, may be in the same line with the extremities of the red and blue images.

Let I*i* be the achromatic image which would be formed but for the interposition of lens at A; draw A*c*, and let the extremities of the red-and-blue images, formed after first refraction, be at R and B; join B C, R C, C being the centre of the second lens; then the extremities of the red-and-blue virtual images, after refraction through second lens, will lie in C R and C B produced. And we now have to show that the line joining their extremities will pass to the right of C, as at E; so that to an eye placed at E, they would appear to be in one line. To show this, suppose a blue-and-red ray, each of them in the direction B A, to fall upon the second lens at Q; then the blue ray, being the more refrangible, will make a greater angle with the axis than the red one does; also, B C and R C, being drawn to the optical centre, emerge at the same angle at which they entered; that is, the blue emergent ray makes a *less* angle than the red one. Therefore, there must be some points between Q and C, to which, if lines be drawn from R and B, they will make the same angle with the axis. Now all rays after refraction, when produced backwards, pass through the *b* and *r*, the extremeties of the blue and red images. The rays, therefore, are refracted in the common direction S.E., which, when produced backwards, will pass through the extremities of the images, *b* and *r*, say; that is *b r* and E are in the same straight line.



Such, then, is an outline of the explanation I propose. I shall have, however, more to add to it, but what will be added will do for the correspondence columns. It will be observed that the explanation requires no particular distance between the lenses, so that we are not restricted to the usual distance; others would do quite as well as far as achromatism is concerned, so that if eyepieces were made capable of variation in the distance of the lenses, we should get a greater variety of magnifying power with the same number of eyepieces than we could have otherwise. I once had the loan of an eyepiece constructed upon this principle, and as far as I can remember, the only difference in the performance caused by varying the distance of the lenses was a variation in the magnifying power. There will be a very slight modification of diagram, but the general result will hardly be sensibly different for a telescope of the proposed form.

It may, perhaps, be thought that the end of this paper is contradictory to the beginning, for we assert that the red and blue rays R S and B S enter the eye not merely parallel, but coincident, whereas in the beginning of the paper it was shown that red and blue rays would not emerge parallel. The explanation is this: produce S R and S B to meet the first lens in H and K; then it will be seen that they are not the red and blue components of one and the same ray, but of two different rays, L H and M K; whereas what was asserted in the beginning of the paper was that no *single* ray could be resolved into coloured ones which should emerge parallel.

W. G. Penny.

(*To be continued.*)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,

Associate of the College of Organists, London.

THE present *Treatment* commands, in addition to the chief merit just named, several other good points which do not exist in any preceding Arrangement. These points are:—(1) That the Coupler Swell-to-Great is Removable in a few seconds, in its entirety, and without losing a fraction of its own Regulation: (2) That such Coupler is wholly distinct from, and its Regulation, therefore, quite Un-involved with, the Key-to-Pallett Action of either of the Manuals: (3) That Participation of the Swell-Org. Keys with the Keys of both the Great and the Pedale Sections comes about naturally (it is *absent*, in the entire Treatment, *only* where such absence is inevitable in order to secure the Clear Coupler)—that is to say, it exists *without* either the Tall-Forking, or any call for extra workmanship;—the Coupler's being between the Manuals giving such Participation as regards the Swell-to-*Great*: (4) That the *Great* Organ Keys are Removable without interfering with their Key-Action: (5) That the Removal of the Swell Manual *entire* is facilitated by there being now no Stickers passing up between the Keys of such Manual: (6) That a totally Detached Clavier Buffet becomes now quite practicable, so far as the Manual-to-Manual Coupler is concerned: and (7) That all Skewing of the Keys is avoided without *involving* the having of recourse to the Cranked Sticker (as was necessary in Treatment No. 4).

The last two of these seven advantages have been already mentioned (at *l*, ante, 1st parag.; and *p*, ante, 8th parag.); the remainder speak for themselves. Some other good points possessed by the present Treatment exist also in one or more of the Treatments previously given: for such, therefore, read again what has been stated with them (as comm. at *e*, ante).

It will have been obvious that the object sought in Skewing the Great-Organ Backfalls is simply to avoid the Wire-Cranking (see at *z*, ante) of one of the sets of Trackers,—which Cranking would of course become necessary if such two sets were kept at one same series of areal points. For the same reason, any Fanning of such Great-Organ Backfalls should never be here permitted, because the Wire-Cranking of the Trackers would then not only become necessary, but it would have to be *varied* in its amount in almost or quite every one of such Trackers; and this would as manifestly involve a very large extent of Setting-out. It is also to be noted that the non-correspondence of the Manual Action points, which is here brought about by the Skewing of the Great-Org. Backfalls, is not now any disadvantage, because, as the Sections are Great and *Swell*—not Great and *Choir*—, it is preferable, and so has been enjoined, that the Pipe-Order in such two Sections be made *contrarient*, and therefore no one Setting-out could in *any* case be made to serve for their two Roller Boards. Besides this, all Settings-out of such Boards can, if thought worth while, be retained, and kept permanently on suitable Templates (consult *Department* Key-Action). Here see again what has already been said (at *r*, ante, 5th parag.) on these points; re-read also the description given of the Wire-Cranking (comm. at *z*, ante). For a fuller account of the Skewing and Cranking of Trackers and Stickers see the future *Departments* Coupling-Action and Key-Action.

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s. The only Defects that can in any way be said to exist in the present Treatment are:—(1) That the Great-Org. Keys are not in Participation with their Coupling to the Pedals: (2) That the Stickers planted on the tails of the Swell-Org. Keys interfere to some extent with the Removing of such Keys: (3) That such Stickers virtually prevent the Noses of the Swell-Org. Action-Squares from being united to their Key-tails in Participation for and with the Coupler Swell-to-Ped., and that, therefore, such Participation has to be obtained by the addition of a Register for the Stickers of such Coupler (the only alternative treatment practicable,—viz., the Wiring of the tops of such Stickers into the Key Tails themselves, being inadmissible because it would interfere with the Removal of such Key; see, however, what is said on this point in the next paragraph): (4) That the Action-Regulation from the Front is limited, so far as the Manuals are concerned, to the Coupler which unites the two latter,—neither of the regular Actions to such Manuals admitting of being so adjusted.

The First of these blemishes is of course unavoidable with the presence of the Clear Coupler. The latter itself, however, by causing the Coupling-Action of the Swell-to-Great to be placed between the Manuals, to a great extent nullifies such want of Participation, because, whenever such Coupler is drawn with the Coupler Swell-to-Ped. at same time not drawn, the Great-Org. Keys will not descend *at all* when their corresponding Pedals are pressed, and therefore any Dancing of such Keys is then obviously impossible. And it must be also remembered that any want of Participation in a Manual is of comparatively small importance in its Coupling to *Pedal* Keys (see 89, *n* and *p*), and that the Participation of Manual as Coupled to *Manual* is here already inevitably secured. The Second point named is of no practical moment, because such Stickers can *themselves* be so easily Removed,—thus then instantly permitting the lifting out of the Key: and it must also not be forgotten that in one way such Sticker might render its Key really *more* easily removable;—that is to say, as supposing the Tail of such Key to have a Sticker set beneath and Wired into it (see a few lines forward; also in preceding paragraph). It has, however, been already seen that the employment of a [utilised] Register here avoids any entry of an under Sticker into the Swell-Org. Key-tail; and this, combined with the Advantage No. 5 stated a little back (at *r*, ante, 14th parag.), and with what has also just been said, is sufficient to deprive this second defect of any real weight whatever. It should be added that a Register for the feet of the said *upper* Stickers is not here advisable, because it would obviously drive the Regulating Screws of the Coupler Swell-to-Great farther away from the point of contact of such Stickers (see on this matter at 89, *l*). The Third blemish is of absolutely no force here, because the fact of the Register's involving extra workmanship is prevented by the said utilisation of such Register for the Throwing in and out of the Action's contact. (At this stage see in *Department* Coupling-Action with respect to the *abstract* merits of such a Form of Coupler.) Besides this, it has already been virtually implied, that a Sticker set beneath and Wired into the [Swell-Org.] Key Tail, is not here really inadmissible, for there is no Square or Backfall Nose in actual contact with such Tail. The Fourth Defect is the only one that carries any real weight: but even this is of trifling amount, because, with the General Arrangement assumed (see *r*, ante, 5th parag.), it is almost certain that Action Regulation at the Interior of the Organ will be quite easy; and especially is this now the case as regards the Swell Manual. At this point compare, in such respect of Swell-Org. Regulation, the *Faringdon* (ref. *l*, ante, 3rd parag.), with the *Hoddesdon* (ref. *m*, ante, 1st parag.) Instrument. Of course, it *is* really quite possible to provide both the Manuals with the means of Front-Regulation,—that of the Swell to be done by a Screw-Button placed at the top of each of the upper Stickers already described, and that of the Great to be by a Button-carrying Screw-Wire, applied to the fore Noses of the regular Backfalls, in the manner also already set forth (at *h*, ante, 3rd parag.); and the comparative facility with which the Swell Manual and Swell-to-Great Coupler can here be Removed (see again *r*, ante, 14th parag.) manifestly favours such a Regulation in respect of the access then necessary to the Great-Org. Key-tails. Yet, for all this, such Front-Regulation is *never* recommended to be, in the present Treatment, applied to *either* Manual, *unless* no proper Regulation from the Interior of the Instrument be really practicable; and the reason is that as the Great-Manual could obviously never be Regulated at its own Key-tails without first disturbing the Swell-Manual, it is better to accept definitely the Regulation of such Great from the Interior, and, while performing this, to similarly Adjust the Swell Clavier also,—one Manual rarely requiring Regulating without the other Manual's needing it also. And thus the additional cost of the Screw and Button to each [Swell-Org.] Sticker may with perfect propriety be saved.

It will have been noted that in the present Treatment there is involved the expense of a set of Stickers not hitherto required for the Swell Organ. This, however, does not represent a really additional charge, because the *Great* Organ Stickers are at the same time dispensed with. It will be equally manifest (see *r*, ante, 9th parag.) that the object of employing such Swell Stickers is simply the raising of the No. 1 Squares of such Manual so that they are well clear of the Great-Organ Backfalls which are beneath them; and the reason why the latter themselves are not lowered, instead of resorting to such raising of the Swell Action, is to avoid trenching upon a portion of space which is frequently required for the *Bellows*. It will be found that in the Treatment directly following (see *uu*, next, fourth and fifth parags.), both the Great-Org. Stickers and the Swell-Org. Stickers are done away with.

t. [In some cases it might be preferred to employ the present Treatment slightly *modified* with respect to its Coupler Manual to Manual; that is to say, to introduce, instead of the Clear Coupler enjoined, the expedient of the already mentioned Coupler *Part Swell to Pedale*,—this latter device being now quite practicable because of the presence of the Coupling-Action between the Manuals (see *qqqq*, ante, 2nd parag.). See also the remainder of *qqqq*, ante, for the Description and Uses of such Part Coupler, and for the reason why it and the said Clear Coupler must never be *both* of them existent in connection with one pair of Manuals. To this may be just added the reminder, that with the adoption of such Part Coupler, the *Non*-Involution of the Great-Org. Action Nose with its Key-tail is no longer obligatory, and that such Key-tail may therefore freely be set again in contact with its Pedale Coupling-Sticker or other driver.

And of course the Part Coupler may be introduced also with any suitable Treatment other than the present one.

Remember, however, that the Clear Coupler is, essentially, both simpler and more effective in its nature than the Part Coupler, and is therefore to be decidedly adopted *rather* than the latter, excepting under special conditions.]

u. As a *Summary* of the present *Treatment*, we may confidently say that it will be always the *best*, under ordinary circumstances, for *every 2-Manual Instrument*, *unless* the still preferable Treatment *next following* be found practicable. The final choice between these two Treatments will depend upon what space is required for the *Bellows*,—the present Treatment, as will have been perceived, not in any way trenching upon the Bellows space existent in the Five preceding Designs, and being therefore, in such respect, superior to the said following Treatment (No. 5½), which *does* demand a portion of such space. It is also to be remembered that in other matters besides that of such Bellows-space the present Treatment does *not* sacrifice conveniences hitherto secured. The many general and other advantages which it commands (as that in one point concerning a Detached Buffet) have been sufficiently stated; and the scheme does not contain any inconveniences or defects—excepting the few that have been mentioned—to set against these advantages: and even were this not so, the simple fact of the comprehension of the Clear Coupler of the kind described would still leave a large balance in favour of the present Treatment. In may be added that the single Skewing here existent,—viz., that of the Great-Organ Backfalls, cannot really be termed a Defect, although it involves the Crossing of the Manual Actions, for a moment's consideration will convince that such a crossing is preferable to its alternative,—the passing of the Great-Organ Sticker up between the Swell-Organ Keys. At this point; see what has been said (at *r*, ante, 16th parag.) as to there not existing any advisable method of avoiding this Skewing of the Great Backfalls.

As further concerning the device of the Clear Coupler of the present kind, a study of what has been already stated (notably at 89, *q*), will demonstrate that it furnishes the *only possible satisfactory solution* of the question of the Bass for all ordinary 2-Manual Organs. Of such Instruments it may be laid down that the absence of a third Manual renders the provision of a full-sized Pedale really uncalled for: and when it is also remembered that one of such two Manuals ought *invariably* to be a Swell;—that such Section, particularly if carried down to CC, is especially *unsuitable* for the supplementation of the Pedale;—that such unsuitability is still further aggravated when the Swell Reeds are deep and powerful (as they ought, in the abstract to be, on such Manual);—and that the *Choir* Section, which is the one pre-eminently fitted for the said Pedale supplementation, is, by the just-mentioned rule, certainly absent—; then, under all these circumstances, we fully realise the importance of any effective though simple method of enabling the Bass of the Great-Organ to be virtually converted into a portion of the Pedal-Organ. Such a method has been furnished in the present Treatment: the Coupler Great to Pedale, combined *only* with the Pedale, or with a suitable portion of latter, will form an excellently balanced Bass for both of the Manuals united,—either as the Full [Manual] Organ, or in any of the valuable combinations possible with such uniting (as with Full Swell Coupled to Great Diapasons); and there will also exist the advantage already named, that, with such using the Pedals cannot depress the Keys of the Great-Organ, and thus will be prevented that unpleasantness which must result whenever the finger is put on a Key that is already down. The Coupler *Swell* to Pedale will of course remain unaffected;—to be used at pleasure, for special effects, either with or without the Great-to-Pedale,—instead of always obtruding itself directly that the last-named Coupler and that of the Swell-to-Great are in action at one same time. One or more *minor* good points in the Clear Coupler will be mentioned in the proper *Department* treating of Couplers generally.

Finally, when we consider how very large is the number, proportionately, of Organs constructed with neither fewer nor more than Two Manuals, and how exceedingly likely it is that such an incidence of manufacture will continue to exist, the value of the Solution which the present Treatment furnishes of the several difficulties just stated becomes conclusively apparent.

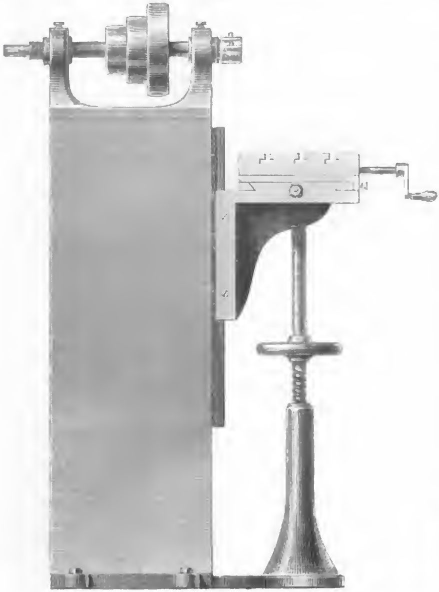
[It is hardly required to observe that the expedient of the Clear Coupler may at pleasure be adopted with any suitable Treatment besides the present one,—the only points necessary to secure being the non-involution of the Great-Organ Action-Nose with its Key-tail, the contact of the Pedal Action with such Nose, and the presence of a Manual-to-Manual Coupling-Action between the two sets of such Manual Keys.]

(To be continued.)

THE MILLING MACHINE.—I.

IN commencing a description of milling machines, their construction, and the mode of using them, it will be well to define what is meant by the term "milling." Two entirely

Fig. 1.



different operations go under this name, with the first of which we have nothing to do, except that, as a few sentences will suffice, I will describe it. It consists, then, in producing, by the pressure of a small revolving wheel, a continuous pattern on the edge (or sometimes on the surface) of a disc whilst running true in the lathe. A familiar example of this is the milled edge of many small screws, such as are used in mathematical and optical instruments. The usual patterns employed are like very small teeth; and the surface may be either flat, concave, or convex. More elaborate patterns are used for some work, the only condition being that the pattern must be continuous, and in the case of large ones, that the diameter operated upon must be such that the impression produced during the first revolution of the lathe is not defaced by subsequent ones. Metal and wood are not the only materials thus operated upon. Bookbinders use this kind of tool to produce various patterns on the backs and covers of books, and precisely the same operation is often performed upon rolls of butter, this being the most plastic material I can think of just now, requiring mechanical manipulation!

But the "milling" with which it is my purpose to deal is a very different thing indeed. It may be described as a cutting or moulding the material by means of revolving saws; the action of the milling cutters being the same in kind as that of the circular saw, and of the cutter used for producing wood mouldings.

Milling machines are used most extensively by firms who have large quantities of parts of machines necessitating uniformity of shape and size; such, for example, as the various parts of sewing-machines, of rifles, and other small arms, &c. Again, the milling machine is a necessity for producing (in quantities, at all events) the semicircular grooves in screw-taps, reamers, and the like; also for key-way cutting, for the formation of hexagon and other nuts, for producing ⊥-slots, as in the saddle of a screw-cutting lathe, and for the removal of metal in the shaping of countless varieties of work performed in the workshop of the machinist or the amateur.

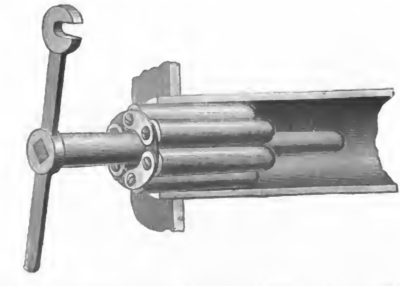
A milling-machine, to meet the requirements of the several operations to be performed thereon, must combine four movements. It must have provision made for the revolution of the tool or cutter; and this takes the form of a headstock, similar to that of a lathe, the difference consisting in the form of the mandrel, which in the milling machine is so constructed that, instead of having a screw-nose for the reception of chucks, it has a circular hole, into which are fitted a number of arbors of different lengths and sizes, upon which the cutters are placed. The other three movements relate to the table upon which the work to be operated upon is fixed. This table must have a vertical, a longitudinal, and a transverse motion, in order to bring the work—first, *up* to the cutter; second, *under* the cutter; and third, to traverse it whilst cutting.

Fig. 1 shows the means of producing these four motions of the machine. The headstock needs no explanation, further than that the mandrel is made with reversed cones, as is frequently the case in lathe-heads; and also that whilst I have shown in the drawing what is known as a "single-speed" headstock, it is not uncommon to add the back-gear precisely as in lathes; for the great majority of work, however, this is unnecessary, but when cutters of large diameter or unusual width, or, as is often the case, several cutters need at once in combination are to be driven, it will be found of great service. The headstock, as will be seen, is mounted upon a massive vertical base, upon the front of which is formed a slide upon which the bracket carrying the table moves vertically, actuated by the leading screw and hand-wheel. The upper side of the bracket is planed to form the longitudinal slide, this being placed beneath the transverse one on account of the facility with which self-acting gear can be attached to it, as will be shown hereafter. The transverse slide moves, of course, from and to the headstock, and, like the lower one, is actuated by a leading screw turned by a winch handle. The upper side of the top slide is planed flat, and furnished with longitudinal ⊥-slots, for the purpose of bolting thereto such appliances as are used to hold the work—e.g., a parallel vice, milling centres, nut-shaping device, &c., all of which will be presently described.

W. S. Brown.

THE "SIMPLEX" TUBE EXPANDER.

THE new tube expander illustrated in the engraving below has just been introduced by Messrs. Selig, Sonnenthal and Co., of Queen Victoria-street, by whom it has been patented. The tool consists of six taper rollers which are forced apart by the taper mandrel as shown. The rollers are connected by six links, three of which are slotted to allow of the requisite play, and admit of the easy withdrawal of one or more of the rollers, thus rendering the one expander available for many sizes of tubes. Amongst the advantages claimed are the following:—It cannot get out of order; there is no casing for the rollers to work in, and consequently no friction



on the ends of the rollers, as necessarily is the case with other expanders working in slots and bearings. It will adapt itself to tubes of unequal shape, caused through expansion and contraction. The tool is made of the best tempered steel throughout; each roller after being turned to shape in the lathe is hardened, and then ground up perfectly true to a standard taper by means of special machinery, thus insuring easy and accurate working, the centre mandrel which expands the rollers being treated in the same manner. A glance at the engraving will show that the tool is properly named "Simplex," and a consideration of the action as the mandrel is driven between the rollers and the whole is revolved in the tube will prove that the end is equally expanded all round, and made as perfect a fit as possible.

PRACTICAL NOTES ON PLUMBING.—XLIII.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page 29.*)

Side Burning.

THIS is illustrated at Fig. 233. To commence learning this, first lay the front lead over the back as shown, and upon a board; lean it at an easy angle of, say, about 25° off the bench—that is to say, take a piece of board about 2ft. long, 9in. wide, and 1in. thick, and lay the lead flat upon it; tilt the edge of the board, say 4in. or 5in., up, as shown at L, Fig. 243; then take the flame, J, Fig. 248, holding it as before directed—that is, in a straight line with the joint, and commence burning the front edge at F until it melts into a bead; then (keep the bead alive) with the point of the flame touch the back lead, bringing the nipple down, so that the hottest part of the flame at 22 will have full power upon the bead and lead until the back lead is just melted; then if the front lead and the back lead are at nearly equal running heat, affinity, or the attraction of the molten molecules will, so to speak, cause them to fly towards each other. The front lead, being the hottest, moves the quickest, and so they become one homogeneous mass, leaving the back lead standing. Proceed to practise this, by degrees raising the edge of the board until you can burn when the lead is quite perpendicular.

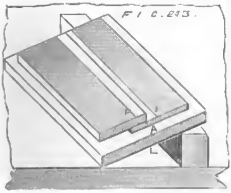


FIG. 243.

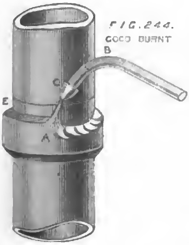


FIG. 244.

Pipe-Joint Burning.

For this, again, refer to Fig. 234. A F E illustrates the prepared joint. Next refer to Fig. 244 at I. This illustrates the joint burnt half-way round. The method will readily be understood after the side burning. Proceed by first melting down the front lead, and walk round, step by step, holding the flame and pipe as at G I B, Figs. 244 and 245.

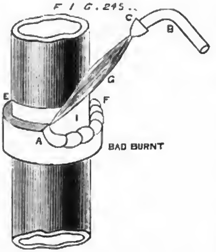


FIG. 245.

Branch Joint for Burning.

To prepare these joints, first cut the lead as shown at Fig. 22; then with the bolt or tommy open the pipe, as shown at G B E, Fig. 24, taking care to well work up the lead to a square thick edge, and to stand up at least ⅛in., as illustrated at B Q, Fig. 249, and not with a thin edge, as shown at B, Fig. 25. Thoroughly clean the inside and outside of the lead suitable for burning, as shown at A E 1, Figs. 245, 246, and 247. When fitting the spigot end, let it fit close and tight, as shown at K B, L Q, Fig. 249. Of course, for soil-pipe especially, the pipe should be branched in on the splay, as illustrated at Fig. 27.

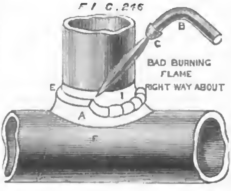


FIG. 246

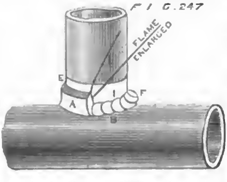


FIG. 247

Branch Joints.

These are well illustrated at Fig. 246 and at Fig. 247, and are nothing more than horizontal burning.

Upright Burning.

Prepare this as you did for side burning. Begin by placing the lead nearly horizontal, as at Figs. 243 and 233. Use a small burner, and not too large a flame—say N O P, Fig. 239; then slope it from G towards E. Keep practising at this, and raising the end G until you can burn upright. This burning should appear like so many split peas lapped over each other. Make G the top of Fig. 233, and view the burning at I. This will appear as upright burning does. The secret of upright burning is to go to work carefully, and with a flame not too large. Of course, you will need much practice, through which you will become perfect.

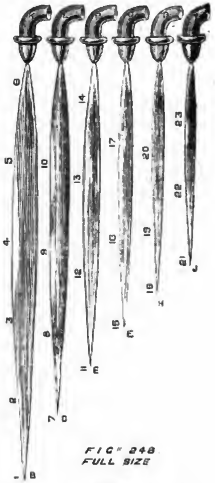


FIG. 248. FULL SIZE

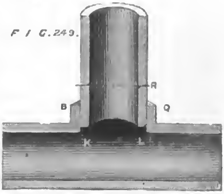


FIG. 249.

I have, before this, published a series of articles, quite independent to these, suitable for the chemical works branch of the trade. The two sets of writings and drawings are quite distinct from each other; but when brought together will form one large and very complete work, too much for any single trade journal to take up. But they will be published in book form, as also my standard works on plumbing, by Messrs. Spon and Co., 46, Charing-cross, S.W.

Our next will be "Cistern Lining."

(*To be continued.*)

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TEMPERING BY COMPRESSION.

THE following is a description of the method of tempering, hardening, and treating metals and alloys, patented by M. Louis Clémandot of Paris. The process is said to produce remarkable results in the case of steel. Briefly described, the invention consists in subjecting the metal, while still hot enough to be ductile to powerful compression, which compression is continued until it becomes completely cold. The nature of the metals after undergoing the three phases of this operation, viz.:—heating, compression, and cooling under pressure, is considerably modified, the grain is much finer, and the density of the metal considerably increased. Metals thus treated undergo a kind of mechanical tempering and may be made to acquire a degree of hardness and density hitherto unattainable. Steel in particular may be said to receive a peculiar temper by compression, by which it acquires "coercive force" which enables it to be permanently magnetised. It is therefore not an ordinary tempering or hammer-hardening operation, but rather resembles forging, although it surpasses it in its effects inasmuch as the metal acquires novel properties and more particularly, an excessive degree of hardness.

With regard to the phenomena due to the application of this method of treatment, it would appear that by the compression, and the cooling of the metal under pressure, the molecular state of the metal is brought into a peculiarly favourable condition for homogeneity. It has been stated that the metal is before compression, heated to a sufficient degree to render it ductile enough for the purpose, and this may be done either by reheating the metal or by taking it at any suitable stage of its manufacture. As above mentioned, this method of tempering by compression imparts to steel coercive force; it is possible, however, to produce the magnetisation of the metal either after or during the compression. By this method of treating metals and metallic compounds or alloys their quality is much improved—for example, steels heretofore unsuitable for tool-making will, after being treated according to this process, be rendered of very good quality for the purpose. Moreover, this treatment when applied to metals in course of manufacture, will permit of the association therewith of still larger proportions of substances by which their properties are modified, according to the purpose for which they are to be employed. This method of treatment is applicable to all the metals including wrought, cast, or malleable cast iron, steel, copper, zinc, gunmetal, bronze, brass, and nickel, and is therefore susceptible of a great and almost infinite number of applications, but it is more especially applicable for producing excellent qualities of steel for magnets, rails, tools, files, gravers, cutlery, coiners' dies, coins, machine bearings, &c. The mechanical means employed for the compression of the metal may be of any suitable kind, but it is preferable to use hydraulic power when available, as being more powerful, easily regulated, and at the same time more readily applied in the different cases enumerated. It is preferred to use hydraulic apparatus operated by means of accumulators, as the sudden action of which they are capable gives the best results.

OBJECT-GLASS WORKING.—I.

By "Prismatique."

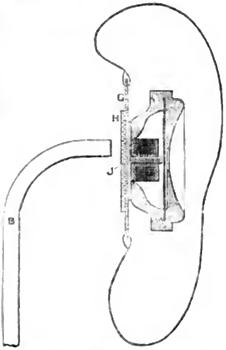
AS articles on the theory of the object-glass are already appearing in these pages from the pen of our indefatigable contributor, Mr. Bradbury ("Orderic Vital"), who has gathered for the readers of the English Mechanic a quantity of interesting and useful matter, and is giving it in a clear and methodical way, I feel bound to redeem my promise of helping. I must say, but for our friend it is questionable whether an exhaustive account would have been possible, practical men having so little time, or, even if they had time, so little inclination to dabble in theory. From experience, I can say that there cannot be a more delightful pastime for amateurs than the manipulation of glass for optical purposes affords, no matter in what direction it is applied. Objectives for the telescope or microscope, prisms for the spectroscope are all "things of beauty," and "joys for [nearly] ever." I can stand on the same platform as the amateur, and feel with him, for optical-glass work has been both my business and my pastime. My motive in adding what I can in matters optical to the information afforded by the pages of this invaluable paper, is to encourage a devotion to this charming pursuit. In concluding these prefatory remarks, I would remind the amateur that the field is not yet half-explored, also that quite a number of recent, as well as past, inventions, are the work of amateur operators.

The first consideration in o.g. construction is the material. It is gratifying to know that whereas the Dollonds and Tullys of only comparatively recent times were obliged to be content with window-glass "knots," or a bit of a plate-glass coach window for the convex lenses of their o.g.'s, and flint of about the same quality as a sixpenny cream-jug is now made; we moderns have a choice of selection from a number of specially-constructed glasses for optical purposes. As I am informed that our friend "O. V." will publish copies of the lists of the eminent makers, Messrs. Chance and M. Feil, the selection of glasses for our purpose will be an easy matter. Mr. Bradbury has given us, too, several tables of curves, so that our intending o.g. maker has, or will shortly, have plenty of materials to start with. Flint glass should be selected with a specific gravity below 3·65. A practical consideration entails this, for glass of greater specific gravity very soon stains in our atmosphere, owing to its construction. The question may arise, Why make it? especially when it will be seen that some flint has a sp. gr. of 5·000. These glasses are extremely useful in the microscope and spectroscope on account of their great dispersion, and can, in those cases, be used as the centre lenses or prisms of combinations, having cemented on them crown prisms or lenses which protect the surfaces from the action of the air. With regard to the crown lens, there is no fear of anything of the sort, for I think there is nothing stands so long as crown glass the influence of the atmospheric changes of this country without losing its polish. As a very important factor in the production of the o.g. is the purity of the glass, it is the better plan to procure discs of guaranteed quality for those who mean to produce a perfect o.g.; but it must be remembered that this guarantee is only partial. Thus, the glass may be imperfect after all; for it is impossible to tell until the first testing, and sometimes after many testings, that the fault is in the glass. The makers will supply others on return of the discs to them. A moment's consideration, however, will convince that it is best to commence with all conditions as favourable as possible. As I intend to give, in the course of these articles, some curves suitable for some of the glasses of both lists, as well as curves for constructing a cheap o.g., those who do not wish anything more than an o.g. will be suited with *them*. But I hope many will take the matter up, selecting various combinations, and publishing results in the same manner as our esteemed friend, Mr. Wassell, has done with specula working.

(*To be continued.*)

BERLINER'S OPERATOR'S RECEIVING TELEPHONE.

RECEIVING telephones used by operators and others whose chief duties consist in listening to and reporting telephonic messages, require to be made as light as possible, in order to avoid the fatigue of holding up the telephones as ordinarily constructed. Mr. E. Berliner, of Boston, Mass., has recently patented a device which can be readily strapped to the ear and retained there without discomfort. Hitherto it has been found difficult to make a receiving telephone which is strapped to the ear, and is so light as not to interfere with the comfort of the operator, and at the same time be efficient in service long continued. The reason is that in the practical receiving telephone a certain amount of magnetic strength is required to polarise an electro-magnet, and as this magnetism represents a certain weight in steel (or a certain weight in insulated wire and iron where an electro-magnet is substituted for a permanent magnet) it has been found that carrying this weight on one's head interferes with one's comfort and health. It has been tried to substitute steel springs for the ordinary bar steel, and shape them so that they will exert pressure only to the sides of the head; but in such steel springs the magnetism is not permanent, and rapidly loses its strength. In his invention, Mr. Berliner disconnects the magnet from the receiving telephone, and makes the former part of the station's fixtures near the operator's ear, so that the remaining parts of the telephone—viz., the sounding-chamber, electro-magnet, and diaphragm—which are strapped to that ear are in its magnetic field. In the figure the core of the electro-magnet is seen fixed to the iron plate J; G is another plate, forming a holder, and to this plate the string is attached. A cushion H of soft material is preferably glued to the back of the telephone, in order to prevent any noise in case the operator should strike with the telephone against the magnet B, which is held to a spring by a screw and nut, thus permitting the magnet to yield in case the operator should touch it, while the height can also be adjusted. It is evident from the above description that the requirements sought after in the invention are perfectly met—viz., a receiving telephone of light weight is strapped to the operator's ear, and magnetism of unlimited strength is supplied without additional weight to the operator's head or discomfort of any kind. The line wires are connected to the coil in the usual way, but are omitted from the cut for the sake of clearness.



BRAHAM'S IMPROVEMENTS IN FIRE-ALARMS.

AN ingenious electrical fire-alarm and extinguisher has been patented by Mr. W. T. Braham, of the Stretford-road, Manchester, which was tried recently at the chief fire-station in that city. The first part of the invention consists of an apparatus that on the occurrence of a fire in its immediate vicinity will sound an alarum, transmit electric currents or telegraphic signals to any place desired, or turn on a supply of water through a series of perforated pipes for the purpose of extinguishing the flames. The patentee employs for the purpose of liberating or setting the apparatus in motion a vessel of convenient size and of suitable material, such as glass, in which is placed some mercury. Upon the mercury is placed a suitable float, which, when a fire occurs, will be carried upward by the air, which, in expanding, forces the mercury up a tube, and causes a float to come in contact with, and liberate a trigger, which releases the apparatus. The apparatus is actuated by means of a weight or coiled spring, and when the spring or weight is released, as before described, the revolving barrel, by means of a chain winding round it, draws back a lever and liberates a heavy key, which in falling turns on the water supply. The barrel of the apparatus is connected by cords or wires, with a distinct apparatus, consisting of a driving barrel, the axis of which carries a wheel, upon which is mounted a revolver charged with blank cartridges, or the wheel may explode any suitable detonator. This wheel carries as many studs as there are chambers in the revolver; these as they rotate raise a lever, which, as soon as a stud has passed it, is forcibly driven by a spring on to the revolver nipple, and so explodes a cartridge. A lever, having its fulcrum on the framing of the apparatus, is connected at one end by means of a wire or cord to a bell; the other end of the lever is actuated by successive teeth or pins upon a wheel gearing with the driving wheel of the apparatus, so that the bell rings continuously until the apparatus has run down. For the purpose of transmitting electric currents or telegraphic signals, the metal work of the apparatus is connected to one pole of an electric generator or battery, and the other pole to a spring contact piece. Upon one of the wheels of the apparatus are placed studs at intervals; these studs, as the wheel rotates, come in contact with the contact piece, and complete the electric circuit. These signals may be transmitted in the usual way to any desired place, as, for example, a fire station, where they may be caused to denote the place where the danger exists by their characteristic intervals, which are dependent on the position of the contact studs before mentioned. Another wheel is driven by the apparatus, upon which is mounted a crank pin, which through a connecting rod actuates bellows, and by their means forces air through suitable pipes to sound a whistle, which may be placed outside the building. In carrying out the second part of the invention, Mr. Braham employs the driving apparatus already described, with as many alarums as may be desired. In order to release the weight or spring, and set the apparatus in action when a burglarious attempt is made on the premises it is desired to protect, he attaches a cord or cords to the catch or detent holding the apparatus at rest. Each cord or wire is carried to the door, or window, or other place, where it terminates in a ring inclosed in a box. This ring is connected with a spring, actuated by means of a hook fixed upon the door or window. The rings may be disengaged by being drawn back by their respective cords, which are connected to a lever when it is required to open the doors or windows without releasing the apparatus. The cords connected with the rings at the doors and windows may be also connected with and actuate a separate alarm in a bedroom or elsewhere.

THE FIGURE OF COMETS.

IN a recent paper to the Paris Academy, M. Faye gives his views as to how the figure of comets is produced. "We know very well," he says, "the solid materials of comets: they are falling stars, bolides, aerolites. We do not know so well the impalpable nebulosities formed by their evaporable materials. To form some idea of them, consider a flake of snow carried into celestial space where no medium exerts pressure, or retains the sun's heat. On the side where this flake receives the solar rays, its temperature will rise, and it will emit vapours which will expand with a certain velocity; but these vapours, too rare to retain the heat, will soon condense into much smaller flakes. These, in their turn, under the influence of the sun's rays, will emit vapours which will be almost immediately condensed like the preceding, by the cold of the surrounding space, so that the action of the sun, which no sensible attraction towards the centre of the original flake counterbalances, will tend to decompose this flake into a nebulosity bathed in unstable vapours of excessive rarity, and soon occupying an enormous volume. In this state, the matter is quite prepared to undergo the action of repulsive forces which the solid and greatly denser materials, referred to at the outset, escaped by virtue of their very density.

"This being allowed, we have to consider that any comet, on approaching the sun, undergoes, by reason of the attraction of that body, and by an effect similar to that of our tides, a decomposition tending to separate, to isolate a part of its materials, which cease to form an integral part of the comet. The essential part of this decomposition, which extends to the denser as well as to the lighter parts, consists in the fact that the separated materials continue to move very nearly in the orbit of the comet, and are disseminated in it. The end of this decomposition will be to reduce the comet, as S. Schiaparelli has shown, to an elongated collection of fragments following the original path. And that is what actually occurs with the solid materials.

"But the evaporable matters, liberated from the attraction of the nucleus, liberated also from the pressure of the layers which formed the comet with a visible increase of density towards the centre, are found to be in the situation of the flake of snow, of which we have just spoken. They are disseminated rapidly in the free space, and acquire the degree of tenuity, of rarefaction, at which the repulsive force of the sun makes itself felt on them. These materials, nevertheless, keep the velocity and direction of motion they had when they formed part of the comet; but the central force being modified for them, they cease to be moved in the original path, and depart from it with surprising rapidity.

"We have had presented to us, in 1846, this double phenomenon, in the decomposition of Biela's comet (see Struve's drawings). The two fragments followed almost exactly the same route; the line which joined them was, on the heavens, the perspective of the common orbit, while the two tails formed by the nebulosities were opposite to the sun, and nearly perpendicular to the path.

"If we abstract nebulosities and tails which they form at a distance under influence of the repulsive force, considering only the act of decomposition, due, like our tides, to the sole influence of solar attraction, it is found, by the analysis of M. Roche, that the materials must fuse at two opposite points, and spread in conical divergent sheets. Though this analysis refers to a state of equilibrium, and to layers which could not exist completely in comets, the distance of which from the sun varies continually, we may suppose that it gives an approximate idea of what occurs in these bodies at the moment when their decomposition takes place before our eye. The aigrettes or luminous sectors directed towards the sun belong, then, to this act of decomposition, and not, as Olbers and Bessel have supposed, to an electric or magnetic repulsion exercised by the nucleus of the comet on its own materials.

"It results from the growing expansion, acquired later by a part of these detached materials, that the nebulosities so produced, fall under the action of the repulsive force and return, while the denser materials remain very nearly in the original path, and merely advance a little on the nucleus.

"There is merely then, in this whole question, apparently so complicated, the play of solar attraction, which tends to decompose bodies of very small mass and large volume, and that of solar repulsion, which commences to act on the evaporable part of those materials whenever, withdrawn from all pressure and submitted to increasing heat, these commence to form nebulosities of excessive rarity.

"If we consider for a moment the remarkable opposition which exists in the manner in which stars and irresolvable nebula are distributed in the universe, we are led to see in it a consequence of the repulsive action which suns, accumulated in a certain region, exert round them on materials reduced to extreme tenuity. The proper light of nebulæ seems to me, moreover, to be exactly of the same nature as that of comets, and to result from the passage of very fine molecules animated with very great velocity in a medium somewhat more material. Calculation shows, at least, that it must be so with some comets, such as that of Donati.

One comes to see that the phenomenon of aigrettes, which suggested to Olbers and Bessel the hypothesis of an electric or magnetic action proper to the comet itself, has quite another cause. I have not, then, been able to accept this hypothesis. Besides, in considering the play of electric forces on our globe, one is not led to attribute to them a cosmic *rôle*. They do not even figure in our terrestrial mechanics. It is indeed true that the least chemical action, the least friction—I will say almost the least contact—of two bodies sets these forces in play; but by the very nature of polar forces, they soon destroy each other. The terrestrial globe is, if you wish, an immense reservoir of electricity, but of neutral electricity. It is with difficulty that, beyond the insignificant and transient effects of thunderstorms, we perceive the existence of these forces. It has been necessary that the ingenuity of physicists should intervene in acts where they are produced, to separate them temporarily, lead them to a distance, and force them to do excellent work in recombining. Far away, beyond the globe, all that disappears. What remains in the celestial regions, is the incandescence of the sun, and it is to that I have attributed the phenomena of repulsion which the gigantic tails of comets present before us so visibly."

THE MAGNETO-SOUNDER.

THIS simple and ingenious device, says *La Nature*, has been devised by M. L. Wiessenbruch, a lieutenant in the Belgian Engineers, to serve as an outpost telegraph without battery. The object of these telegraphs being to establish communication between the main guards and sentinels, the distance they are required to operate over never exceeds two or three kilometres. Owing to the special character of these "flying" lines, a light, simple, portable, and at the same time powerful apparatus is necessary. The magneto-telephone is not always powerful enough on account of the noise which arises during an action; the microphone is more powerful, but it is also more delicate, and requires regulation, as well as a battery, which often proves cumbrous. The magneto-sounder of M. L. Wiessenbruch resembles both the telephone and the Morse sounder. It is a magneto-electric transmitter weighing only 750 grammes. It can be inclosed in a box 13 centimetres long, 6 centimetres wide, and 5 centimetres deep, from which protrudes only the manipulating button, and the two terminals for attaching the conductors. The transmitter consists of a Gower magneto-electric telephone, with fine wire, the vibrating disc of which is made convex in its centre, so as to act as a spring under pressure. An ordinary Morse key is arranged upon this convex plate, and exerts pressure on its centre when the manipulating button is pressed. Each time that this button is pressed, the plate of the telephone, in virtue of its form, approaches the magnet sharply and develops an induced current in the coils. When the button is released, it takes up its former position as sharply, and develops a second induced current of opposite sign. A complete system of communication by this means includes a circuit consisting of a single wire connecting the two posts, and at each of these posts a magneto-sounder connected on the one side to line, and on the other to an ordinary Bell telephone, which acts as a receiver; the circuit is completed by the earth by means of a wire connected to the second terminal of the telephone-receiver, and to the hilt of a sabre stuck into slightly damp ground. The operator works the instrument with his right hand and holds the telephone-receiver to his ear with his left. The induced currents developed in the convex-plate are far more energetic than the vocal transmission in the most perfect telephones, and the despatch can therefore be read by sound, despite the surrounding noise. In experiments made by M. L. Wiessenbruch, he was able to insert a resistance equal to 600 kilometres of iron wire, four millimetres in diameter (6,000 ohms), without perceptibly interfering with the clearness of the reception. At the Exhibition of 1881, Colonel W. Jacobi, a Russian, exhibited under the name of *tilikul*, a telephonic transmitter, without a battery; but it was much heavier, and more cumbersome than Lieutenant Wiessenbruch's magneto-sounder, since it weighed from five to seven kilogrammes, was 34 centimetres long, 22 wide, and 11 high.

CAMEO-CUTTING.

ONE of the best examples of adroit manipulation under the simple microscope is the operation of cameo cutting as described in an article in *Our Home and Science Gossip*:

A visit to a cameo cutter's workshop found him seated at a table covered with tools, varying from a triangular-pointed steel instrument to the most delicate; pointed bits of steel wire fastened in handles. Very fine files and knitting needles, set in wooden grips and ground to infinitesimal points, figured in the lot. On a pad of leather, before the cameo cutter, was a block of wood just big enough to be grasped with his hand, and cemented to the middle of it was an oval object that looked like a piece of alabaster, just big enough to make a seal for the finger of a man who did not object to wearing large rings. Upon this the artist was just finishing a copy, with a pencil pointed to needle fineness, of a photograph in profile of a gentleman, which was leaned against a little photograph easel before him. Having finished the outline, he laid his pencil by, and taking up a fine wire tool he scratched the pencil mark around with it. Then he took a darning needle with a sharp point and scratched the line deeper. He worked with a magnifying glass at his eye, and stopped continually to inspect the progress of his work with critical minuteness. Then he went at it again, working slowly, scratching over the same line again and again, and always examining after each scratch. He changed his tools as he went on, and from the darning needle descended to a trifling little fragment of steel wire, not as thick as an ordinary sewing needle, set in a slender handle.

With this he scratched and rescratched, until the lines he had drawn with his pencil had quite vanished, and a thin, fine streak of a dark colour had marked the outline of the head he had been tracing his way around. Next he took one of his burin-like tools and commenced again. This time he worked on the outside of the outline, cutting and scraping at the surface until the white turned grey, then brown, and finally vanished, leaving the face in relief, surrounded by a black ground—that is, the portrait remained intact in the white substance which formed the outer layer of the cameo, while it had been cut away around it to the lower or dark layer. The portrait or figure is then modulated upon its surface until it assumes the roundness of nature. The edges are left square to the dark ground.

This is necessary, as, if they are gradually rounded down, the outline becomes undefined toward its juncture with the relieving surface, owing to the white of the raised portion being partially transparent and permitting the dark to show through it when it is thinned down. Care is taken to finish this dark surface as much as possible with the cutting tools and so separate the white from it as to leave it smooth and unscratched. A final polish is given it, however, with putty powder applied dry with a stiff brush, but the utmost care is necessary in this operation, as the slightest slip will ruin the work. This is the cameo cutter's work, the mountings being the jeweller's work. The cameos sell, unmounted, for about twenty-five dollars.

THE DIFFUSION OF BACTERIA.

THE researches of M. Pasteur and Darwin have shown how earthworms may aid the diffusion of small organisms, some of which may produce disease. Professor Schnetzler states that the dejections of earthworms always contain numerous living bacteria and their germs (the hay-bacterium included). It is clear that bacteria in enormous quantity float in the air about us; and we have at easy command, Professor Schnetzler points out, a small apparatus traversed by about 8,000 cubic centimetres of air per minute, which may inform us as to these floating germs. This is no other than the nasal cavity, on the mucous surface of which air-particles are deposited. To observe these he advises injecting the nose with distilled water (completely sterilised) by means of a glass syringe previously calcined. The liquid so obtained is put in one perfectly clean watch glass and covered by another. With a microscope magnifying 700 or 800 one finds, among various particles in the liquid, some real live bacteria. If the liquid be kept a few days in a clean glass tube hermetically sealed, the bacteria are found to have increased very considerably. One sees *Bacterium termo, vibrio, spirillum, bacillus subtilis*, even some *infusoria*, and spores and fragments of fungi. Professor Schnetzler has further successfully cultivated the organised germs by means of a mixture of gelatine and distilled water. Why do not those bacteria in the nasal cavity always multiply and develop and penetrate to the windpipe and lungs? Their progress is doubtless opposed by the vibratory movements of cilia (or minute hairs) in the air-passages, and the weakly alkaline reaction of the nasal mucus may (it is also suggested) be unfavourable to some of them. Colin has proved that bacteria producing acid fermentation perish in liquids with alkaline reaction. Infectious bacteria may, however, multiply to a formidable extent on living mucous surfaces, witness the growth of the *micrococcus* of diphtheria, brought by the air into the air-passages; also the *bacterium* of anthrax. The *bacillus* of tubercle, as Koch has lately shown, may be transmitted from one person to another by the air passages. Professor Schnetzler thinks hay fever may also be due to bacteria entering the nose. While the development of bacteria on normal mucous surfaces is usually limited, millions of them are found in the dejections of healthy children.

A METHOD OF MOULDING GEAR WHEELS.*

THE following method of moulding heavy gear wheels, which I believe was original with myself, and which I have found exceedingly useful in a great many instances, is really a rough substitute for a moulding machine, and like a moulding machine, possesses the merit of making wheels which are tolerable approximations to truth. The method of making wheels by using short cores on which the teeth are moulded, and spacing them around in a pit, is one not to be tolerated, for although a thing may be made tolerably satisfactory to the moulder, the application of the machinist's calipers will show that the teeth and spaces vary in thickness from the difficulty in setting the cores, while the cores themselves change their shape from the shape of the core box, in handling and drying. There are mill owners who imagine they have accomplished a good work when they insist upon having the gears turned, thus truing the points of the teeth, forgetting that the points of the teeth, even in the most perfect work, are not intended to touch anything. It is, however, a somewhat melancholy sight to a man who bears the expense, to observe one of the old-fashioned boring mill, or lathes of light weight, nibbling off a little cut, and the machine jumping from tooth to tooth, as though trying to make time between the cuts.

Fig. 1 represents a section through the sand of the foundry floor. A, A, is a vertical spindle, tapered at the lower end and fitted to a tapered hole in the base plate. C is a casting, having bored holes carefully fitted, so as to slide freely upon the spindle. A board is bolted to C, which levels the floor on the line *a*, *b*, and leaves the lift *c*, if required, to form the boss. The cope is then placed, and rammed up as usual with a piece of tubing or gas-pipe slipped over the spindle to allow the cope to be lifted without disturbing the sand. The cope being lifted and swung to one side, another board is used, which sweeps a pit in the green-sand of the floor to the shape *d*, *e*, *f*, *g*. The part *f* is for the boss at the lower side, and *g* is the core print. The casting C is now lifted from the spindle, and the index plate D, D, placed and secured by the set screw. This index plate is smoothly turned, and while in the lathe a number of circles are struck with a fine-pointed tool. These circles should be graduated, and the holes drilled on a gear cutter, or, as the English say, a "dividing engine;" but in my case the dividing engine was a sharp-eyed apprentice, armed with a pair of compasses, a hammer, and a centre-punch, in preference to the pattern-maker, with his glasses and lead pencil.

FIG. 1.

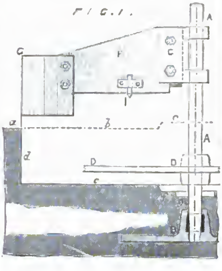
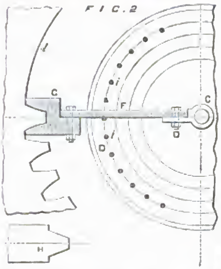


FIG. 2



The board F, having the pattern G attached, is now bolted to the casting C, and slipped down upon the spindle, and the point I adjusted so as to drop into the centre-punch marks 1, &c., and allow the lower end of the pattern to come very close to the bottom of the pit on the level *c*. The green-sand forming the space between two teeth is then rammed, and the board H, Fig. 2, laid on with a 10lb. weight on top to hold the sand down, when the pattern is being drawn, and the arm shifted to the next hole in the index plate. It is well to give this pattern some "draught," not to make it lift easier, but because the "straining" of the lower part of the casting, particularly when the face of the gear is wide, tends to make that part larger. It is also well not to allow too much for shrinkage; in case of these heavy wheels, 1-16 per foot I have found ample.

After the teeth are formed, the spindle and attachments may be removed, of course leaving the plate B in the sand until after the casting is made. The arm cores and centre core may be placed in the ordinary manner, being made of dry sand, or in some cases where the gear is large and the arms plain, the core-box may be laid in the mould and rammed up with green-sand, in the exact location where it is required to be.

The cope may now be put in place, and weighted as usual in work of this character. It will be observed that in Fig. 2 the teeth are shown of the involute form, which I adopted some years ago as the best form for rough wheels. They certainly are the strongest as to form, theoretically; and for smooth running, some of these wheels made with this rough apparatus as coarse as 7¼in. pitch on the pitch circle, I have never seen equalled by any gear moulded from a pattern.

THE INFLUENCE OF FORESTS ON CLIMATE.

DR. SCHOMBURGK, the Director of the Botanical Gardens at Adelaide, has added to his recently issued report an appendix on the subject of the influence of forests on climate. The object of this paper is to prove that the destruction of forests usually has the effect of reducing the rainfall, while, on the contrary, the planting of trees broadcast over a country is one of the best methods which can be adopted for ameliorating its climate and increasing the annual fall of rain. It cannot, indeed, be proved that the climate of South Australia is altering for the worse in this respect. In fact, a comparison of the meteorological records will show that the annual average rainfall for the colony during the past 10 years has been 21·1in., as compared with 20.1in. for the previous 10 years. The fact is, that in the agricultural districts of the colony, and especially in those which were not originally timbered, the bringing of the land into cultivation has had the effect of slightly favouring the fall of rain. Ploughed land attracts moisture to a much greater degree than the unbroken soil. In considering the effect which the removal of forests *per se* has in altering the climate in South Australia, the only direct test that could be taken from the records issued by the Government astronomer is the experience of the neighbourhood of Adelaide. If the time is divided which has elapsed since 1839, the year in which observations were commenced, into two periods, there is found for the first an average rainfall of 22·8in., and for the second one of 21·7in. It will thus be seen that, on the whole, the rainfall at Adelaide is diminishing, though very slightly, and perhaps the diminution in the amount of timber may have something to do with the change. Dr. Schomburgk, in searching for illustrations of the effect of trees on climate, goes further afield, and brings forward some striking instances, in which it is evident that loss of forests means loss of rainfall, and *vice versâ*. He recalls how the Russians, by burning down some of the Trans-caucasian forests at the time of their struggle with the Circassians, converted the country from a fertile land into a desert, simply through the cutting off of the supply of rain. Similar instances of rain having deserted a country denuded of forests have occurred in the Mauritius, in Jamaica, the Azores, and it may also be added to a still more remarkable extent in several of the smaller West India Islands. No sooner had the forests of these places been destroyed than the springs and rivulets ceased to flow, the rainfall became irregular, and even the deposition of dew was almost entirely checked. On the other hand, it is generally accepted as a fact that Mahemet Ali increased the fertility of Egypt enormously by planting trees. He alone planted some 20,000,000 on the Delta, his successors followed up the work, and it is a noteworthy circumstance that the rainfall rose from 6in. to 40in. Planting has also, it would seem, produced remarkable effects in France and Algiers. Extensive regions have been planted with gums and other trees, which, for the most part, grew to about 30ft. or 40ft. in height, and it is noticed that the quantities of rain and dew which now fall on the adjacent land are double what they formerly were.

HYDRAULIC MACHINERY.—II.*

By Prof. Perry.

I HAVE one more general observation to make about the hydraulic press. I said there was no storage of energy in the press. This is not quite true, even if we disregard the compression of the water, and elastic yielding of the press. There is a lifting of the ram itself always going on, as well as a lifting of the weight on its top. Now the lifting of the ram it is easy to take into account. In hydraulic presses you simply regard the ram as part of the load to be lifted, and you regard the lifting of it as an absolute waste of a not very large kind. But when the weight lifted by the ram is less than the weight of the ram itself, and this is the case in warehouse and hotel hoists, it is usual to take it into account. But it is rather difficult to take into account, because as it rises its weight gets greater. You know that a stone, when surrounded by water, is easier to lift than when it is in the air, and as more and more of a long ram leaves the press, the weight of the whole ram gets greater and greater, just in proportion to the weight of the water which it displaced. I say that in hydraulic presses we can leave this out of account, but we cannot do so in hoists. In a future lecture I shall tell you how Clark and Standfield's balance method, applied to lifts, enables us to get over the difficulty. The punching bear, of which you have a section in Fig. 8, is similar in construction to the lifting-jack. The upper part of the stout ram H terminates in an indiarubber dish, which is fastened by the washer and a bolt passing through the middle of the washer from the ram. As you work the top lever B, the ram H holding the punch is pressed down by water through a valve arrangement exactly similar to that in the lifting-jack.

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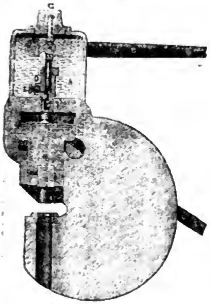
* By Wm. H. Harrison, in *American Machinist*.

* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

Fig. 8.



Wherever the water comes in contact with a solid surface, it presses against the surface, and the direction of this pressure is directly normal. There can be no such thing as oblique pressure in water when the water is at rest, for oblique pressure means a force partly along the surface, and this would imply some frictional resistance to sliding, which we know cannot occur in water at rest. It is evident from our discussion of the hydraulic press, as a machine in which there is no store of energy, that on every square inch of the solid surface touched by the water there must be the same force acting, the water tending to escape everywhere; and, when we consider the whole case mathematically, we find that very little interspace separating any two portions of water is acted on by this same pressure per square inch. You will, perhaps, some of you, have been troubled by the notion that the shape of the end of the ram ought to have some effect on the total force with which the ram is pressed upwards. You will be perfectly safe in all your notions of fluid presence, if you consider each particle of water to be a very small being, greased all over, so that it cannot possibly resist sliding past its neighbours. It can press normally against a wall, or against any surface, but there cannot possibly be a tangential or frictional pressure between it and a wall, because it is well greased. All the water is trying to escape, and the total pressure on any surface is evidently proportional to the number of water particles pressing against the surface. Although the end of the ram may be curved, and it is therefore being acted on by a series of pressures, it is easy to show that the resultant action of these is really the same as if the ram had a flat end.

You will understand this better, perhaps, if we consider a vessel, A B C (Fig. 9), to be filled with fluid at such a great pressure, that we can neglect the pressure due to the fluid's own weight. This we can do in the hydraulic press and in steam-boilers. The pressure on the surface everywhere is shown by the arrows. Now it is evident that the total horizontal force on the curved surface, A C B, is exactly equal and opposite to the total horizontal force on the flat surface, A B, because if there were, on the whole, more force on one than the other, the vessel would move bodily—an idea which is absurd. Hence, when we want to find the total horizontal force on the curved surface, we never dream of going into the long calculation, which you might think necessary, for it is simply equal to the area in square inches of the flat surface, A B, multiplied by the pressure per square inch.

Hence, suppose we want to find the horizontal bursting tendency of the egg-ended boiler, M N, Fig. 10; that is, say, the force tending to burst it by direct pull of the iron at the section A B, we do not trouble ourselves with the shape of the boiler anywhere except at A B itself. The bursting force is the inside area of A B, in square inches, multiplied into the pressure per square inch. The area of the iron in the section A B is exposed to this pull. These are the two important facts to be remembered. Consider any section whatsoever of a boiler, or ram, or pipe. Remember that the fluid pressure is calculated over the whole area. The resistance of the iron is only calculated over the actual sectional area of the metal. Thus, if we want to find the tendency to burst along such a section as M N, we take the total inside area of the section here multiplied by the pressure, and this is equal to the stress in the iron all along this section, multiplied by the whole sectional area of the iron.

Fig. 9.

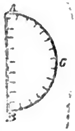
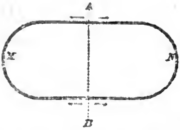


Fig. 10.



In a cylindric boiler or press, which is everywhere of the same thickness, it is easy to show that, if we neglect the effect of the ends, the tendency to burst laterally is twice as great as the tendency to burst endwise. Thus, in the endwise bursting, if p is the bursting pressure in pounds per square inch, f the tensile strength of the material in pounds per square inch, r the radius of the boiler, and t, the thickness of metal, the total force tending to produce a bursting is the area of the circular cross section, $3{\cdot}14\,r^2$, multiplied by p, and the total force resisting fracture is the circumference of the circular cross section, $6{\cdot}28\,r$, multiplied by t and by f. Hence—

$$3{\cdot}14\,r^2 p = 6{\cdot}28\,r f t,$$

or the bursting pressure $p = 2 f t \div r$.

Again, if a boiler is l inches long, the total force tending to burst the boiler is the area l times the diameter of the boiler, multiplied by p, or $2\,r\,l\,p$, and the total force resisting fracture, if we neglect the ends, is the area of the iron $2\,l\,t$, multiplied by f. Hence—

$$2\,r\,l\,p = 2\,l\,t\,f,$$

or the bursting pressure $p = f\,t \div r$.

Hence it would take twice as much pressure to burst the boiler, if we assumed it to burst endwise. We always calculate the strength of a pipe or boiler on the second assumption therefore, and we have the rule:—The bursting pressure in pounds per square inch is equal to the tensile strength of the metal in pounds per square inch, multiplied by the thickness of the metal in inches, divided by the radius of the boiler or pipe in inches.

When the press is thick, as we find it in a hydraulic machine, it is rather more difficult to calculate the bursting pressure, because the tensile strain is not distributed uniformly over the section at which there is a tendency for rupture to occur. The inside portions of the metal near the water are subjected to more pulling forces than the outer portions.

Cast-steel is now getting common for the cylinders of small jacks and bears. The large presses used in warehouses are, however, still made of loam-moulded cast-iron, as all presses used to be in my apprenticeship days. But in a great deal of large press-work cast-steel has come largely into fashion, its tensile strength being so much greater than the strength of cast-iron as to make a most extraordinary difference in the outside sizes of the cylinders.

For warehouse use, the pumps are often worked by hand, but even fifteen years ago I remember that orders were generally for pumps worked by power; that is, driven from shafting and worked by cranks. In this case it was common to attach a series of these presses to one set of pumps, all the presses in a warehouse being fed from a long pipe, each having its separate valve. You will see that, although in hydraulic jacks for lifting heavy weights, the weight on the ram is the same during the whole of any operation, this is not the same in baling presses. Thus, for example, in the Indian cotton trade, governed as it is by the Suez Canal regulations, it is necessary to press cotton so compactly that it is like a piece of oak, and it can be planed up like oak. During the early part of the operation the pressure on the ram is therefore small, becoming very great towards the end; and it is the greatest pressure, of course, which decides the relative sizes of plunger and ram. If the ram were made to rise quickly at the beginning, and more slowly towards the end, it is obvious that there would not only be a saving of time, but a more regular doing of work. In hand presses, it is usual to change the fulcrum of the lever, so that a labourer may work more rapidly at the beginning. It is also common to use a large pump in the early part of a pressing operation, changing it to a small one at the end; or to use two of equal size, throwing one of them out of gear towards the end of the operation.

We see, then, that capability of working very rapidly when the pressures are small, and working very slowly when the pressures are great, on the supposition that the steam-engine is always working at the same speed—these are the important things to be looked for in hydraulic presses. It must be quite evident to all of you that there will probably be great changes in the future in these machines. Probably it is in the direction of the use of combinations of accumulators, employing Mr. Tweddell's principle, that we may look for improvements.

USEFUL AND SCIENTIFIC NOTES.

Regenerating Battery.—J. Rousse replaces the zinc of the Bunsen cell by ferromanganese, of the strength of 85 per cent. Pure manganese has such an affinity for oxygen that it decomposes boiling water. This gives to the new battery an electro-motive force similar to that of amalgamated zinc. In order to produce energetic currents diluted sulphuric acid is employed; the depolarisation is obtained by concentrated nitric acid. For feeble currents, and when the battery is to be employed in ordinary apartments, permanganate of potash is employed as a depolariser. The salts produced by the battery are sulphate and nitrate of manganese or of potash. To remove the sulphuric acid from the liquid he treats it with the nitrate of lead, which is produced in his lead battery. The sulphate of lead which results from this reaction is transformed into ceruse, by boiling with carbonate of potash. The soluble salts separated by decantation contain only nitrates of manganese and of potash. Pouring in carbonate of potash all the oxide of manganese is precipitated in the state of carbonate. This precipitate is washed and calcined, to reduce the metal to a sesquioxide, which is heated with potash and nitrate of potash, and thus transformed into permanganate of potash. Peroxide of manganese is then easily obtained by known methods. All these chemical operations are simple and can be easily executed, they are so combined as to produce dynamic electricity economically and without leaving useless residues.

A Photo-electric Battery.—A series of experiments has led a French chemist (M. Saur) to the construction of an electric battery which gives a current only when exposed to light. The battery, which is described in *l'Ingenieur*, consists of a square glass vessel, with a solution of 15 parts of marine salt and 7 of sulphate of copper in 100 of water. This has an electrode of sulphide of silver. An inner porous vessel with mercury has an electrode of platinum. The electrodes are connected with a galvanometer, and the battery is placed in a box with the light excluded. Closure of the circuit displaces the needle, the sulphide of silver being the negative. When the needle is at rest, exposure of the battery to solar light causes further deflection, the extreme sensitiveness of the battery being shown by the fact that the passage of a cloud causes a variation. The effect of the battery is due to the mercury being attacked by the bichloride of copper formed by the mixture of marine salt and sulphate of copper. The proto-copper formed reduces the silver sulphide; but this reduction requires the intervention of solar light, which produces the photo-electric current. We do not know whether this photo-electric battery has been tried as a recorder of sunshine, but if it is as sensitive as represented, it should be of some value in this direction.

SCIENTIFIC NEWS.

THE death is announced of Prof. Emil Plantamour, director of Geneva Observatory. The deceased was born in that city in 1815, and took his degree at Königsberg. Soon afterwards (in 1840) he was appointed to the post of director of the observatory in his native city. He was elected an Associate of the Royal Astronomical Society in 1844, and since 1865 he has been a corresponding member of the Institut de France. Prof. Plantamour was widely known by his scientific writings, apart from the annual publications in connection with his observatory work.

Two Dun Echt circulars (54 and 55) have been issued recently. The first announced that M. Cruls had telegraphed from Rio de Janeiro by the Science Observer code the discovery of a comet on Sept. 11·718 M. T. (Rio?), in R.A. 9h. 48m., S. Dec. 2° 1'. M. Cruls reported it visible to the naked eye, and probably the expected comet Pons of 1812. The second circular contains a Science Observer telegram from Boston, announcing the discovery of a comet by Barnard, on Sept. 10 (?), described as circular, 2' in diameter, with some central condensation, and of the 10th magnitude. It was observed at Harvard College, Sept. 14·8162 G.M.T., in R.A. 7h. 19m. 17·8s.; N. Dec. 16° 3' 51"; Daily motion in R.A., + 1m. 44s.; in Dec., — 43'.

Mr. A. A. Common, at 10.45 a.m. on Sept. 17, found a magnificent comet, west of the Sun about 6 min., and approaching him rapidly. It must now be looked for east of the Sun, and is probably the comet reported by M. Cruls.

From Dun Echt Circular No. 56, we learn that Mr. Lohse has observed this comet. The spectrum of nucleus is continuous with many bright lines—D far the brightest, and all the bright lines displaced towards the red.

The Transit of Venus observing parties appointed by the United States are preparing for their work, and some are already on the way to their destinations. There will probably be four stations in the southern hemisphere. One is at the Cape of Good Hope, under Professor Newcomb; one at New Zealand, under Edwin Smith, of the Coast Survey; one at Santiago, Chili, under Professor Boss; and one in Santa Cruz, Patagonia, under Lieutenant Very, of the United States Navy. Some of the stations in the United States will be Cedar Keys, Florida; San Antonia, Texas; and Fort Thorn, New Mexico. The directors will be Professors Hall, Harkness, Eastman of the Naval Observatory, and Professor Davidson of the Coast Survey.

From the jury of the Paris International Exhibition of Electricity Mr. Crookes has received a gratifying recognition of his labours in connection with the attainment of high vacua. According to the official report on the four systems of incandescent lamps—"None of them would have succeeded had it not been for these extreme vacua which Mr. Crookes has taught us to manage. The members of the Jury of Recompenses are anxious to express to Mr. Crookes their high approval of his beautiful researches, and at the same time their regret that it is not in their power to award him a prize."

We have received the Syllabus for the first half of the winter session of the Bow and Bromley Institute, and would recommend those of our readers who reside within reach of the N.L. and G.E. railway stations at Bow to procure a copy. In addition to a full list of science and art classes, the institute offers to its members and the public a variety of entertainments, musical and dramatic, with occasional scientific lectures. The organ has been enlarged and reconstructed, a third manual having been added, and the popular "recitals" commence next Saturday. In connection with the Institute are the East London Natural History and Microscopical Society, the East London Floricultural Society, a cricket, and a bicycle club.

M. C. A. Faure has obtained letters patent for an electric meter, based upon the well-known apparatus to demonstrate the rotation of a current round a pole. A core of soft iron wrapped with an insulating conducting wire has an extension upwards surrounded by a non-conducting envelope. In this connection at the upper extremity is a footstep which receives a spindle carrying a couple of arms dipping down into the mercury which surrounds the extension. The current passes through the magnet coil and enters the mercury, whence it rises up the arms and escapes to the negative terminal. The spindle carrying the arms revolves, and the moving force being directly proportional to the square of the current, and the resistance to the square of the velocity, the speed of rotation is a measure of the current passing. At each revolution of the spindle, a projection comes into contact with a spring connected with a counting apparatus—*e.g.*, an electro-magnet, the armature of which is made to act upon a toothed wheel, and so upon a counting train.

The prospects of the Railway Appliances Exhibition, to be opened at Darlington, October 3rd, are very satisfactory. Applications for space are numerous; the railway companies will carry the exhibits at half-rates, and the officials of the North Eastern are rendering all the assistance in their power. The promoters have applied for the use of a siding on the North-Eastern line, in order that experiments with couplings may be made of the full size required in actual work. Mr. David Dale, a director of the North-Eastern, will open the exhibition.

On the subject of railway whistling, the *Lancet* says:—We quite agree that there is far too much whistling on railways; but it is not true, as stated in a paper read by Mr. Price Edwards before the British Association, that "a low note would be equally efficacious for railway purposes as a high one," because "given the same initial intensity in the production of two sounds—one of low, the other of high pitch—there would be little difference between their penetrating powers at long distances, and none at all at such distances as sounds are required to be heard for the purposes of signalling." There is some begging of the acoustic question in the way the proposition is stated; but setting that aside, it is notorious, and capable of demonstration, that a flat note does not penetrate so well as a full one of the same pitch, and all sounds have a tendency to fall flat as well as to be less distinctly heard as they traverse space. In other words, the trajectory of a sound-wave falls flatter as it is prolonged. It follows that a low sound which has naturally a low trajectory will become flat sooner than a high one. If whistles are to be heard, and it is essential they should be, at great distances, they must be high-pitched. Meanwhile, public health and happiness demand that there should be as little use of the railway-whistle as possible.

A high rate of speed has been reached on the West Jersey Railroad by a special train running from Camden to Cape May, at the mouth of Delaware Bay. The train consisted of Class C locomotive, a combination car, and two passenger coaches; 124 passengers were on the train. The train ran through from Camden to Cape May, stopping at only one point, about 40 miles out, for water. The train left Camden at 2.10½ p.m., and arrived at Cape May at 3.34. Records of speed were taken as follows: Westville to Cape May, 76·1 miles, in 76 minutes; Woodbury to Court House, 61·1 miles, in 60 minutes; Glassboro' to Vineland, 16·5 miles, in 14 minutes. The last named section is in about the middle of the run.

Messrs. Alexander and M'Cosh (of William Baird and Co., Gartsherrie), have, it is said, successfully solved the problem of extracting ammonia and tar from the waste gases of the blast-furnace without increasing the cost of manufacture or interfering in any way with the process of smelting.

The United States Patent Office decided, some little time ago, that Mr. Jacob Reese was the prior inventor of what we know as the Gilchrist-Thomas basic process. Mr. Reese has, however, not yet obtained a patent, and Mr. J. Henderson has stepped in with an "interference," on the broad claim by the former, of dephosphorisation after decarburisation.

The annual fungus hunt of the Essex Field Club will be held to-morrow (23rd), in the northern section of Epping Forest. The headquarters for the day will be at the "Crown," Loughton.

The Austrian Arctic Meteorological observations were commenced on August 15th, on the Beeren Mountain, Jan Mayen, at an altitude of 5,000ft. The party reached the island on July 13th, and in addition to the buildings carried out in the ship, erected two others from drift-wood, which was found in abundance.

Many chemists have doubted the existence of black phosphorus, holding that it is a mixture of ordinary phosphorus and metallic phosphide that gives the colour. M. Thenard, while admitting that this may often be the case, does not think it is always so. A short time ago, when moulding phosphorus in the ordinary way, and after obtaining a dozen rods all of the usual colour, he found that the thirteenth suddenly blackened at the moment of congelation, this effect extending throughout its mass. Other rods blackened partially. The black, or rather dark grey, phosphorus becomes white again when melted, and remains white if cooled suddenly; but if surfusion be produced, it becomes black, as before, on contact with white or black phosphorus.

An international conference of electricians is to begin in Paris on 15th October. The French Government have voted 90,000 francs towards the expenses. At the same time a conference will be held in Paris, likewise at the instance of the French Government, to consult on the rights of property in, and the protection of, submarine cables. An international Postal Congress is to be held in Lisbon in 1884.

It is stated in a recent German work on the development of champagne manufacture in Europe, that in 1845, France produced 9½ million bottles of champagne, of which 4 millions were exported, whereas the production now is 32 to 33 millions, and the exportation 19 to 20 millions. Germany now produces at least 9 million bottles annually, and exports 2 million to England and 1 million to America.

On the initiative of the Municipal Laboratory of Paris, an important capture of milk adulterators was recently made at the station of Batignolles. These milkmen filled a part of their measures with water from the taps at the station, and mixed it with the milk brought by railway. They used, besides, bicarbonate of lime, and a dye to colour the cream. Those who received the milk sealed employed small stoves formed of a round case (for conserves), placed on the lantern of the cart, with wax contained in a small tin goblet. The seals were adroitly cut after slight heating, and afterwards renewed. It is unnecessary to say that all these objects were confiscated, and the delinquents cited before the tribunal.

A severe outbreak of typhoid fever, which occurred last year at Nahant, a rocky peninsula near Boston occupied by a few very rich cottage owners, has been in the main accounted for by the condition of the drinking-water; but, in some cases, it is thought the infection came from use of contaminated ice, which was brought from a foul pond in the neighbourhood. Such a cause certainly explained a severe epidemic of the disease not long ago at a seashore hotel in New England.

A company has been recently formed at Lausanne, with the name of *Société Suisse d'Electricité*, to distribute throughout the town motor-force, heat, and light. Another company for application of electricity (Edison's system) has been started at Milan.

Under the patronage of the Syndical Union of Brussels, an association has been formed to provide Belgians with institutions necessary to insure for its working population a technical education enabling them to compete advantageously with foreign nations. The founders of the society note, in their appeal, the increasing extent of industrial competition nowadays. "The only nations which, ere long, will triumph in the world's market are those which will satisfy most completely the triple condition of cheapness of products, perfection of work, and taste in form." Schools of apprenticeship should be formed, also institutions of a higher order; the industrial schools should be modified, and connected in their programme with establishments under them. Industrial museums, special libraries, exhibitions, and prize competitions are all urged as important means to the end in view.

In view of previous contradictory data, Prof. Ludwig has recently inquired anew into the distribution of arsenic in the body in cases of poisoning by this substance. In the case of a man so poisoned, he found that the proportion of arsenic contained in the same weight of brain, liver, kidney, and muscle was represented by 1, 84, 129, and 3, severally. His observations, both on men and lower animals, lead him to consider Sonnenschein mistaken in saying arsenic is very difficult to find in the bones. Both in acute and in chronic poisoning it may be found, and the author found it in the bones of a dog even 27 days after the last of a series of doses of arsenic had been given. The brain never contains more than a small proportion, be the poisoning chronic or acute; the liver always has a great deal, so have the kidneys (in acute cases even more than the liver). The muscles contain little, but always more than the brain. After cessation of chronic poisoning, the liver contains arsenic longest.

There are at present (we learn from *Der Techniker*) 33 railway schools in Russia to furnish capable native officials, &c., for the lines of the country. A short time ago it was impossible to find fairly-educated natives for the service, and even now half the locomotive drivers in Russia are German. Twenty years ago, e.g., there were, on a stretch of only 25 miles, four station officials who could not read nor write, and had to employ a clerk for the purpose. These schools now furnish engineers, locomotive drivers, station officials, stokers, and telegraphists. The pupils are chiefly sons of railway and telegraph officials. The course is three years in length, and, in many cases, two years of probation are added. A one-year preparatory course is provided for those who, at the outset, can neither read nor write. Afterwards, the pupils must remain at least two years in the service of the railway whose schools they have attended. These schools are not yet beyond the experimental stage. One of the oldest of them (founded in 1872) has supplied 25 of its pupils to the railway service.

Over the Brünig Pass, which is familiar to Swiss tourists, and is situated 430m. above the Lake of Brienz, and 600m. above Lake Lucerne, a toothed-wheel railway (1m. gauge) is to be shortly made, at a cost of seven million francs.

A proposal was lately made, it is known, to cut the Peninsula of Malacca, so as to relieve ships of the necessity of passing round by Singapore in going from Indian to Chinese waters or vice versâ. An eminent engineer, M. Dru, read a paper on the subject at the Geographical Congress in Venice. Since then a visit of reconnaissance has been undertaken to the Peninsula of Kraw, by M. Deloncle and Dr. Harmand, French Consul and Commissioner to the King of Siam, who have lately returned. Thanks to the man-of-war and the elephants put at their disposal by the Siamese Government, the travellers went successfully up the Tchoumpfong, traversed the isthmus by Tasan, redescended the Pak Tchan of Kraw to Marass, and examined the surrounding country. The entire course of the future canal has been satisfactorily surveyed, and the conclusions arrived at are highly favourable to the execution of the project.

Steel Casks.—A Wolverhampton firm have turned their attention to the manufacture of casks and barrels of steel. The two edges of the sheet of steel which form the cask are brazed together in such a manner as to justify the title of "seamless," which the patentees have applied to these productions. The head of the barrel is also riveted to the body, so as to leave no seam, and the end rims are shrunk on hot, thus making a very solid end, whilst, at the same time, the rims are thick enough to give a good purchase to the grappling-hooks of hoists and cranes for loading and unloading purposes. The bush for the tap does not project beyond the rim, so that the nozzle is not liable to be knocked about and injured. The casks are more durable than wood, less bulky and lighter—an 18-gallon steel cask weighing some 10lb. less—a not unimportant consideration as regards transit. In point of shape the steel barrel is exactly that of a well-formed wood one, the bulge of the belly allowing of its being easily rolled along and better managed by one man than drums can be by two.

SEVERAL Belgian firms prepare an ornamental paper, which, at first sight, cannot be distinguished from satin. The method of production consists in covering common paper with an adhesive size, and asbestos, dyed to the shade required, is sprinkled upon the moist surface. Asbestos takes up all colours, especially the anilines, very readily. The superfluous matter, when dry, is easily taken off.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

**** In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

MORE WEAKLY SCIENCE—VAPOUR (?) IN SPACE—PERSONAL EQUATION IN MEASURING DOUBLE STARS—FROM THE EXE; BUT SCARCELY FROM THE WISE—DIURNAL PATH OF THE POLE STAR IN A FINDER—SIC VOS, NON VOBIS—ONE MORE IMPOSTOR OUT OF SPIRITS—GNAT LARVÆ IN WATER-BUTTS—FOCAL IMAGES, &c.—2in. v. 5in. APERTURE FOR PLANETARY OBSERVATION — SOLAR ECLIPSES — MEASURING THE HEIGHT OF A MOUNTAIN — COLOURED STARS.

[20518.]—IN these days of competitive examination (when I believe even laundresses in convict prisons have to go out in arithmetic), I think that critics of scientific literature ought to be compelled to give some preliminary proof of a certain amount of rudimentary knowledge of the subjects on which they profess to enlighten the public. I was strongly impressed with this idea on reading, in the *Saturday Review* for August 26th, a notice of the late Mr. Thomas Dunman's "Talks about Science," in which the reviewer extracts the author's account of the Lunar method of determining Longitude "as an example of Mr. Dunman's power of clear exposition." The exposition, I admit, leaves nothing to be desired in point of clearness; but it is no more Mr. Dunman's than it is Cetewayo's. It is all to be found, in fact, almost verbatim, in Sir John Herschel's "Outlines of Astronomy," articles, 258, 268, 269, 270, and 272 (pp. 170 and 176, *et seq.*). Nay, it appeared in Sir John's original "Treatise on Astronomy" (Articles 212, 220, 221, 222), published in Lardner's "Cabinet Cyclopædia," which was published many years before ever Mr. Dunman was born. It is rather amusing to find a pseudo-critic of astronomical literature so ignorant of a classical work like Sir John Herschel's as not to recognise that great philosopher's words and ideas when reproduced (as I have said, almost verbatim) by another man.

I do not know what the teetotalers will say to the alleged discovery of alcohol in space (p. 10); but to a mere physicist it would seem that the existence of any such (relatively) dense material as alcoholic vapour in the regions through which our solar system moves, must infallibly retard the planets in their orbits, shorten their periods, and end by their precipitation into the Sun. This result must happen even with the luminiferous ether, but that it is (hypothetically) imponderable. The vapour, however, of alcohol and benzine is of a sufficiently substantial character to offer a calculable resistance to the movement of a planetary body; but this little difficulty seems to have been unworthy of the attention of the gentlemen who discussed "The Light of the Sky" at Southampton.

If Mr. Beaven (letter 20461, p. 11) will compare the measures of double stars given from time to time in these columns by Mr. Muschamp Perry, he can, I think, scarcely fail to come to the conclusion that either a very marked "personal equation" pertaining to, or some peculiar mode of measurement adopted by, that gentleman, seems to cause all his distance measures to err in defect.

Does not Mr. Harris (letter 20464, p. 12) see that the induction of a high electric potential—say, 50 ohms (in conjunction, of course, with the law of decrease of attraction as the cube of the distance, combined with the existence of the vapour of rum-and-water in interstellar space)—might easily have the effect of making comets' tails turn towards the Sun, and the Moon rotate on her axis once a week? Seriously, though, I would appeal to any one with the most rudimentary knowledge of physics, whether the sentence I have just penned is one whit more senseless or preposterous than the communication of which it is but a very slight caricature indeed? It is an inscrutable puzzle to me however such a letter was permitted to find its way into these columns.

In reply to "Lens" (query 47895, p. 22), it would, of course, be possible to have a circle of the angular diameter of the Pole Star's diurnal path struck on mica or thin glass, and placed in the focus of his finder; but its adjustment would be rather troublesome. Its linear radius would depend, not upon the magnifying power, but upon the focus, of the object-glass. Let us suppose this to be 12in., a tolerably common one in the finders of moderate telescopes. Now, Polaris is about 1° 19′ from the Pole of the Heavens; so that if we multiply the sine of 1° 19′ by 12, we shall get 0·275737in. for the radius of our circle. If, then, the optical axis of "Lens's" finder coincided accurately with the true Pole, the Pole Star ought to be on some part of this circle through the whole of its diurnal course.

It is particularly worthy of note, in connection with what I said concerning Dr. Siemens's address (letter 20460, p. 11), that it now turns out that the observers who detected spectroscopic signs of the existence of a Lunar Atmosphere during the Solar Eclipse of May 17th, were really MM. Thollon, Trépied, Puiseux, and Ranyard.

I note by the papers that yet another of those wicked swindlers, the Physical or "materialising" Spiritual Mediums, has been detected and exposed at Peterborough in the shape of a Miss Wood, of Newcastle. It appears that this person tried to delude her fatuous following into the belief that a little Indian girl of 13, "Poche," was her controlling influence or Spirit, and that, under her (Miss Wood's) mediumship, "Poche" appeared in a solid and substantial form. All the effete charlatanism of the dark cabinet, the hymn singing, musical-box playing, light lowering, *et id genus omne*, appears to have been practised as a preliminary to the appearance of the "small form in white" of "Poche," who graciously accepted some lollipops from the master of the house, a portion of which she presented to a lady present, whom she further honoured by a kiss. Just, however, as the devout Spiritualists present were penetrated with faith and admiration at so convincing a proof of the materialisation of a disembodied Spirit, a certain Mr. Cade made a spring for the small Indian ghost, and clasped her tightly in his arms. I need not add that, moreover, Miss Wood's confederates, or confederate, at once extinguished the lamp; but Mr. Cade's muscular power did not fail him in the dark, and he hung on to the violently struggling visitant from the other world, until lights were procured; and then——then, of course, he found that he had hold of Miss Wood herself, who had taken off her black gown, swathed herself in muslin, and stooped or squatted down to convert herself into a dwarf! The whole story reads like a repetition of the detection of the notorious Miss Florrie Cook (who so utterly imposed upon Mr. W. Crookes), by Sir George Sitwell and Herr Von Buch, which I remember noticing in these columns at the time it occurred (letter 16796, Vol. XXX., p. 502). The most disheartening feature in all this is to note the absolutely drivelling fatuity of the (so-called) Spiritualists themselves, who see exposé after exposé like this of the impostors who prey upon them; and yet rush opened-mouthed to welcome the fresh ones who reign in the stead of those found out. The Fox girls, Mrs. Haydon, Forster, Mrs. Marshall, Mrs. Guppy, Herne, Williams, Bastian, Taylor, Egerton, Slade, Monck, Florrie Cook, Jemmy Maddocks, and now Miss Wood are a few of the names which occur to me among those who have been caught flagrante delicto; and yet there are people, not actually under restraint, who believe, or believe that they believe, in spiritualism! If this Miss Wood, of Newcastle, performed her tricks for fee or reward, and Mr. Cade does his obvious public duty, he will prosecute her before the Peterborough Bench, under 5 Geo. IV., ch. 83, s. 4.

As no one appears to have noticed query 47821 (Vol. XXXV., p. 604), I may tell "W. P. M." that the "small tadpole-like creatures" in his water-butt are the larvæ of the common gnat, and that unless he can cover his butts with gauze sufficiently fine to exclude the female gnat from laying her little raft of eggs in them, he may scrub them until doomsday without producing the slightest effect.

Reading letter 20493 (p. 37), I think that I can now clear up what seems to me to be "Lens's" difficulty by the aid of a few very simple considerations. He has, I will suppose, a 3¼in. object-glass of 48in. focal length. He finds, in the way so repeatedly described, that the image of the object-glass on the eye-lens of a given eyepiece measures ·0541in. Of course 3·25 divided by ·0541 = 60, so that the power of that eyepiece we call 60, at 48in. from any lens or mirror of that focal length. Now we turn the telescope on Jupiter, whose angular diameter is, say 37″ (obviously at the focal point of the object-glass as well as in the sky). Then 37″ × 60 = 37′—the seeming angular amplification of the image as referred to the original one at the focus of the telescope. At a distance of 48in. the linear measure of an angle of 37″ is ·0086in., and multiplying this by 60, we obtain ·05160in. as the seeming linear amplification. If "Leos" will direct his telescope to the Moon, take out the eyepiece altogether, and remove his eye as far from the focal image as that itself is from the object-glass, he will see that the aerial image will appear of precisely the same size as the Moon herself does to the naked eye. Probably by this time your correspondent will see that it is really a solecism to talk of the object-glass of a telescope "magnifying" at all. In a microscope, in which the object is placed *within* the focus of the objective, obviously this does magnify. On the other hand, in a telescope, the objective receives parallel rays and forms, not a magnified, but a reduced, image of the object. With reference to the two object-glasses of different foci, the illustration of the candle is (forgive me for saying) rather irrelevant. What happens is that in one case the rays of light travel 92,359,300m. 4ft. 2in., and in the other 92,359,300m. 8ft. 4in.

Merely as a matter of course "Padlock" (letter 20198, p. 38) would see Jupiter incalculably better with a 5in. achromatic of 7ft. focus than he would with a 12ft. telescope of only 2in. aperture—always assuming that the instruments were equal in quality. "A leading maker" does not represent much. I have myself seen a large star present the appearance of a luminous tenpenny nail in an 8½in. equatoreal by a very "leading maker" indeed. The only "objection" to an instrument of the wholly abnormal dimensions of that of your correspondent is its small amount of light-grasping power.

If, as I suppose, "F. B. A." (query 47955, p. 46) wishes to know in which of the Eclipses between 1851 and 1878, the maximum duration of total darkness occurred, I may tell him that it was in the one which happened on August 17th, 1868, when totality lasted in India for nearly seven minutes.

Perhaps, as simple a way as any, by the aid of which "Glen" (query 47957, p. 46) can roughly estimate the height of his mountain without instruments is this. Suppose that in Fig. 1 M is the mountain top, then from the point A on a straight line looking towards it set off the perpendicular line A B to any convenient length. Set off B C at right angles to M B, and produce M A to C. Then A C : A B :: A B : M A or A B² divided by A C = M A. Thus we get the horizontal distance of the top of our mountain M from A.

FIG. 1.

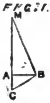
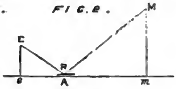


FIG. 2.



Then at the point A, we must put a reflector R (which may be either a piece of looking-glass levelled as accurately as we can, some tar in a bucket, or some water in a black tea-tray), and walk backwards until we see the top of the mountain reflected in it. Measuring now the height E*e* of the eye from the ground, we say: As our distance A*e* from the reflector : *e*E :: the distance A*m* (which we have previously measured): *m*M, the perpendicular height of the mountain.

Mr. St. Croix (query 47964, p. 46) may rest assured that nothing but the most powerful telescopes (aided possibly by the spectroscope) can throw any light upon the nature and constitution of coloured Stars. All coloured Stars are, ex necessitate, single bodies, although rarely (as in the case of γ^2 Andromedæ) two may be so close together as to appear as a single Star, with inferior optical means.

A Fellow of the Royal Astronomical Society.

NOTES ON DYNAMO MACHINES.—IX.

[20519.]—66. The amount of work performed in giving motion to a closed coil in the vicinity of a magnet is proportional to the addition or subtraction during the motion of lines of force inclosed by the coil. If C be the current generated in the coil, N and *u* respectively the number of lines of force cutting the coil in first and last positions, *t* the time during which the motion continues, and E the E.M.F. induced, then the work done in moving the coil = C (N + *u*). But the work done by the current must equal the work done in giving motion to the coil, whence C (N + *u*) = C E *t*, and E = N + *u* / *t*, which shows that the E.M.F. is proportional to the *rate* of adding or subtracting lines of force. Every element or turn of the coil contributes a certain E.M.F., and the resultant E.M.F. is due to the sum of all these contributions. The total quantity of electricity in Coulomb's Q is equal to C *t*. Substituting for C *t* its value, and for E its value, we have C (N + *u*) = Q C R and Q = N + *u* / R, whence it follows that the total quantity of electricity depends not on the *rate* of adding or subtracting lines of force, but on the *number* of lines added or subtracted.

67. Assuming that the space occupied by any coil remains unchanged, the substitution for one particular size of wire of another gauge of half the diameter will give an E.M.F. four times as great, because there are now four times the number of turns in the coil (see note 22); but the resistance will be increased sixteen times because the wire is one quarter of the area and four times as long as before. If the current, however, has no external work to perform, its whole energy being expended in heating the wire, the work done by the addition or subtraction of a definite number of lines of force will be the same in each case.

1st. Case.	2nd Case.
E.M.F. = 1; R = 1.	E.M.F. = 4: R = 16.
C = 1.	C = ·25.
E.M.F. × C = 1 = work.	E.M.F. × C = 4 × ·25 = 1 = work.

So, while constructing a dynamo characteristic curve to represent the gain by adding coils (Note 63), it must not be forgotten to raise the line A D, (Fig. 4), representing the internal resistance of the machine. It will then become a question of how far it will be practicable to increase the E.M.F., while at the same time increasing the resistance.

FIG. 18.

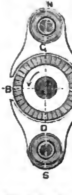


FIG. 19.

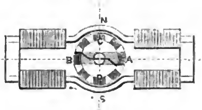
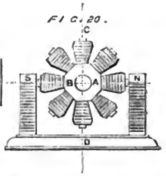


FIG. 20.



68. Remember it is not the magnetism which creates the current, but change of magnetic condition. All dynamo machines are constructed on one principle—namely: that of a coil, the magnetic condition of which is being constantly changed. It is important to bear these three facts in mind:—1st. When a current is induced by moving a coil, its direction is such as to oppose the motion given to the coil. 2nd. The North pole of a magnet behaves like a coil in which the current flows in a direction opposed to that of the hands of a watch. 3rd. Currents flowing in the same direction attract each other, those in a contrary direction repel each other. Bearing in mind these facts, it is easy to tell the direction in which the current is flowing at any moment, also the position of the coil in which the current will be reversed. (Compare Notes 1—5).

69. It is scarcely worth while remarking here the impossibility of constructing a machine, as some have vainly imagined, without currents alternating in direction in the revolving coils. A machine in which the current is not reversed in the coils would mean one in which one particular kind of lines of force (say from an N. pole), were added or subtracted for ever; obviously an impossibility.

70. Consider where the current reverses in the Gramme machine. N and S are field-magnets, and C and O pole pieces, as shown (Fig. 18). Lines of force leave the N. pole, enter into the ring, and pass to the S. pole. Consider a coil or section, as it is termed, at A. As the coil moves from A to C in the direction of the arrow, N. lines of force are being subtracted on the side of the coil next C. If the observer is stationed in front of the arrow, so that he looks at the approaching coil, the current will flow in the direction of the hands of a watch. The coil continuing to move from C to B, N. lines of force will be added to the other side of the coil, and an observer in front of it will find the current still flow in the same direction (see Note 7). As the coil descends from B to D, still observing the approaching side of the coil, S. lines of force will be subtracted, and in consequence the current will flow in a direction opposed to that of the hands of a watch, and will continue to flow in this direction until the coil arrives at A. C and D are the positions of maximum E.M.F., because in these positions lines of force are being added and subtracted with the greatest rapidity. At A and B, the positions where the current is reversed, there is no E.M.F., the lines of force being at those points simply parallel with the direction of motion of the coils, and neither added nor diminished for a short period. These remarks apply to the Schuckert, Brush, Bürgin, and Maxim machines.

71. Another consideration will enable us to check our result. The current must flow through the armature and magnetise it in a way tending to stop its motion. When driving the machine we make that part of the ring immediately below C a South pole by induction, and that part above D a North pole by induction. To oppose the motion of the ring in the direction of the arrow it is evident that the currents flowing round it must conspire to produce a S. pole at B, and a N. pole at A. And, to add a further proof of these statements, if a current were to be sent round the armature from some external source so as to magnetise it as we have indicated, obviously the machine would run backwards as a motor.

72. The Siemens machine armature consists of a cylinder on which the coils are wound over the top, across the ends, and underneath the bottom. Let A B (Fig. 19) represent one of these coils, N and S being the field magnets. It is evident that when the coil is in the position shown, lines of force are being neither added nor subtracted, consequently there is no E.M.F., and at this point the current is reversed. C and D are, for reasons before given, the positions of maximum E.M.F. These remarks apply to the Edison and Weston machines.

73. In Lontin's machine we have what has been termed a pole-armature where the coils stand out radially from a rotatory centre, as shown, being wound on soft iron pins (Fig. 20). N. and S. are the field magnets. When the coils are in position A B, the magnetic condition of the pins is being changed at the slowest rate, indeed, for an instant there is no change whatever, and in this position the current is reversed. In positions C and D the magnetic change is being effected with the greatest rapidity; consequently, in these positions, we have the maximum E.M.F. These remarks apply to Siemens' alternating current machine, also to the Wallace-Farmer machine.

74. Machines may be broadly classed into those which can work without iron in the armature, and those which cannot. To the former class belong Siemens continuous current and alternating current machines, as also those of Wallace-Farmer, Weston, and Lontin. To the latter class belong all machines in which the coils are lapped round a ring, such as Schuckert, Brush, Gramme, Bürgin, and Maxim. Iron increases the effect in all machines, but is a source of loss in that a considerable amount of work is done in heating it. In the sixteen-light Brush Machine the iron of the armature gets so hot with a twenty-minutes' run, that the naked hand cannot be placed on it. This heat is due to the rapid changes of magnetism in the iron core. There is every reason to believe that the machines of the future will have little iron in their armatures.

75. In consequence of the soft-iron cores not taking up the magnetism instantly, but requiring some time for their full magnetisation, it is necessary to let the rotation go on through a certain angle determined by the retardation of the magnetism of the cores before taking off the current. For this reason the brushes will not be placed exactly in the position indicated at A and B (Figs. 18, 19, 20), but will require to be moved round in the direction of rotation. The amount of lead given to the brushes depends on the amount of iron, shape of coils, &c., and increases with the speed of the armature. The brushes are in the best position when there are least sparks at the commutator.

E.

RAILWAY SIGNALS.

[20520.]—I have no more to say, but shall be agreeable to take a summing-up of Mr. Manock's system, and the system given by me, from Mr. Stretton, provided both gentlemen care for the step. This gentleman's decision for either system I will regard as final. **H. Stooke.**

SATURN'S SATELLITES.

[20521.]—If D. Smart (letter 20497) will strike ellipses to scale for Saturn's ring and satellites, and mark by the aid of Herr Marth's tables the hourly change of position of each satellite, he will have no difficulty in following them round the planet. I found Herr Marth's tables of the greatest use last year. He gave us the major and minor diameter of each orbit, and the co-ordinates of position for each hour after conjunction with the minor axis. I constructed a diagram from his data, but so far from his long tables being not required, I had constantly to refer to them. Thus Mr. Marth, on a particular date, informs us at 10 p.m. Tethys would be 4 hours past conjunction. Referring to my diagram, I saw instantly his position without calculation or reduction; but I could not have constructed the diagram without such data as Herr Marth furnished, nor could I have used it afterwards, excepting by the same guidance. I hope the same kind assistance will be given us this year, and if so will send a copy of my diagram to the editor, who will please himself about reproducing it. I do not think he will. Meanwhile, I have no data at hand for its production.

E. Holmes.

PROF. WINCHELL ON THE ORIGIN OF THE SOLAR SYSTEM.

[20522.]—I have no doubt that Prof. Winchell, of Michigan University, is well known—at least, by repute—to many of your readers, and as he has recently delivered a series of popular lectures before the Martha's Vineyard Institute on the origin of the earth and the solar system, I thought your readers would like to peruse his opinions, especially as I see some of them take a great interest in Mr. G. Darwin's views of lunar evolution. Prof. Winchell, in commencing his first lecture, referred to the subject as being seemingly too vast and too difficult for human intellects to discuss. He, however, went on to point out that we have reason for believing that the general tenor of events has been the same in ages long past as in modern times. The forces of nature have not changed, and their modes of action must be admitted to be the same in all ages and in all regions. We may, therefore, gaze from the eminence to which science has lifted us, upon the stream of passing events; we may look onward toward its final issue; we may look backward toward its sources. Thus the most familiar phenomena and the most commonplace events possess a profound significance; for they indicate tendencies and bearings of the course of terrestrial history, which point towards the conditions of things in the remote past. Thus many indications lead to the conclusion that the surface of the earth was once in a heated condition, and that a process of cooling has taken place. The very stones which line our beach were hardened and vitrified by heat. They came from the vast formations of granite and syenite and schist which underlie a large part of New England, and which, though once fresh sea-sediments, have been hardened and crystallised by heat and other agencies. Wherever the basaltic column builds its wall of palisades; wherever the broad sheets of ancient lava, emptied through deep fissures in the solid earth, overspread their thousands of square miles, as along the Pacific slope of our own country, there are proofs of an ancient heat which sufficed to fuse the very rocks. From those times to these a great subsidence of surface temperature has occurred. The world has been cooling; but the heat is not extinguished. Observation and measurement, let it be added, verify the induction from the data cited, by showing that the measured aggregate of heat received by the earth annually, from all sources, is less than the total radiation. Thus the cooling process continues. From what condition of the world's matter did the cooling proceed? We conclude that there was a time when all the rocks were molten, and the whole earth was a molten sphere. Was this the beginning of the process of cooling? No reason can be assigned for assuming it. At a temperature higher than that which fuses, all matter is capable of volatilisation. What prevents us from concluding that the great terrestrial globe once existed at that higher temperature which held all its substance in the condition of an incandescent vapour? But if the matter of the earth once existed as a vapour, we must affirm the same of all the planets of our system. They are bound together by so many common conditions that the strongest presumption exists that they have had a common origin and common history.

Conceive, then, the whole mass of the solar system—planets, satellites, and sun—as existing, at a very remote period, in one mass of fiery vapour. We cannot affirm that even this was the remotest condition, but we may assume it as a starting-point in a process of evolution. It was a mass of matter intensely heated, and was in a state of rotation. It radiated its heat into space; it contracted, and by virtue of a physical principle its rotation was accelerated as its diameter diminished. It began to flatten at the poles, and become protuberant at the equator. At length, with ever-increasing rotational velocity, the centrifugal tendency at the equator became equal to the central attraction. Then, as further contraction took place, an equatorial belt of matter was left behind as a rotating ring. This, through the influence of external perturbations, was broken, and all its matter gathered in a globe destined to become a planet. The great mass repeated the process of ring-making, and in the course of time all the planets of our system had come successively into existence. The sun remains to-day the residual mass, and testifies to the gaseous condition of that primeval matter out of which the planets sprang. The sun then appeals to our intelligence and senses as the historian of a past inconceivably remote. But we must trace the further history of one of the planetary masses, like the earth. On its own part it detached a ring, which became our moon. It was then too far cooled to detach another ring, as Jupiter, a vastly larger mass, had done.

It had begun to pass from the fire-mist stage to the condition of a molten globe. Drops of mineral rain descended to the centre, and a liquid sphere came by degrees into existence. Thus it grew until the fiery clouds were exhausted. The sun was even now shining on the molten self-luminous earth. But it continued to cool. Next in the order of events was the formation of a solid crust over the terrestrial surface; but it remained at a glowing temperature. In the course of further ages, the vapour of water began to condense in the upper regions of the heterogeneous atmosphere. All the water of the ocean still existed there as invisible gases. The forming clouds thickened to a dark pall. Sunlight was excluded, but the gleam of the fervid rocks was reflected from the vault of the watery canopy. Rains descended, lightnings blent their light with the lurid glow of the burning crust, and responsive thunders reverberated through all the vault of the clouds. The rainy torrents struggled towards the earth: they reached the fiery crust, and, after a prolonged conflict, gained possession, and covered the earth with a film of ocean waters. In these waters was waged a long conflict between the forces of chemistry. Beds of sediments were thrown down. When a quieter time arrived humble plant forms were seen in existence. A new twilight dawned as the clouds became exhausted, and at length the sun shone again full on the face of the darkened planet, and penetrated the depths of new-formed ocean. The records of these times are preserved in the forms of the enduring rocks. Geological science has taken up the theme, and on the pages of the text-books may be found the continuation of terrestrial history.

I think these brief notes of Prof. Winchell's discourse state in the skeleton form the accepted view of the origin of the planetary bodies of the solar system; but what was the origin of Sirius and of those other great suns, an idea of whose immensity has only as it were recently been grasped by modern science?

Trenton, N.J. **J. O'S.**

THE MOON AND THE WEATHER.

[20523.]—The statement of Sir William Thomson on this subject must be taken with the proverbial grain of salt. So far from careful investigation having proved what he says it has done, the results have rather been in favour of the opposite conclusion—i.e., that the Moon does affect the weather. Her influence, however, would seem to be very feeble, and constantly liable to be overcome by stronger forces. Hence the difficulty of tracing the effects that are really due to her action. Mr. Gardner is getting into the right track in putting popular sayings to the test. I cannot rid my mind of the idea that there must be a foundation of truth (be it ever so narrow) in some of these "superstitions," and I regard it as a very important function of the weather watcher to examine them carefully.

J. A. Westwood Oliver.
4, Bellevue-terrace, Springburn, Glasgow.

[20524.]—I think if Mr. Gardner, p. 40, would but consider the real "inwardness" of this question he would lose some of his faith in old weather adages. Sir W. Thomson's method of putting it is indeed a very neat answer—itself unassailable. The Northamptonshire saying that "Saturday's change was never good, and Sunday's change is sure to bring a flood," was coined by those who would have been puzzled to explain what is the exact meaning of the word "change" in this connection. It is not unlikely that if Mr. Gardner started to find out what this wonderful "change" is, he too might view the question in somewhat the same light as the scientists. The popular idea was, and to a certain extent still is, that the moon's "changes" occur suddenly as it were, much in the same way as the lantern operator changes a slide. It is just because those who have attended a popular lecture on astronomy know better, that the idea of the moon influencing the weather is ridiculed. It was an article of faith with an old and deservedly respected writer on gardening subjects, that the weather always changed with the moon, but he allowed two days each side of the date put down as the time of the technical "change." That, it will be seen, accounted for four of the days between the phases, and as the days of change themselves were to be taken into the reckoning, it would have been strange indeed if his theory had not been borne out by facts, for the weather changes and so do the phases of the moon, but there is not a particle of proof that one is in consequence of the other. The idea, however old it may be, is merely a beautiful example of the "post hoc, ergo propter hoc" style of argument, which will not pass muster in these days of board schools, even amongst those who are supposed to be the uneducated classes. I note that Mr. Gardner speaks of the barometer having a total fall of 160°, but I cannot attempt to solve the riddle, even by suggestion of a printer's error, for it is impossible to imagine any feasible explanation of such a blunder. The barometer has nothing to do with degrees, and a fall of 160 on the thermometer is happily unknown in this country. Mr. Gardner, I see, very unwisely ventures on a prophecy for about the 7th and 27th of next December, but he does not specify any locality for his "wind and rain." Surely he does not mean all over that comparatively small piece of land known as Great Britain. Mr. Gardner will, I trust, excuse me when I point out that he has not yet learnt the very first rudiments of "weather-ology." There are some thousands of so-called residents of London who, obliged to reside at some distance from the scene of their daily labours, are fully aware of the vagaries of that fickle jade, Weather. It has often happened in my experience to have a persistently wet day in the city, and to find on my return home at night that it was necessary to water the garden which had been exposed to the full glare of the sun all day, and yet the distance has been less than ten miles from St. Paul's. What sort of effect is the moon supposed to exercise over such weather as that? The prophet who has, as I learn from a letter in a recent number, gained so much honour in his own county, must be a close student of local meteorological influences, for it is not so many miles from Westmoreland to the east cost of Northumberland, and yet the records of rainfall show that it is impossible the same weather can have prevailed in both districts. Sir W. Thomson's verdict that "if there is any dependence of the weather on the phases of the moon, it is only to a degree quite imperceptible to ordinary observation," is demonstrably and irrefragably true, and any coincidences which may lead to a contrary belief are coincidences and nothing more. There is one loophole of escape for the lunar weather-prophets, and that is, they can suppose it is a different moon one sees at Torquay to that which is visible at Yarmouth. Such a suggestion is, I venture to think, quite as likely to be true as that which attributes changes in the weather to the influence of the moon.

Nun. Dor.

VEGETARIANISM.

[20525.]—I have just returned from my holidays, and see Dr. Edmunds's letter (20377) on "Vegetarianism." I, as a vegetarian and a medical man, am very much pleased with that article, and only wish the rest of the medical profession would treat us with as much fairness. I wish to call Dr. Edmunds's attention to a few points. Most vegetists simply dislike to take animal life; they use animal products so long as life is not destroyed in procuring them. Certainly in the egg there is potential life if put under proper conditions. Again, the cheese may contain ova which would form maggots if they were left alone. Man cannot help taking life—eat what he will, or drink what he will. Every piece of lettuce I eat may contain a paradise of small animalcula, and every drink of water I take may kill thousands of small bodies which are living there.

We object to taking life when we can live without doing so. In the struggle for existence the weakest must die; and if I find a rat or mouse eating my corn then I kill it without the least remorse; I know it is only eating my corn that it may live, but then I want to live too, and, as we cannot both eat the corn, then I—the stronger—kill the weaker. I am a vegetarian because I find I am a great deal stronger and healthier on such food. I have adopted it for health reasons purely. My whole structure shows I ought to be a vegetist, and it also suits my nature. The long habit of flesh-eating by our foreparents may give us a tendency to be able to digest flesh; but I should think—as our organs have not changed—that a pure vegetarian dietary would be better. We vegetists wish to destroy the animals, and put higher animals in their places—viz., men. We wish also to improve the stamina of our present race, and to abolish sickness, disease, and premature death, as much as possible.

Dr. Edmunds speaks of our rivers and seas not affording food. Now this is only because they are not cultivated. I know, at present, of three kinds of seaweed that are eaten on the coast of England, and these I got to know of from working people. As the population goes on increasing we shall have to turn our attention to our sea-coasts, and produce food on them. Why should we not produce food at the depths of the ocean as on land—are not the conditions favourable?

Animal food, especially if taken in much quantity, is productive of a very great deal of disease. We can trace its work from a simple bilious attack, on to rheumatism, gout, calculus in bladder, gall-stone, cancer, disease of kidneys, disease of heart, and apoplexy.

I cannot quite understand how it is that *sleeplessness* is produced by a vegetable diet. I find that since I have been a vegetist that I can sleep a good deal better. I know that this summer I have slept a great deal better than last; I was not a vegetarian last summer.

Vegetism also produces a dislike to alcoholic drinks, and it is a very uncommon thing to know a vegetarian who takes his glass of wine or beer daily. The same with tobacco; very few vegetists smoke. They find that these habits do not suit their simple tastes.

I must thank Dr. Edmunds again for his courteous letter, and trust it will help to give us a fair field and no favour.

T. R. Allinson, L.R.C.P., &c.,
Hon. Sec. London Food Reform Society.
2, Kingsland-road, E., September 12th.

REMARKABLE STEAMSHIPS.

[20526.]—THE article under this head, quoted (p. 6) from the *Shipping Gazette*, reads very much like romance, and I should be glad to have the opinions of some of your correspondents on the statements made. The engines of the first-named vessel are, I see, to make 350 revolutions a minute, which seems rather a high speed for anything of the kind used for propelling ships, especially as they give a "velocity of the wheel" equal to 45 miles an hour. The engines have the high-pressure cylinder within the lower pressure, which is said to prevent condensation, though it is not clear how it can do that, so far as the larger cylinders are concerned. The vessel is, I see, only some 512 tons in builders' measurement; and if the Yankees can drive such a ship at a speed of 25 miles an hour across the Atlantic, they will, undoubtedly, cause a revision of some time-honoured theories. The second vessel described is, however, the greater curiosity, for she is not twice as long as she is broad, and is apparently to be carried on "wheels," for that is what the spheres which are to roll over the water amount to from a mechanical point of view. From the rather meagre description furnished it is impossible to gather much information; but, so far, it seems to be a resuscitation of a very old invention. The hull of this vessel is not intended to touch the water, and it will, no doubt, be so constructed as to be unaffected by the wind; but how is not explained. If these devices are not the outcome of vivid imagination on the part of American newspaper reporters—for that is the real origin of the article—we may well wait in astonishment for a realisation of these grand schemes. It is generally conceded that the Old Country is almost played out; but, if the Yankees can succeed in doing what they propose, we shall have to take a back seat in what is supposed to be an art peculiarly our own. **Glasgoviensis.**

TRICYCLES WORKED BY GAS.

[20527.]—I THOUGHT my humble disclaimer of mechanical knowledge would have prevented such a critical reply as that of "Nun. Dor." (20466). I arrived at the idea that a gas tricycle was possible in this way. A mixture of coal-gas and air, exploded behind a piston, furnishes power, as may be seen in hundreds of places. A mixture of light petroleum vapour, as is too well known, explodes also. This can be proved easily by putting a few drops of the liquid into a wide-mouthed bottle, turning it round so as to cover the sides and applying a light. The mode of saturating air or other gas with petroleum vapour must have been patented in twenty ways. A chamber of light metal is filled with sponge, lamp-wick, or anything which will absorb the liquid and present a large wet surface to the air, which is being driven or drawn through it, emerging so loaded with vapour as to ignite when a light is applied. This method may be seen in use to furnish gas for illuminating purposes, and has been discussed frequently in your columns. If, then, it becomes possible to carry a store of condensed gas, is it not also possible to apply this to the propulsion of a vehicle, whether tricycle or any cycle? That it presents grave difficulties, I have sufficient mechanical knowledge to see. When it dawned on the brain of some wild schemer that it was possible to apply steam-power to locomotive purposes, I don't doubt but that the "Nun. Dor." of that period said it was a pity the proposer had not been a mechanic, for then it would have occurred to him that such and such an objection existed, and that the water and coals must be carried, and so on; but eventually it was done. Liquid gas can be carried and converted into the proper gas form and exploded, producing power. Problem waiting for an answer. Can this be applied to a locomotive, as it is to a standing engine?

Mr. E. Thomas (20467). I mean benzoline, light petroleum, or any other liquid capable of diffusing into atmospheric air, and furnishing an explosive mixture. The ordinary light petroleum used to sell at about 1s. 6d. per gallon; what amount of atmospheric air it would saturate, I have no means of ascertaining. A few shillings expended, and the loan of a small gas-engine, would do more to prove or disprove the feasibility of my proposal than the expenditure of gallons of ink; and would also prove whether power for small purposes, such as sewing-machines, &c., could not be had at places distant from a source of coal-gas.

P. H.

BICYCLE AND TRICYCLE RIDING.

[20528.]—I SEE some of your correspondents are asking for information as to whether any injury is caused by bicycle and tricycle riding. Several answers have appeared (p. 21, for instance), and I think it will be clearly understood that there is no more risk of injury than in walking or running—that is, if common sense is allowed to have anything to do with it. Straining every nerve to get up speed will surely affect the weak and won't improve the strong; but there can be no harm in the steady riding of the tourist. I clip the following opinions from the *Lancet*, which give the arguments pro and con., and may be of interest to your readers:—Dr. C. W. Robinson, of North Shields, says:—

"I have had considerable experience both as a rider and also of observing others who make use of the bicycle, both as means of exercise and in the capacity of racing. I also hold the post of honorary surgeon to one of the largest clubs out of London. Numbers of bicyclists in my own club and also in neighbouring clubs have consulted me as to their chance of becoming affected either with hernia or varicose veins. I have always been very careful in giving my opinion. 1st. Those who already have a hernia should be extremely careful in not fatiguing themselves, as I find that during the taking of undue exercise—as, for instance, racing or hill climbing—on the machine, the tendency is to the coming down of the rupture. I have seen a case of this where a competitor had to be lifted off his machine. I returned the hernia without any difficulty, but he was violently sick. Also a truss should constantly be worn, as a well-fitting truss can be kept in position without any difficulty. 2nd. Those who are likely to be affected with hernia should observe the above precautions (with the exception of the wearing of a truss, which is unnecessary), as there is a distinct predisposition in some persons. 3rd. As to bicyclists and tricyclists suffering from varicose veins, they are few and far between, and the malady is seldom caused by the use of either the bi or tri order. It is most noticeable in those who do any large amount of running or walking, and in this faction there are numerous instances, more or less severe. There is also another disease which is not mentioned by any of your correspondents—e.g., varicocele. I have known this brought on or aggravated in a few instances by long distances, constantly repeated, on either machines or in walking. This disease is far more common than is at present anticipated; still, I do not mean to say that it is caused by the use of the bicycle only where undue exercise is taken for great distances; but when present it is certainly made much worse if the person so affected takes an undue amount of exercise, but not so under any moderate amount. As to whether the bicycle or tricycle is most likely to cause rupture, or, if present, aggravate it, I should think that the tricycle is the most likely, owing to its more open structure as compared with the bicycle, and also to the different action required by the muscles. But, taking the exercise as a whole, in moderation it is perfectly safe, and the good derived from it speaks for itself when we look at a collection of bicyclists making their way along the country roads, looking, without exception, as jolly and in as perfect health as anyone could wish to be; and in truth they are, on the average, the healthiest set of athletes in existence."

Dr. Creswell, of Birmingham, writes:—"Mr. Westropp is quite right in supposing that his racing friends are suffering from varicose veins through bicycle-riding. In fast riding it necessarily follows that the veins of the lower extremity are filled faster than the saphena can empty them, and as racing men are of necessity much on the track, even when not actually competing, it follows that a permanent over-distension of the veins ensues, which will often in these cases be found well marked as far up as the saphenous opening itself. Such a condition may, of course, happen to men of weak fibre who only ride moderately, and is naturally incidental to tricycle riders as well as bicyclists. With reference to the statement that Mr. Westropp knows some persons suffering from hernia who dispense with their trusses when riding tricycles, it is only necessary to suggest that if he is their surgical adviser, he should inform them of the urgent need of their trusses being worn at all times except when lying down, since even tricycle-riding can hardly be a good alternative for truss-wearing."

Another correspondent says: "Whilst on the subject of bicycle-riding, it may be interesting to some of your readers to be informed of a peculiarity which occurred to me some years ago, when practising on the then newly invented machine. It was this. When I became tolerably expert at the exercise, I invariably noticed, after being at it for about twenty minutes, that my left thigh swelled enormously—so much so that my trousers were distended to the utmost, without my feeling any pain whatever. I thought it prudent, however, to discontinue the recreation, which I was very fond of, and so cannot say whether a similar result would happen with the improved bicycle now in use. I may add that I am a fair athlete, a good pedestrian, and I ride a great deal; but in none of these pursuits have I experienced even a tendency to the discomfort above mentioned."

I think one may safely say that in bicycle or tricycle-riding there is no more risk of injury than in any other exercise, provided always that due precautions are taken not to strain.

Coventry Rotary.

THE LONGEST DAY'S SOCIABLE TRICYCLE RIDE ON RECORD.

[20529.]—I SEND you the following account, taken from the *Walsall Observer*, of the longest day's sociable tricycle ride on record. I think there can be no doubt that at an early period a "sociable tricycle" will be considered as indispensable a possession in every household as a pianoforte, and productive of much more healthy enjoyment:—

On Tuesday, August 22nd, at 12.5 a.m. (Monday midnight), Mr. John Hawkins, jun., captain of the W. and D.E.T.C., accompanied by his wife, on a sociable tricycle, made by Messrs. Bayliss, Thomas, and Co., Coventry, also another gentleman, a member of the club, on a 50in. No. 1 "Excelsior" tricycle, started for a run to London and Uxbridge. The roads were everything that could be desired, and the wind favourable. Coventry was the first stop, which was reached at 3.17 a.m., being 3 hours and 12 minutes from the start. Half an hour was spent here for refreshments, which the party carried with them. The next stop was Daventry (48 miles), for breakfast at the "Saracen's Head"; after which short calls were made at Towcester, Stoney Stratford, and Hockliffe, and a stay of two hours, from four to six, at the Saracen's Head, Dunstable, for dinner. St. Alban's was reached at seven o'clock, when the gentleman on the single tricycle parted company, taking his way to Uxbride, where he arrived at 11.30, after losing his way, and a ride through the heavy rain, which commenced after leaving St. Alban's. One hour was spent at the Crystal Palace Hotel, St. Alban's, by Mr. and Mrs. Hawkins, when, after filling, trimming, and lighting up lamps, a start was made at eight o'clock in a heavy downpour of rain and head wind—it having changed. Barnet was reached at 9.30, where it was decided, owing to the rain, to stay the night at the Old Salisbury Hotel (B.T.C. house). Distance, about 113 miles; time on road, 21½ hours; riding time, 14½ hours; weight of luggage carried, over 40lb. Next morning a run into London was made after breakfast.—On Thursday, August 24th, at 12.15 p.m. (mid-day), the return journey was commenced from London by Mr. and Mrs. Hawkins, on the sociable. Starting in the rain, which had been coming down during the night and the greater part of the morning, and with heavy roads to face, but being well protected by Gossamer waterproofs, it was determined to see what could be done in bad weather and on heavy roads. Barnet was reached at 1.15, and dinner partaken of at the Old Salisbury Hotel, which occupied until 2.35. St. Alban's was passed through at 3.40, Dunstable at 5.30, and Hockliffe reached at six o'clock, where tea was had at a friend's house. From here a run was made to Stoney Stratford, which was reached at eight o'clock, and one hour spent at the Foresters' Arms. Leaving again at nine o'clock, the Pomfret Arms, at Towcester, was next stopped at, from 10.15 until eleven being spent there. When continuing through the night, except for short stops to trim and refill lamps and partake of refreshments, Coventry was passed through at 4.30, and a call made at Stonebridge, and again at the Three Horse Shoes—Small Heath being next reached at eight o'clock, where breakfast was had, and a stay made until ten o'clock. A final stage was now made to Walsall, which was reached at 11.30 (Friday midday). Distance, 120 miles; time out, 23½ hours; riding time, 16½ hours; stoppages, 7½ hours; both parties feeling well after their ride. Too much praise cannot be given to the machine, which answered admirably, every hill being ridden on the return journey. Rain fell the greater part of the way; the wind blew on the West side, being neither for or against the riders; but the roads were very heavy all through, and occasionally during the night very heavy showers were encountered.

West Bromwich. F. J. L.

THE WORK OF FAST LOCOMOTIVES.

[20530.]—Some of your readers may be aware that Dr. P. H. Dudley has fitted up what he calls a dynagraph car, by means of which he has tested the actual work accomplished by fast express locomotives. At the recent meeting of the Master Mechanics' Association, held at Niagara Falls, Dr. Dudley communicated a paper, in which, among other statements, I find that the resistance of long and heavy trains is said to be much less than that given by the latest formulas. As the paper will doubtless be of interest to some of your readers, I make an abstract, with a request that Mr. Gobert or some other of your readers will kindly say whether the following is true:—"The Swiss and German locomotives are reported to carry from 165lb. to 180lb. pressure as a rule, with exceptional ones at 225."

In his paper, then, Dr. Dudley said that the practical performance of the American fast express locomotive of to-day far exceeds what was thought possible ten years since, and we know from experience that the improvements constantly being made will increase its speed for heavy trains. If the data in regard to fast ten and twelve car trains were all collected it would leave no doubt as to the ability to run them 50 miles per hour, on nearly level roads, or five and six cars at 60 miles. Having drawn with my dynagraph car fast express trains upon various roads, I present a brief tabulation of part of a trip, showing the performance of an ordinary locomotive upon a train composed of three 8-wheel and six 12-wheel cars; weight, 250 tons; total weight of locomotive ready for the start, 126,000lb., distributed as follows: Tender, 54,000lb.; engine, 72,000lb.; 48,000lb. being upon the drivers, which were 6ft. in diameter; cylinders, 17in. by 24in.; steam-pressure gauge set at 135lb. The first column shows the number of miles; the second, the time of run in minutes and seconds; the third, speed in miles per hour; the fourth, velocity of the wind in miles per hour; the fifth, approximate grades; the sixth, ft.-lbs. of work, shown by the dynametrical curve, in drawing the cars per mile; the seventh, ft.-lbs. per minute expressed in h.-p.; the eighth, approximate calculated ft.-lb. of work required to move the locomotive itself, expressed in h.-p.; the ninth, the sum of columns seventh and eighth. Column eight will vary with every locomotive, and could only be determined by direct experiment.

It is not necessary to give this table; but I pick out a few of the figures, choosing those relating to parts of the journey where the line was level.

At the fifth mile the speed was 50·7, and the ft.-lb. of work per minute expressed in h.-p. amounted to 382; the approximate calculated work required to move the locomotive was 406 h.-p., so that the total power exerted by the locomotive was probably 788 h.-p. At the eleventh mile, the speed was 52·89, the work shown by the dynametrical curve 316, and the calculation for the engine 447, making a total of 763 h.-p. At the seventeenth mile speed 52·89, the curve showed 371, and the calculation for engine was 443 (difference being produced by the wind, which in former case had a velocity of 4·2, as compared with 3), making a total of 814 h.-p. All those are on the level. I now take two (the highest speeds) on down gradients. At ninth mile, speed 53·70, wind velocity five miles, gradient 8ft. down, the curve gave 319, the calculation for engine 483; total, 802. At twenty-third mile, speed 53·70, wind 3, gradient 10ft. down, curve gave 333; calculation for engine, 462; total, 795.

In starting the train, the locomotive, says Dr. Dudley, would record la tension of 11,000lb. to 12,000lb. for 100ft. to 200ft. of distance, then by linking up the cut-off and other causes would reduce to 2,800lb. to 3,000lb. when the speed of 50 miles per hour was attained in the fifth mile. As the speed increases the resistance of the air against the locomotive becomes greater, and more of its own power is required to move itself, and less can be used to draw the cars. The increased ft.-lb. of work in the first four miles show less than one half of that required to overcome the inertia of the train for the speed of 50 miles per hour. Inertia is an important element of train resistance, especially on local trains, as it limits the speed for short runs, and must be considered in choice of locomotive for the service. In starting a train the working adhesion of the steel-tired drivers, on dry steel rail, is usually above 33 per cent. of the weight upon them, and reduces as the speed increases, but in what ratio has not been ascertained by experiment; 8 to 20 per cent. has been obtained at 56 miles per hour, the percentage of slip not exceeding 1½ per cent. The great and substantial improvement in the permanent way, of late years, permits a higher percentage of adhesion than formerly. One of the most important features shown in the tabulations is the quick steam-generating capacity of the boiler; 800, 900, or 1,000 h.-p. developed in the brief time of one minute may be expressed in figures, but the mind fails to gain any adequate conception conception of the enormous power. At 135lb. steam pressure, 300lb. or 338lb. of water will be evaporated per minute with a consumption of 40lb. or 50lb. of coal; this requires a very rapid generation of heat, and its quick absorption by the water. Owing to the large amount of heat which is absorbed by the water before it makes any pressure of steam, a less proportion of heat-units is required to do the work at high pressures than low, therefore the rate of transmission per minute will be less for the heating surfaces. In drawing fast and heavy trains on various roads, the greatest difficulty in making time has been want of steam. There are so many contingencies which may daily arise of winds, storms, &c., that provision must be made for a greater capacity than is required for ordinary occasions. In observing what the train resistance would be for the above-mentioned train, about 11lb. per ton, it must not be concluded that this would also be true of any other weight of train; the resistance of the same number and class of cars increases in same ratio as the speed increases, and as we increase the tonnage number of cars the amount per ton decreases. Another important element of train resistance is the condition of the track. Having upon my instrument apparatus for mechanically determining the condition of the track, it is found, even on the best roads, each mile cannot be in equal condition, owing to increased wear and quality of rail. On grades is this especially the case, and at stations where many trains stop and start. Experiments upon all classes of passenger trains are too limited to give any reliable formulas for general use.

The facts above noted show what an enormous increase in power is required with increased speed, the total for the train above described being only 590 h.-p., at a speed of 38·3, while on a slightly greater falling gradient it was 818 h.-p. at 52·89 miles.

E. S. A.

RAILWAY SIGNALS.

[20531.]—I am rather surprised that so few of your correspondents have replied to my "challenge," if I may so name it, and rather disappointed that no drivers (who are really the persons interested primarily) have lent us the benefit of their criticism. I have already expressed the opinion that twenty years hence the present signals will be relegated to the limbo of abandoned things; but just now that is only an opinion, and the question is whether one position of the semaphore would not answer all purposes. By "one position," I mean the 45°, or "clear," the arm within the post being regarded as no position at all. By this arrangement you get rid at once of half the slack, through variations of temperature, and as I think, also remove all doubts as to whether a signal is "off" or "on." Mr. Stooke, who courteously replies on p. 595, gives us the recognised answer to my suggestion, that there would be delay in waiting for the distance signals, which in some districts would mean a serious loss of time. That I regard as one of the defects of the present system of signalling; there is no indication which would enable a driver to know whether he may come on full-speed or only cautiously, and I think that in practice there would be very little difference with the arm within the post or put to "on," for in each case the driver might pass the distant cautiously and be ready to pull up before reaching the home signal. That he could do readily with the Westinghouse brake. The suggestion I have put forward does not involve any radical change at all, when you come to think of it, for it only obviates the 90° signal by abolishing it, and leaves the 45° as the clear, just as it is now. The advantage would be that it does away with the necessity for allowing for compensation as regards slack, at least to the extent now requisite. With line clear the semaphores would be put out to 45°, or thereabouts; with line blocked the arm would be within the post, and, in the absence of a signal, the driver would receive an order to stop or to come on cautiously, just as it is at present. This, however, is a mere detail, and does not touch the revolution which may fairly be expected shortly in railway signalling. I must, however, join issue with Mr. Stooke about the arm within the post in foggy weather. No doubt, an arm projecting from a post is in foggy weather more definite than a mere post; but, looking to the Hornsey accident, I contend that in foggy or even misty weather the companies are not justified in leaving so much to the drivers. I have a lively recollection of being at a London suburban station when the metals could not be seen as I walked on the platform, and the drivers called out to the signalman for instructions, saying that they could not see even the posts, let alone the semaphores. Of course, fogmen were out then; but why should they not be whenever there is a possibility that the signals are not distinct? In clear weather Sykes's system seems to be as perfect as we are likely to get semaphore signalling; but it is surely not up to the wants of the 19th century later days, and will probably perish when the electric system is brought into use. There is no mechanical difficulty, there cannot be any electric difficulty, in indicating the state of the road right under the nose of the driver as it were, and, sooner or later, some such system must be adopted. I have been amused in looking over the recent lists of patents to find that a number of embryo inventors have wasted their money in applying for patents on such "inventions" as "the engine in passing over the metals depresses a lever which strikes a gong." Many pounds have been thrown into the coffers of the Patent Office over that idea—if it can be called an idea, and the first loss it is to be hoped is the last, for certainly no railway company would pay royalty for such an invention, which is almost as old as railways themselves. Sir David Salomon's idea, and some I saw at the Crystal Palace Exhibition, were much better (I believe they have been fully described in these columns); but as they involve the adoption of a central insulated rail, I am afraid there is little chance of their being adopted. I hoped that some of those gentlemen who exhibit so absorbing a desire to learn the numbers and weights of locomotives on our principal lines would have favoured us with their views of railway signalling, which is of far greater importance; but unfortunately, like the drivers, they apparently have nothing to say, and we can only suppose that they view the existing system as the best that could be adopted.

Nun. Dor.

THE CONTINUOUS BRAKES RETURN.

[20532.]—Referring to Mr. Stretton's letter (No. 20446, Vol. XXXVI.), I find that no mention is made of the Great Eastern Railway's removal of the Smith's Vacuum Brake from three engines this year (Nos. 275, 283, and 300), and replacing it with the Westinghouse. Also their train fitted with Barker's Automatic Hydraulic is disconnected and working on branches.

H. S. P.

THE MEKARSKI COMPRESSED-AIR TRAMCAR.

[20533.]—The Mekarski tramcar, which has been running very successfully in Nantes for several years, is about to be introduced into London, the route chosen being from King's-cross, via the Caledonian-road, to Holloway. The road will fairly test the merits of this system of locomotion, and if it is successful we may shortly see a great change come over the whole of the tramcar traffic of the metropolis.

In his paper, read before the British Association, Sir F. Bramwell gave a general description of the Mekarski car; but, so far as I can find, did not state the weight, which, considering that it carries engines and several reservoirs for air, which must necessarily be fairly heavy, is a rather important point. According to Sir F. Bramwell, the "automobiles," as he calls them, are under the most complete control. I found (he says), after a very short observation, that I could drive without any difficulty, and, as a matter of fact, they stop to pick up and set down passengers just as a horse tramcar would do. Nothing can be more satisfactory to the passengers and to the public generally than the performance of these "automobiles." There is no smoke, no smell, no puffing, no escape of steam. The exhaust air is let into a box between the engines, and from this escapes quietly just above the level of the road. The impression conveyed to the mind on first seeing one of these "automobiles" is that an ordinary horse car has been allowed to run away down a hill of a sufficient gradient to keep the car in motion. The mode of working is to use the "battery" only when on the level, and to keep the "reserve" for a bad bit of road, or for a rise over some bridges which have to be traversed, and thus, although the pressure in the "battery" may be getting low when nearing home, the "reserve" is always there to aid over a difficult place. The locomotive is able to make the journey out and home, 7¾ miles (that is at Nantes), without needing any replenishment of the air, but the "automobile"—which, on reaching the termination of its outward journey, has had the pressure in the "battery" lowered from 30 atmospheres to 12 atmospheres (the "reserve" being intact)—takes a partial charge, raising the pressure in the battery to 22 atmospheres. At the principal depot the first pump compresses from atmospheric density to six atmospheres absolute, while the second draws from the first and compresses to 30 atmospheres absolute. On the arrival of an "automobile" opposite the depot it runs on a turn-table and is then driven into the filling shed. This is alongside the engine-house, and in the partition wall are fixed six sets of filling-pipes with their stop-cocks: A certain quantity of the water is run out of the "hot pot," and, while this is being done, the compressed air connection and the steam connections are being made. The connections consist of copper pipes bent into one or two turns of a helix, so as to give some elasticity. These, by means of unions at their ends, are coupled to the fixed valves, and to the valves on the "automobile." The valves are opened and the air is charged in while the steam is sent up through the water which remains in the "hot pot." Six to eight minutes suffice for this operation, but ten minutes are an excess allowance.

Sir F. Bramwell was enabled to take indicator diagrams from the engines and the pumps, and was surprised to find that as much as 82 per cent. of the gross indicated horse-power in the steam piston reappeared in the pistons of the compressing pumps, so that the friction of the engine, the power absorbed in working its condenser air-pump, and the friction of the compressing pumps, only amounted to 18 per cent. of the total gross indicated horse-power. He had no means of obtaining diagrams from the engines of the "automobiles," themselves, and cannot, therefore, say what was the power given forth by the compressed-air engines. It would appear, however, from information given him, that the cost of working is somewhat less than that of horse-power, and, if this be so, then on various grounds the compressed-air system is to be preferred. It is cleanly, it is trustworthy, and above all it does away with the fearful waste of animal life.

As it is not possible to put turntables in the public road at King's-cross end of the proposed journey, it has been necessary to construct the car so as to run either end first, and thus the long standing platform at the rear end of the Nantes "automobile" has been suppressed, and the passengers, who at Nantes stood on this platform, are in London to be carried on the roof. The engines also have been removed from the end of the under frame, and placed in the middle. The Board of Trade limitation of extreme width made it very difficult to obtain space for working the link-motion by means of eccentrics placed on a return crank; and Sir F. Bramwell availed himself of the extremely ingenious valve-gear of Mr. Joy, where the motion is obtained from the connecting-rod, and is, therefore, in the plane of the centre of the cylinder. **S. G.**

SMALL DYNAMO-MACHINES.

[20534.]—THE other day I saw one of Mr. Patrick's small dynamo machines at work. One man, treading with his foot, was able to produce with this machine a current powerful enough to light four incandescent lamps of 10 candles each. The machine is neatly made, and strong, and probably good for the lecture-room or laboratory.

This, and all the other cheap small dynamos now in the market, has two field magnets with cast-iron cores, and a Seimens armature of the old type. There are only two brasses on the commutator, and, as there are only two impulses of induction and two reversals of current for each revolution, all such machines must be made to run at an excessively high speed—viz., from 2,000 to 4,000 revolutions per minute. If, then, such a machine is wanted for the electric light, and run by steam or gas-power for any length of time at that high speed, the armature becomes greatly heated and injured thereby. It is for this reason that, in Mr. Ladd's small dynamos of this type, a current of cold water is constantly circulated round the armature in order to keep it cool. But this artificial cooling of the armature, or rather the heating of the water caused thereby, results in a great loss of energy. Those, therefore, who want small dynamos for electroplating, electric lighting, or other continuous work, and run their machines by power, must have machines with compound commutators, in which several reversals of current take place for each revolution, or in which the armature is made up in several sections. Such machines need not be driven at a speed higher than 1,500 revolutions per minute. Ere long there will probably be improved machines sold whose speed of revolution does not exceed 800 turns a minute. **T. W. S.**

THE EDISON INSTALLATION IN NEW YORK.

[20535.]—REFERRING to your article on this subject last week, would "Sigma" or some other electrician kindly explain what would be the result of a leakage of current into the earth? I cut from an American paper the following, which appears to me to be largely dosed with the reporter's imagination:—"A curious accident happened last week, more amusing than serious. It was noticed that horses passing through Nassau-street, near Ann-street, sprang as if frightened when passing over a particular spot. It afforded much amusement for the crowd which quickly gathered after the manifestations began, until somebody guessed that the horses were getting shocks from leaks in the electric-light conductors. This proved correct, for the fun ceased when the current was turned off. The investigation which followed showed that an earth current had been accidentally established between two groundings—one through a loose cap on the end of a service-pipe to a house near the scene of the trouble, and the other through a light-wire attached to a gas-pipe in a building some distance away. The jarring caused by heavy trucks passing the house containing the service-pipe with a loose cap on its end caused intermittent communication between the ends of the conducting rods and the iron protecting tubes in which they are placed. The latter, in direct contact with the damp earth, diffused a part of the current intermittently along the line, which is only 20in. or so below the surface. At the spot where the horses were frightened was a short length of dry earth, around which the intermittent current passed through the animals when their fore and hind feet were on the damp earth. Horses seem more sensitive than men to the current, for experimenting with bare hands connecting the same spots failed to detect any current. The galvanometer, however, showed a feeble current—of seven or eight cells of a common battery. The accident was due to the carelessness of a hurried workman."

Assuming this to be all true, can anyone explain why the current should leave the earth to enter the bodies of horses, and then return to the earth again? It reads to me very much like an invention of the enemy. I can understand, in the case of electric railways, where the current is conveyed by the insulated rails, horses may get a shock by stepping on the metals; but this New York case puzzles me. **E. G. M.**

LEGAL REPLIES.

[20536.]—BOUGHT OR NOT? (47942)—In this case there does not seem to have been a complete contract of sale. If one offer another a price for a certain article, and that be accepted, although this is, in one sense, an agreement for a sale, it is not in law a binding contract of sale, unless something more be done by the parties, such as delivery of a portion or part payment. Even at common law, therefore, from the case as stated, I think there was no sale; but if the machine was worth more than £10, and there was nothing in writing, no action could be brought by the Statute of Frauds. For these reasons I think the bargain fell through, and there is an end of the matter.

COPYRIGHT: PHOTOGRAPH (47944).—Presuming the photograph to be registered, and to bear upon each copy the name and address of the proprietor, as required by the Act, it would clearly be an infringement of the copyright to reproduce the likeness for sale in any form whatever.

LIQUIDATION (47962).—If the receiver or trustee, in carrying on the bankrupt's business, uses the materials, he will be liable to pay for them, and so the querist will be safe. But, otherwise, the materials, being in the possession of the debtor at the time of his failure, would form part of his estate, unless it could be shown to be the custom of the trade in question that materials should be so intrusted to him by others—which raises difficult points of law, and rests upon facts not stated.

WILL: HEIR-AT-LAW (47963).—The devise to B. vested the remainder in him immediately after the testator's death, and therefore he could, and did, lawfully devise the property to his wife Mary. Presuming she died without a will, her heirs, and hers alone, are the persons entitled to the property. The fact that Jane, the tenant for life, is not dead does not touch the question, as she had no power over the remainder vested in B.; neither has the eldest son of A. any claim, because his father, by a valid and well-drawn will, gave the property to his son B. Property and possession are distinct in law, and B. had the property in, though not the possession of, the estate, which he gave to his wife Mary, and which must descend to her heirs.

LIABILITY FOR INJURY: EMPLOYER (47969).—Under the Act of 1881 an employer can only be made liable for injury arising through defective plant (as this would be) if the defect were caused by his negligence, or that of his foreman or servant. Here there seems to be no evidence of such negligence, as the van was hired from a contractor. The querist can, therefore, only sue the contractor, basing his action upon the ground that the van supplied was not fit for the purpose. The amount to claim must depend upon the extent of the injury, at which I cannot guess. In actions against employers under the Act, it must be first proved that notice of the accident was given within six weeks, and that the summons itself was issued within six months after it happened.

RATING: CLUB-HOUSE (47970).—As the club-house in question would not come under the definition of a purely scientific or literary institution within the meaning of the Act, I do not see upon what ground it can claim to be exempted from paying poor-rates, &c. That it was never charged before is no argument; but the question can be cheaply and quickly raised by appealing.

REASONABLE WEAR (47981).—I cannot see anything ambiguous in the usual clause as to wear and tear, and have no doubt that it applies to both the house and the fixtures therein. It seems to me that any other construction would be absurd and ungrammatical, and I have never had so fine a point raised before with so little reason.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

SEPARATING SILVER FROM ALLOYS.

[20537.]—THE following simple method of separating silver out of alloys may be useful to those who dabble in photography and electro-metallurgy; and as it forms a supplement to some replies which have recently appeared, you can possibly find a corner for its insertion.

The process is described by Herr Solthien:—The silver-holding alloy or metals are dissolved in the least possible quantity of crude nitric acid. The solution is mixed with a strong excess of ammonia and filtered into a high cylinder, provided with a stopper. A bright strip of copper, long enough to project beyond the liquid, is next introduced, which quickly causes separation of pure metallic silver. The reduction is completed in a short time, and the reduced silver is washed, first with some ammoniacal and then with distilled water. The more ammoniacal and concentrated the solution, the more rapid the reduction. The strip of copper should not be too thin, as it is considerably attacked, and any little particles which might separate from a thin sheet would contaminate the silver. The operation is so simple that it seems preferable to all others for such operations as the preparation of nitrate of silver from old coins, &c. Any accompanying gold remains behind during the treatment of the metal or alloy with nitric acid, chloride of silver (produced by the impurities [HCl] in the nitric acid) is taken up by the ammoniacal solution, like the copper, and is also reduced to the metallic state; and whatever other metal is not left behind, oxidised by the nitric acid, is separated as hydrate (as lead, bismuth) on treating with ammonia. Any arseniate which may have passed into the ammoniacal solution is not decomposed by the copper. **F. N. R.**

THE BLUE PROCESS OF COPYING SKETCHES.

[20538.]—ON page 305 of your last volume, Mr. F. G. Du Pont, of Wilmington, Delaware, gave a description of his method of making astro. sketches with the blue process, but did not explain the process he employs definitely. I have no doubt that, for making sketches of star positions, the process is an excellent one, as it is for other purposes, and your readers may, therefore, be glad of the following detailed method:—

Put forty grammes of citrate of iron and ammonium, forty grammes of ferricyanide (red prussiate) of potassium, and one and a half pint of distilled water into a glazed stone jar, or into a bottle protected by a coating of asphalt or some other black colour impervious to light. The mixture must be carefully kept from exposure to the sun or to bright daylight. When dissolved, apply the solution, in a place only faintly illuminated by artificial (yellow) light, by means of a broad camel's-hair brush, to one side of sized paper, and dry the latter in the dark. Place the drawing, which should be made on transparent paper, upon the prepared paper, face down, and cover it with a sheet of perfectly clean, rather thick, glass. The prepared paper itself should lie upon several sheets of soft paper, so as to be rendered sufficiently elastic to be pressed against the drawing equally in every place. Now expose the surface to the direct rays of the sun for fifteen minutes, or for twenty or thirty minutes, if the background is desired to be darker. Then remove the whole apparatus from the sunlight, take off the drawing, wash the prepared paper thoroughly with water, and dry it. The outlines of the drawing will appear white upon a more or less dark-blue background. Copies should only be made if bright sunlight is available.

Essar.

SECONDS PENDULUM.

[20539.]—I HAVE constructed a seconds pendulum, according to Mr. Warman's Central Contact principle, copying diagrams figured 3 and 4, as given in the ENGLISH MECHANIC of December 30, 1881.

So far as it has been possible to rate the vibrations up to the present time, the performance is decidedly superior to that of any wooden rod pendulum constructed on the usual principle; and it seems to not only demonstrate beyond a doubt the necessity for central contact with all wood rod pendulums, but to exhibit as conclusively the considerable effect of heat and of cold in the dilating and contracting of metals—at all events of lead and of brass.

If Sir Edmund Beckett, or anyone else, would like to see the pendulum in action—as applied to a very beautiful old clock of inlaid (marquetrie) work—I shall be very happy to show it.

6, Vernon-place, Canterbury. **W. Pugh.**

WORK OF MR. CALVER'S 18¼ MIRROR —MR. S. W. BURNHAM'S DOUBLE STARS, β 139 AQUILÆ 59. β 248. 2 VULPECULÆ, Σ 2545, Σ 2547, β 658. B.A.C. 6762, δ CYGNI, Σ 2583. π AQUILÆ, O Σ 387, O Σ 395, Σ 2690, O Σ 533, β 64, λ CYGNI, β 367, O Σ 418, ε EQUULEI, Σ 2741, β 68, β 69, 61 CYGNI, STELLAR PARALLAX, PROPER MOTION OF 1830 GROOMBRIDGE, β 159, β 74, β 167. CYGNI 363, β 75, β 476, β 477, β 379, β 381, β 277, β 382, B A C., 7983, β 365.

[20540.]—I THANK Mr. S. W. Burnham for his kind and prompt recognition of the work of Mr. Calver's mirror in letter 20434. No doubt it is true, as Mr. Burnham states, that a large reflector has rarely been tested in so severe a manner as I have tested mine; but the more I see of the performance of Mr. Calver's handiwork, the more convinced I am that it only requires really fine atmospheric conditions to enable his mirror to do, as Mr. Burnham says, the very best work in the field of double-star observation. This month I have had two tolerably good nights—the 7th and 8th, on which I made nearly all the measures given below. Many of them are Mr. Burnham's own discoveries, and if my measures are approximately correct, several of them will, I think, turn out to be rapid and interesting binary systems. It is unfortunate that there are so few published measures of Mr. Burnham's discoveries to serve for purposes of comparison. Mr. H. Sadler informs me that M. Struve has promised to publish the measures he has made of these difficult and interesting stars. I hope he will shortly do so, and thus enable observers to concentrate their attention upon those pairs which give promise of the greatest interest. But it appears that since Baron Dembowski's lamented death we must look chiefly to Mr. Burnham himself, and to his fellow-countrymen on the other side of the Atlantic, for information about the movements of his discoveries. Would that our climate enabled us more effectively to co-operate!

The following are the measures which I am now able to lay before your readers:—

(1) β 139. Aquilæ 59. R.A. 19·7. Mags. 6·7, 8.

Dembowski	P = 139°·5	D = 0″·72	Ep. 1875·90
Perry	P = 140·7	D = 0·72	,, 1882·64

(2) β 248. 2 Vulpeculæ. R.A. 19·12. Mags. 5·7, 9·5.

A B Dembowski	P = 125°·0	D = 1″·83	Ep. 1875·6
A B Perry	P = 119·0	D = 2·17	,, 1880·71
A B Perry	P = 121·0	D = 1·96	,, 2·63

(3) Σ 2545. R.A. 19·32. Mags. 6·2, 8·1, 8·5.

I give the measures of this and the following pair, as a small contribution towards clearing up the confusion that appears to have existed in regard to them.

A B Perry	P = 320°·0	D = 3″·60	Ep. 1882·66
A C Perry	P = 170·0	D = 31·10	,, ·66

(4) Σ 2547. R.A. 19·32. Mags. 7·7, 9.

A B Perry	P = 333°·0	D = 21″·55	Ep. 1882·66
A C Perry	P = 144·0	D = 42·40	,, ·66

(5) β 658, B.A.C. 6762. R.A. 19·39. Mags. 6·5, 10.

β	P = 295°·2	D = 0″·57	Ep. 1878·5
Perry	P = 286·5	D = 0·51	,, 82·68

This star was difficult, and only fairly divided in moments of best definition.

(6) δ Cygni. R.A. 19·41. Mags. 3, 7·9.

This is one of the most celebrated binaries in existence. The magnitude of the companion given above is that assigned by Mr. Gledhill, after Σ. Dawes gave it as 8 or 9. Smyth as 9. Dembowski thought it variable, both in colour and magnitude, an opinion which Dawes appears not to have shared, at least as regards its brightness. In 1823, H, and South could not see the least appearance of the companion. Speaking of the difficulty of this star, Dawes observes that it is a case in which "great perfection of telescope is of far more importance than large aperture beyond about 6in."; but Brodie remarks, that it is "a difficult object even with an 8½in. refractor, and requires a fine state of atmosphere." As far as my experience goes, the difficulty with this star is entirely atmospheric. On a good evening, before sunset, the companion stands out widely separated from its primary. Its period seems not to be accurately known. Formerly, it was thought to be about 40 years; but this is now known to be very much under the mark. Hind puts it at 178 years and 256 days. Behrmann calculates it at 415 years. The following are some of the measures:—

H,	P = 71°·6	D = 2″·50	Ep. 1783·72
H, and South	"Perfectly round."		,, 1823·00
Dembowski	P = 355·5	D = 1·58	,, 1863·61
Dunér	P = 343·7	D = 1·53	,, 70·85
β	P = 332·6	D = 1·40	,, 8·64
Perry	P = 328·6	D = 1·56	,, 82·65

(7) Σ 2583. π Aquilæ. R.A. 19·43. Mags. 6, 6·8, 14.

A C was measured at the request of Mr. H. Sadler.

A B H, & South	P = 135°·5	D = 1″·96	Ep. 1823·70
A B Dawes	P = 124·5	D = 1·83	,, 30·56
A B Gledhill	P = 121·4	D = 1·48	,, 74·85
A B Perry	P = 116·0	D = 1·92	,, 82·62
A C Perry	P = 305·0	D = 31·16	,, 82·66

(8) O Σ 387. R.A. 19·44. Mags. 7·2, 8·2.

A binary in rapid direct motion.

Dembowski	P = 52°·5	D = "oval"	Ep. 1870·56
Dembowski	P = 23·0	D = "oblong"	,, 3·73
Dembowski	P = 17·7	D = 0·46	,, 7·67
Perry	P = 16·5	D = 0·56	,, 82·69

(9) O Σ 395. R.A. 19·56. Mags. 5·8, 6·2.

Probable direct motion in this system, according to Gledhill.

Mädler	P = 89°·2	D = 0″·5	Ep. 1843·53
O Σ	P = 79·3	D = 0·64	,, 44·16
O Σ	P = 96·3	D = 0·68	,, 74·76
Perry	P = 89·0	D = 0·58	,, 82·68

(10) Σ 2690. R.A. 20·25. Mags. 7, 7·5, 7·6.

In 1840, Dawes detected the duplicity of B; it was also detected independently by O Σ in 1842. There is probably a slow retrograde motion, with decrease of distance, according to Gledhill.

B C Dawes	P = 211°·4	D = 0″·65	Ep. 1841·95
B C O Σ	P = 210·7	D = 0·63	,, 42·58
B C Dembowski	P = 202·2	D = . . .	,, 66·30
B C Wilson and Seabroke	P = 227·3	D = . . .	,, 73·68
B C Perry	P = 209·0	D = 0·45	,, 82·67

This is the same class of star as μ¹ Herculis; but more difficult, being closer.

(11) O Σ 533. R.A. 20·33. Mags. 4·7, 11·3.

Gledhill remarks, "This star, owing to the great difference in the brightness of the components, is very difficult to measure."

O Σ	P = 11°·9	D = 10″·26	Ep. 1851·71
O Σ	P = 359·4	D = 10·32	,, 59·62
O Σ	P = 335·1	D = 10·88	,, 74·79
Perry,	P = 321·0	D = 12·20	,, 82·68

(12) β 64. R.A. 20·39. Mags. 8·7, 9·0.

Dembowski	P = 172°·4	D = 0″·64	Ep. 1876·2
Perry	P = 193·0	D = 0·50	,, 1882·68

If my measure is correct, there is an increase of angle here, amounting to nearly 21° in six years.

(13) λ Cygni. R.A. 20·42. Mags. 5, 6·3.

Dawes writes: "A close and beautiful binary discovered by Mr. Otto Struve." He notes the great discrepancy in the measures, the great difficulty of the object, and the absence of change in the distance.

O Σ	P = 122°·0	D = 0″·65	Ep. 1842·66
Dawes	P = 108·0	D = 0·7	,, 51·99
Dawes	P = 92·5	D = 0·68	,, 66·99
Dembowski	P = 88·7	D = 0·6	,, 71·41
Perry	P = 83·5	D = 0·67	,, 82·68

(14) β 367. R.A. 20·49. Mags. 7·5, 7·9, 12.

A B Dembowski	P = 115°·7	D = 0″·55	Ep. 1876·4
A B Perry	P = 105·0	D = 0·45	,, 1882·68

Apparently a decrease of angle and distance.

(15) O Σ 418. R.A. 20·49. Mags. 7·3, 7·4.

Here there is a gradual decrease in angle and increase in distance.

O Σ	P = 301°·8	D = 0″·56	Ep. 1842·67
O Σ	P = 287·9	D = 0·74	,, 53·20
Dembowski	P = 292·4	D = 1·01	,, 66·90
Perry	P = 282·0	D = 1·13	,, 82·68

(16) ε Equulei. R.A. 20·53. Mags. 5·7, 6·2, 7·1.

A was discovered double by Σ in 1835. Slight change in angle, but increase of distance. In A C also the angle was gradually diminished, and the distance slightly increased.

A B Σ	P = 300°·5	D = 0″·4	Ep. 1835·62
A B O Σ	P = 287·5	D = 0·68	,, 43·64
A B Dembowski	P = 285·1	D = 1·00	,, 56·66
A B Gledhill	P = 287·0	D = 1·10	,, 73·91
A B Perry	P = 285·0	D = 1·23	,, 82·68
A C Σ	P = 80·4	D = 9·37	,, 21·25
A C Dawes	P = 76·2	D = 10·31	,, 53·75
A C Doberck	P = 75·3	D = 10·77	,, 77·81
A C Perry	P = 76·0	D = 11·03	,, 82·68

(17) Σ 2741. R.A. 20·54. Mags. 6, 7·3.

The published observations of this star are very discordant. It is difficult to account for this, as there seems to be no special difficulty about the object.

H,	P = 36°·2	D = 1″·41	Ep. 1828·55
H,	P = 34·2	D = 2·89	,, 29·61
Dawes	P = 32·3	D = 1·71	,, 47·91
Gledhill	P = 33·7	D = 1·89	,, 74·91
Doberck	P = 28·6	D = 1·91	,, 76·77
Perry	P = 36·6	D = 2·20	,, 82·60

(18) β 68. R.A. 20·55. Mags. 8·5, 9.

β	P = 170°·0	D = 1″·5	Ep. 1872·00
Perry	P = 151·0	D = 1·82	,, 82·68

There seems considerable movement here. If my measure is correct, the change in angle amounts to 19° in 10 years.

(19) β 69. R.A. 20·56. Mags. 8, 9.

β	P = 350°·0	D = 2″·0	Ep. 1872·00
Perry	P = 313·5	D = 1·22	,, 82·68

This seems to be a rapid binary; the change in angle, if my measure is correct, being 37° in 10 years.

(20) 61 Cygni. R.A. 21·1. Mags. 5·3, 5·9.

This glorious pair of golden suns is celebrated in the annals of astronomy. Webb remarks, "These suns were the first of the host of heaven to reveal to Bessel (1838) the secret of their distance. This is probably 366,400 times that of the earth from the sun, itself 92,400,000 miles—a space so vast, that light, which reaches us from the sun in eight minutes, employs nearly six years to traverse it. We see these suns, therefore, not as they are now, for of their present existence we have no information; but as they were six years ago. How vast must be the dimensions of this great universe! What a temple for the Creator's glory! 'All the whole heavens are the Lord's.' Those heavens are crowded with millions upon millions of stars, and of all that countless multitude, millions, probably, for one, are at a distance incalculably exceeding that of 61 Cygni."

Attention was first drawn to this pair of suns on account of the discovery, by Piazzi, of their extraordinary proper motion through space. Referring to this most interesting question of the proper motion of the stars (our own sun included), Newcomb instances 1830 Groombridge, a telescopic star in Ursa Major, as possessing the most extraordinary proper motion at present known. He says—"The most careful determinations of its parallax seem to show that its distance is so immense that the parallax is only about one-tenth of a second; that is, a line drawn from the sun to the earth would subtend an angle of only a tenth of a second when viewed from this star. But the apparent motion of the star, as we actually see it, is more than seven seconds per annum, or 70 times its parallax. It follows that the star moves over a space of more than 70 times the distance of our sun from us in the space of a year. If, as is likely, the motion of the star is oblique to the line in which we see it, its actual velocity must be yet greater. Leaving this out of account, we see that the star would pass from the earth to the sun in about five days; so that its velocity probably *exceeds two hundred miles per second*—a velocity so great that if the masses of the stars composing our sidereal system be not vastly greater than we have reason to suppose, then 1830 Groombridge is a 'runaway star,' and the attraction of 'all the bodies in the universe can never stop it.'" "Which of these is the more probable alternative," says Newcomb, "we cannot pretend to say.' That the star can neither be stopped nor bent far from its course until it has passed the extreme limit to which the telescope has ever penetrated, we may consider reasonably certain. To do this will require two or three millions of years. Whether it will then be acted on by attractive forces of which science has no knowledge, and thus carried back to where it started, or whether it will continue straightforward for ever, it is impossible to say."

This astronomer gives the proper motion of 61 Cygni at 5·2″ per annum, and Auwers gives its parallax at 0·56″. The method by which Bessel discovered the parallax is given in a letter which he addressed to Sir John Herschel in 1838, which runs as follows:—"I selected among the small stars which surround 61 Cyni, two between the 9th and 10th mags., of which one (*a*) is nearly perpendicular to the line of direction of the double star; the other (*b*) nearly in this direction. I have measured with the heliometer the distances of these stars from the point which bisects the distance between the two stars of 61 Cygni. And as I considered this kind of observation the most correct that could be obtained, I have commonly repeated the observation sixteen times every night." As the result of his measurements, he found that in summer 61 Cygni was further from *a* by 0·620″ than in winter (when the earth was about 184 millions of miles distant from the point where the summer observations were taken—such is the length of the base line); and, further, from *b* by 0·437″. Hence, he derived a parallax of 0·314″, giving the distance of the star at 657,700 mean distances of the earth from the sun. More recent researches have considerably reduced this distance, as stated above.

In addition, 61 Cygni is probably a binary system. The following are some of the measures:—

Bradley	P = 35°·4	D = 19″·6	Ep. 1753·80
Bessel	P = 79·1	D = 16·7	,, 1812·30
Dawes	P = 90·3	D = 15·7	,, 30·66
OΣ	P = 108·7	D = 18·2	,, 60·80
Doberck	P = 116·7	D = 20·0	,, 78·72
Perry	P = 116·0	D = 21·14	,, 82.68

(21) β 159. R.A. 21·6. Mags. 6·1, 9·2.

A B Dembowski	P = 318°·7	D = 1″·32	Ep. 1876·4
A B Perry	P = 300·0	D = 1·34	,, 82·68

Apparently, considerable decrease of angle here.

(22) β 74. R.A. 21·29. Mags. 6.5, 10.

β	P = 315°·0	D = 1″·5	Ep. 1871·00
Perry	P = 325·0	D = 1·6	,, 82·68

(23) β 167. Cygni, 363, R.A. 21·31. Mags. 7·0, 11·4.

Dembowski	P = 89°·2	D = 2″·08	Ep. 1876.5
Perry	P = 91·0	D = 2·17	,, 82·68

(24) β 75. R.A. 21·49. Mags. 8, 9.

β	P = 30°·0	D = 1″·2	Ep. 1872·00
Perry	P = 34·0	D = 1·23	,, 82·68

(25) β 476. R.A. 22·8. Mags. 9·5, 10.

β	P = 93°·0	D = 2″·6	Ep. 1876·00
Perry	P = 90·5	D = 2·27	,, 82·68

(26) β 477. R.A. 22·10. Mags. 9, 11.

β	P = 46°.0	D = 6″·4	Ep. 1876·00
Perry	P = 46·0	D = 7.04	,, 82·68

(27) β 379. R.A. 22·16. Mags. 8·5, 9.

β	P = 330°·0	D = 1″·0	Ep. 1875·00
Perry	P = 336·0	D = 1·08	,, 82·68

(28) β 381. R.A. 22·27. Mags. 8, 10·5.

β	P = 210°·0	D = 1″·2	Ep. 1875·00
Perry	P = 235·5	D = 1·54	,, 82·68

There seems to be very considerable movement here. If my measures are approximately correct, there is considerable increase of angle, and slight increase of distance.

(29.) β 277. R.A. 22·34. Mags. 8·2, 8·4.

Dembowski	P = 199°·4	D = 0″·50	Ep. 1875·3
Perry	P = 168·5	D = 0·55	,, 82·68

If my measure is correct, there is a change of angle here amounting to 31° in 7 years.

(30) β 382. B.A.C. 79·83. R.A. 22·48. Mags. 6, 8, 10·7.

A B Dembowski	P = 205°·7	D = 1″·07	Ep. 1876·4
A B Perry	P = 219·0	D = 1·13	,, 82·68
A C Dembowski	P = 353·6	D = 26·43	,, 76·2
A C Perry	P = 357·0	D = 27·78	,, 82·68

(31) β 355. R.A. 23·4. Mags. 7·1, 7·9.

Dembowski	P = 135°·8	D = 0″·42	Ep. 1876·4
Perry	P = 128·9	D = 0·51	,, 80·77
Perry	P = 124·0	D = 0·41	,, 82·68

Of the above 31 objects, 18 are the discoveries of Mr. S. W. Burnham. They are mostly stars of some difficulty; but it seems more than probable that many of them will well repay careful attention. For much of the information given above, and for the comparison measures, I am indebted to the published works of Mr. Gledhill and Mr. Chambers.

Jevon J. Muschamp Perry.

St. Paul's Vicarage Observatory, Alnwick,
Sept. 14, 1882.

THE TRIPLE STAR 12 LYNCIS, &c.

[20541.]—May I call the attention of observers with 3in. or 3½in. telescopes to the beautiful triple 12 Lyncis. Both on September 11th and September 13th (with a power of about 140) it was distinctly visible as a triple, the discs of 6 and 6·5 being just separated. According to Webb, the distance between them was 1·65″ in 1832, and only 1·4″ in 1876, while, to my eye (for I have not got a micrometer), they seemed nearly 2″ apart, about the same as ξ Ursæ Majoris. The colour of the other comes (7·5) came out well, bluish. Turning to that glorious object, ϵ_1 ϵ_2 Lyræ, not only were the two pairs very distinct with the 9th mag. star between them, but, looking at some minute stars in the field, one of the debilissima became just visible, viz., the one lying to the left of the line joining the two pairs. The other remained unseen. May I infer that, though both are called 13th mag. stars, one is slightly brighter than the other? I should like to ask "F.R.A.S." whether the components of ε Arietis are separating? According to Webb, p. 235, they were 1″ apart in 1866, 1·3″ in 1876; to me, the two discs just overlapped, like an 8.

Liverpool, September 15. **J. H. H.**

ASTRONOMICAL—TO C. GAUDIBERT.

[20542.]—μ^2 Boötis (letter 20490) has always, this last season, appeared far easier to me than η Coronæ. I seldom have any difficulty in seeing the former as two disinct round dots, with powers of 300 or 400 on 7½in. of my 8½ Calver.

Will Mr. Sadler or M. Gaudibert oblige me with a drawing of the minute stars close to the annular nebula in Lyra? **F. R. C. S.**

ASTRONOMICAL.

[20543.]—The following list of places of pairs may help M. Gaudibert (letter 20490, p. 37):—

Near the place of his first star are two double stars, viz.:

	h. m.	° ″			
Σ 2356	18 33	+ 28 36	D = 1″	P = 47°	Mg. 8, 9
h 1333	33	+ 26 57	D = 2	P = 229	Mg. 10, 11

For his second pair we have:—

Σ 2320	18 22	+ 24 36	1″·7	11°	7·1, 9·0

For his third pair:—

Σ 2401	18 43	+ 21·0	4″	37°	7·0, 8·6

β Delphini is one of Burnham's pairs.

The next pair, 19·2, 32 51°, I have failed to identify. For the last pair we have:—

h 1383, 19 14 3°, 20 D = 6 P = 110° Mgs. 10½ 10½

which might be A C, while A B is a new double.

T. E. Espin.

Church-road, West Kirby, Birkenhead.

THEORY OF SOLAR REGENERATION.

[20544.]—Dr. Siemens' theory of the sun is not new; more than 30 years ago Mr. Schmitz, of Cologne, published this theory in his "Weltall," in which he says (p. 291): "Without a world-air filling infinite space, the sun were inexplicable and impossible. The notion that the sun subsists in a vacuum, and for ever engenders light and heat without being fed, stands opposed to sound reason and nature. The sun fire does feed itself because it burns; and it burns continually because its own heat continually brings it fuel. This is the perpetual process of nature, far simpler than any that man can devise."

In regard to the origin of planets he says: As combustion always produces cinders, slacks, or scoriæ, and as every meteor seen in the sky leaves such behind it, so neither can the burning of the world-ether in the sun's flame take place without them. These scoriæ or dark spots in the sun exceed those of a meteor in size as the sun itself exceeds the meteor. These scoriæ gradually gather into firm bodies.

Observations on comets teach us that at intervals of from 40 to 70 years such spots suddenly disappear from the sun, and at the same time a comet appears in his vicinity.

In conclusion I may, perhaps, with the Editor's kind permission, be allowed to state that in regard to the cause of tides Mr. Schmitz assumes the moon to be within the earth's atmosphere, and that the two bodies have, instead of a fancied attraction, merely an increased pressure of the atmosphere between them; it is very intelligible how the water of the ocean immediately under the moon should be slightly pressed in, about two or three feet at the equator and hardly at all at the poles; it is also evident that the water will rise again when the pressure is over—namely, three hours after the moon has left the meridian. Again, in the limitation of the pressing force, we can discover a limit to the water's motion, whereas that a gradual upward attraction should be limited to two or three feet is incomprehensible, especially as "the attractive force increases as the square of the distance diminishes!"

Southampton, September 18. **G. Schutze.**

CASSEGRAIN TELESCOPES—TO "ORDERIC VITAL."

[20545.]—"Orderic Vital" is not quite right in assuming that "*y* is very small as compared to F." The focal length of the large mirror is usually only four to six times its diameter, while the thickness of mirror, the depth of cell behind it (to contain the holding-up springs), and the necessity for throwing the focal image some distance up into the eypiece, combine to make *y* a considerable proportion of F, probably about one-sixth. It would, therefore, appear that "O. V.'s" rule can only give a very rough approximation.

In connection with this, it would be interesting to know what amount of focussing movement of the eyepiece is equivalent to a given movement of the small mirror, which latter is the usual, and, I think, almost invariable, method of focal adjustment.

Yet another point. How can one get a focal image thrown on to a card, in the Gregorian and Cassegrain construction, using the mirrors alone without the eyepiece? If the card is held behind the hole of the large mirror, the light that passes direct through the hole extinguishes the focal image, or renders it too faint to be of any use. I have tried, unsuccessfully, to obviate the difficulty in the endeavour to obtain the distance *y* by actual measurement, and thus practically test the formula of "O. V."

Perhaps other possessors of these forms of telescope will experiment and communicate the results.

Like others of your correspondents, I take much interest in these old-fashioned instruments, and hope "O. V." will lend his help in elucidating their theory and practice. **Venn Cross.**

CROWN-GLASS ACHROMATISM.

[20546.]—It is always unpleasant to contradict, or seem to do so, one of our correspondents, when he is writing about what is, or what he believes to be, an historical matter of fact, and so I reluctantly take notice of the letter of "Prismatique," p. 16, No. 911. He says, "Experience and experiment both tell me that a long focussed crown concave lens cannot correct a short focussed crown convex lens of plano or double form. What may yet be done by extraordinary meniscus and concavo-convex forms I cannot say." Now, really, when a person rushes into print without first having ascertained whether achromatism in any way depends upon the form of the lenses, we may fairly doubt whether his historical information is any greater than his mathematical knowledge. It is due to him to say that he only gave an opinion in response to an invitation to do so. **W. G. P.**

AN ELECTRICAL PROBLEM IN CONNECTION WITH AËRIAL NAVIGATION.

[20547.]—When Mr. Harris (letter 20164) says "Science has already endowed soft iron with artificial magnetism, which counteracts fourfold the effect of gravitation," he explodes his own theory; for the "navigation" of his "magnetised soft iron" would not be towards the moon, but towards the centre. We have already "aërial navigation on the basis of planetary flotation," as witnessed at the Crystal Palace in the ascension and flight of the air-balloons. There can be no doubt that the "moon is a notable illustration of planetary flotation"; but I doubt if this "flotation" is due to internal and external electricity. I would rather think that (like the air-balloon) it is the consequence of imprisoned gases (perhaps incandescent). Why should we not regard the planets as huge air-balloons, revolving round the sun by some rotary influence he possesses, yet unexplained? This is my theory as against the "earth being charged with positive electricity," and its motions being due to "electrical conditions." I must controvert the idea that the moon's distance from the earth is inexorably fixed "in accordance with the principle of polarisation." Its distance varies, and the *harvest moon* is a very big one. I cannot think that "the regulated distances of the different planetary bodies from the sun is caused by the intensity of their electrical condition." I put the phenomenon down to the respective capacity (so to speak) of those huge air-balloons to float away from the sun. What does Mr. Harris mean by a "balanced condition of flotation?" Does he mean the sun floats in the same sense as the planets? That is an impossibility, for there are many conditions to be taken into consideration in respect of the "flotation of the planets" that cannot apply to the sun. In conclusion, I can only say that I wish the "guttapercha electric globe" a safe experimental journey to the moon. **G. B. T.**

BREAD.

[20548.]—The letters and replies which have recently appeared on this subject are rather contradictory. "Du Pain," p. 41, complains that bread is too crusty; "Disgusted Foreigner," p. 573, has discovered that it will not pay to bake bread thoroughly. In London, it is true that you can have almost anything you like to pay for, and I have no doubt that there are bakers who, for a consideration, would make bread to suit the taste of each individual customer. Certain it is, that as good bread can be bought in London as elsewhere; but obviously there must be a deal of difference between a quartern loaf at 6d. and the same weight at 8½d. Personally, I like good well-browned crusts, and will eat nothing else, if I can help it; others like crumb. I have recently come across a new method of making bread, which, as the inventor, Dr. T. H. Poupon, of Paris, thought it good enough to patent, ought to give something very excellent, I suppose. His method dispenses with kneading, and prevents loss, and the production of acetic acid. It consists in adding to the dough a matter susceptible of being acted on by the ferment (in lieu of the flour decomposed in the ordinary method of bread-making) and of producing alcohol and carbonic acid in proportions identical with the ordinary process, and at the same time of opposing the decomposition of the flour. By this means the gas for raising the dough is generated in the required proportions whilst the flour is preserved in its absolute integrity. Thus the loss usually incurred is avoided, the gluten retains its sapid, digestive, and nutritive qualities, and the bread is of a superior flavour and quality and will remain new for several days and keep stale for an indefinite time. The bread is made in two hours, inclusive of baking, the laborious and unhealthy operation of kneading, which constitutes two-thirds of the work of the ordinary process, being avoided. The elements which are added to the dough are identical with those which yield alcohol and carbonic acid in ordinary panary fermentation, but as in the latter case the principles which are decomposed are combined with the other elements of the wheat, it is evident that a preliminary work of deorganisation is indispensable to their decomposition by the action of the ferment. By this invention a principle is added to the flour which possesses the double advantage of being directly susceptible to the action of the ferment and of opposing the decomposition of the flour. These elements are found in all matters which contain or are susceptible of being converted into a saccharine principle. For instance, starch of all kinds, cereal flour, and other substances of similar composition converted by the direct action of diastase or the infusion of malt, may be employed. All saccharine principles contain the necessary elements, the grape and many other fruits, manna, honey, molasses, unfermented wine, syrup of wheat or starch, grape sugar, moist sugar, inverted white sugar are among the elements which may be employed, the choice depending on the cost. He dissolves the saccharine matter in a quantity of water, proportionate to the weight of the flour used, and add first a suitable ferment (brewers' yeast or sour dough, &c.), and then the flour, working the dough for a few minutes only. The dough is put into tins and left for about 30 or 35 minutes to rise, and then baked for about 25 to 30 minutes. It must be understood that the proportions, and the time vary in each case, according to the materials used, the quality of the flour, the temperature, strength of the yeast, and other circumstances. The cardinal feature of this invention is that the saccharine matter employed preserves the flour from being attacked by the ferment, prevents loss, and the formation of objectionable compounds. **Essar.**

THE REPUDIATED WEATHER TABLE.

[20549.]—LET us now examine Herschel's weather table, as improved by Dr. Adam Clarke. Sunday, January 30th, 1881, new moon—"0.48 morn, hard frost"; sharp frosty nights followed, and two distinct storms of rain, snow, and wind came, February 8th and 10th. February 14th, full moon 6 24 morn. The table says stormy, snow, rain, and wind 13th, 14th, and 15th. New moon, February 28th, 11.32 morn, to bring frost, unless wind be S. or S.W. Stormy weather prevailed 2nd March to 8th ditto. Full moon, March 15th, 10·37, to bring fair and frosty weather. Last quarter, March 23rd, 3.29 morn, to be followed by snow and stormy weather. Rain, snow, stormy weather 23rd to 26th. April was to be fair, and so it was. May was to be cold and stormy, and stormy weather prevailed 13th to 20th, and again 26th and 27th. June and July were to afford tolerable weather, and such was the case. August was to be rainy, and it was very much so. September was to be changeable, and so it was. October and November were to bring rain, snow, and storms, and here again the table was true. December was to bring wind and rain, and it came between 14th and 23rd. High wind was to be felt in January, 1882, bad weather prevailed 2nd to 11. Stormy weather was to prevail in February, and it came 10th to 19th, and 25 to March 5th. April was to be stormy, and it was so. July was to be rainy, and such was the case. Wind and rain may be expected between 13th and 17th of November.

I find that Saturday and Sunday moons coincide with the worst parts of the weather according to the weather table, and the 20-day period agrees with both. The eastern edge of the storm path passes over the British Islands, so that storms occasionally miss us altogether. Full moon, 7th October, 1881, came when the moon was ascendant four days past perigee. Full moon, 25th November, 1882, will come four days past perigee. New moon, October 23rd, 1881, came seven days past apogee. New moon, December 10th, 1882, will come seven days past apogee. Full moon, December 24th, 1882, comes seven days past perigee. We shall see how the conditions agree this time.

W. M. Gardner.

SECONDARY BATTERIES.

[20550.]—WE have heard very little of Sutton's secondary battery since it was presented to the public, and as the Sellon-Volckmar-Faure squabble seems to have been cleared up, we shall probably hear very little of the wonderful improvements which were said to have been made in the batteries used (scarcely exhibited) at the Palace. The number of storage batteries, patented and otherwise, is already very large, but as Planté's is free for everyone, I should like to hear from "Sigma" whether it is not as good as any. Planté has recently turned renewed attention to his battery and has been experimenting with it in various ways. He has tried the effect of electrolytic deposit of lead on the plates; but as the metal would not adhere well, he has arrived at the conclusion that the best plan is to transform the metal of one electrode into peroxide nearly through, and that of the other to reduced lead. That has been accomplished by changing the direction of the primary current at intervals with periods of rest between. By this method of preparing the cells, M. Planté states that it will be feasible to obtain a discharge current sufficient to deposit about 1,150gr. of copper for every 2½lb. weight of secondary battery. This system of charging the battery in contrary directions, reduces the lead on one plate and oxidises the other to a corresponding depth, so that during the subsequent discharge the hydrogen from the decomposed water in the battery reduces the peroxide of lead formed by the primary current, and the oxygen oxidises an equivalent quantity of lead. The efficacy of the period of repose between the opposing currents is explained by M. Planté on the ground that at the end of a certain time the plates of lead become less conductive on their surfaces; hence the primary current, when it starts again, naturally follows the path of least resistance and enters the liquid at the metal surface under the film of oxide, and not by the surface of the oxide itself; thus oxidising a new thickness of metal, and superoxidising the oxide already formed. A cell thus formed preserves its charge for months. The formation takes a considerable time, but it may be hastened by heating the liquid. That is, however, a process requiring trouble, and M. Planté has substituted the following plan. The plates are left for twenty-four or forty-eight hours in a bath of nitric acid diluted with half its volume of water. They are then washed and placed in the dilute sulphuric acid bath, and submitted to the action of the primary current. The action of the nitric acid corrodes the surface of the plates and gives a better surface for the oxidation by the current. Secondary batteries thus treated give in eight days, after three or four changes of the primary current, discharges of long duration, whilst those made without the preliminary bath of nitric acid only give the same results after several months of preparation. Apparently, this process renders Planté's cell practically of as much use as any of the others. Can any of your readers, therefore, tell me what thickness of lead it would be advisable to use?

C. F. E.

"HINTS TO CORRESPONDENTS."

[20551.]—KINDLY excuse a few "hints to correspondents" from a reader of every number since your ninth volume. "Ours" keeps well abreast of the latest discoveries in science and mechanics, but I seem to miss some of the more practical series of papers in the earlier volumes. I am only a poor "all-round" amateur, and my suggestions are doubtless worthy only of the contempt of thorough-going mechanics, and the like; still, here are a few things I *should* like to see treated on in some such style as "A Fellow Workman" wrote on watch-making, as Mr. King writes on cart and wheel-making, and "Jack of all Trades" on everything!

Carpentry is one: not a series of papers suitable for an apprentice or young workman, but for awkward householders, with a whole army of little jobs waiting, and few tools and very awkward fingers to work with. I have several things to do which I hesitate to set about. I want to put a plain fence across my little garden, separating my modest lawn from the vegetable department, with a central gate. A simple sketch, with hints as to the cheapest stuff to get, the strongest and plainest sort of gate to make, &c., would be very acceptable. I also want to build a small shed at the bottom of the garden as a stable for my boy's tricycle and my own "Coventry convertible." Could not some such example be introduced into a short and easy series of "Lessons in Amateur Carpentry"? Answer, "O. J. L.," or somebody else with the will and ability!

Fret-cutting is another subject I should like to see taken up. A few papers on home-made household furniture would be acceptable; so would a few more on house-painting, papering, &c. Where, too, are the contributors of those "Domestic Recipes" which used to appear at intervals? Could you not spare half a column occasionally for them? Other correspondents lately have pleaded for more about geology, and you have endorsed their appeal. I would only, therefore, add that a series of papers like Mr. Underhill's, in Vol. XII., on "The World, its Formation, and Antiquity," written up to date, so far as later discoveries or hypotheses are concerned, would interest me greatly. A few lessons in drawing and water-colours would complete my present requirements, and encourage me to "ask for more."

Oliver Twist.

A "NEW ELECTRO-MOTOR."

[20552.]—I HAVE just seen a very pertinent criticism of the claims made for a new electro-motor, which may be read with interest by some of your contributors. The criticism appears in the *American Machinist*, and is by Mr. A. Buel, of the Troy Polytechnic. He writes:—

Having noticed in many papers throughout the country accounts of the new electro-motor invented by Mr. J. B. Atwater, of Chicago, a working model of which I have seen through the courtesy of the inventor, I should like to ask a few questions. First, let me state that the motor derives power from a Bunsen, or other ordinary battery, working through a peculiar form of electro-magnet, discovered by Mr. Atwater, and from which he calculates on deriving a power cheaper than steam power. Amongst other uses, he proposes to apply this cheap power to a dynamo, to produce a current for electric lighting purposes cheaper than can now be done by steam power; the only expense in maintaining this power is in keeping up the battery.

Now, on the basis of the inventor's calculations, should not the dynamo current derived from the apparatus be as much greater than the battery current put into it, as the cost of a battery current now exceeds that of a dynamo run by steam-power, plus his calculated saving on steam? And if he gets a greater current out of his apparatus than he puts into it, can he not shunt a portion of the derived current through the motor, and dispense with the battery?

Then, would he not have a *perpetual motor*, producing a considerable current at no expense? Does not this show his calculations to be wrong, and the cost of his power to be greater than steam? Does this show that the correct way to work for a cheap electro-motor is to work for a cheap current?

The claim made for this electro-motor is much on a par with that made commonly for electricity. It is to supersede coal, and gas, and steam, and so on. Well, we have water-power and wind-power; but at present we have no electric machine that gives out more power than was put into it by the coal consumed. **F. A. M.**

TRICYCLE MOTORS.

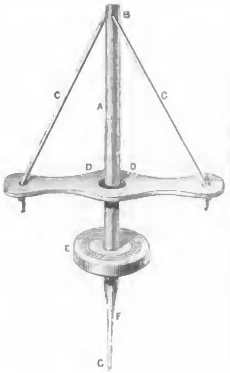
[20553.]—IN respect to tricycles being driven by a convenient motor, could not the two side wheels thereof, by a particular construction, be made to represent revolving armatures and propelling instruments as well—the electro-magnets being supplied by a convenient battery, and the magnets and battery forming parts of the machine?

G. B. Taylor.

RIVETING CHINA.

[20554.]—IT having occurred to me that some difficulty may be experienced in procuring or making the form of diamond drill figured in my former letter, 20383, I here give a sketch of a simple one, which I saw in use, which was made by the operator himself. Lapidaries supply them made, as far as the tube and diamond are concerned. Any amateur mechanic of the meanest capacity would be able to make it complete at comparatively little cost beyond the outlay for the diamond point, this being the chief item of expense. A diamond such as is needed for a medium-sized drill would weigh possibly about half a grain. As three grains go to a carat, and as a carat of white diamond would cost about 25s. or 30s., it follows that the drill point would cost, unset, about 5s or so. Looking at the value of these diamond points, and at their small size, it is evident that great care has to be taken in setting and soldering them into the metal. The diamond would not be affected by the heat during soldering, so hard-soldering is preferable. If a tin tube is used, it can be soft-soldered only. The diamond should be set end on, not flatwise (as ordinarily set in watch jewelling), and be well bedded into the solder, a good cutting-edge only protruding. The metal point should barely exceed the width of the stone. To make such a drill as figured in my letter, procure a piece of rod steel about 12in. long and ¼in. diameter. At the extreme end make a hole B.

Taper the other end truly and centrally to about the 1/16th of an inch in diameter, leaving it the same thickness for ½in. up. I imagine very little difficulty will be experienced by anyone in making the other parts. The bar D is made somewhat in the form of a spokeshave, and has a hole drilled through its centre, through which the rod passes freely. The disc E should be made of box, beech, mahogany, or any hardwood, and should be about 3in. in diameter, and ¾in. thick. This forms a sort of light flywheel, and is fixed on simply by driving the rod through a hole in the centre. The strap or thong c should be of flat, *pliant* leather, about ¼in. broad and ⅛in. thick. It passes through the hole B and through the holes in the bar, and is knotted underneath. The action of the drill is this:—Being held upright in the hand, the fore and middle fingers are placed on the bar at D, which, after being revolved a few turns to coil the strap round the steel rod, is pressed gently down and allowed to rise again easily. By this action the strap is again coiled on the rod, but in a contrary direction, and so, with a steady and light up and down motion, the drill is rapidly revolved. A little practice is necessary to manage the recoil nicely, so a broken platter should be operated upon first. The drill should be constantly lubricated with either oil, soapsuds, or turps. In a future letter I hope, with the Editor's permit, to go into the subject of drill and chamfer making, and give, *as far as I am able*, practical instruction how to shape and temper the various kinds in use among clock and watchmakers, premising that in doing so I shall be able to give something useful to young hands and amateurs.



Alfojoe.

METALLIC COPPER IN WHEAT AND OATS.

[20555.]—In "Scientific News" column in last issue you notice the discovery of M. J. Van der Berghe of metallic copper in wheat and oats. Now might not the appearance of copper be attributed to the dressing of the seed, before sowing, with sulphate of copper, in the proportion of 1lb. to three bushels of seed, in order to protect it from the wire-worm and smut? It would be interesting to know more of this.

J. Rochard.

TRAIN INDICATORS.

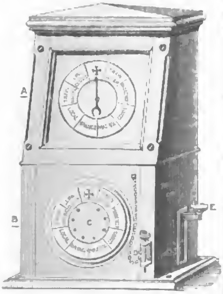
[20556.]—Several instruments have been invented, and are in use for the purpose of enabling a signalman to indicate to another signalman the description and destination of a train approaching his junction, so that the "be-ready" signal may be forwarded in the proper direction.

The recent article in the *Times*, and the correspondence which followed, showed that much of the "whistling" at crowded junctions might be avoided, and many mistakes prevented, if proper train-indicators were used.

The following diagram illustrates the Tyer's train-indicator, which I find in practice is perfectly accurate and reliable.

The apparatus consists of a receiving-dial (A), and a transmitting-dial (B). Upon these dials any signals are enamelled suitable to the requirements of the particular traffic of the railway.

The transmitting portion of the apparatus has a central metal ring (C) with holes corresponding to the signals. A small peg (D) is provided, which is inserted in one of these, according to the signal to be sent.



On the side of the instrument there is a lever (E), which being depressed causes the commutator within the instrument to rotate until the signal required to be sent is reached, when it stops.

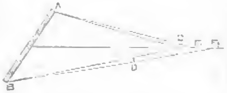
As soon as the commutator begins to rotate, the zero-cross drops, and a red disc takes its place: but upon the completion of the signal the red disc is again displaced, and the "cross" resumes its normal position.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Sept. 15.

ON THE ABERRATION OF FOCUS CAUSED BY A "FLAT" BEING ROUND.

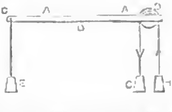
[20557.]—Since propounding the question as to the effect on definition of a curved diagonal mirror I have worked the matter out for myself, and am quite satisfied that even a small curvature would produce much distortion. It is easy to calculate the amount of lengthening of the path of each ray, but it seems to me a little diagram will elucidate the matter better than columns of figures. In the figure herewith I have shortened the focus to save space; but this, except as a matter of proportion, in no way affects the argument. Also for simplicity, I have only taken the central ray and the two from extreme ends of the diagonal. The rays from large mirror are brought to a focus at F. If we suppose the diagonal curved just enough to alter the path of the end rays 1°, then, as the ray which strikes the lower part of diagonal has a greater distance to travel before intersecting the central ray than the ray from the upper part has, it will evidently be further away from it at the previous focus, and consequently intersect at a more distant point. Illustrating by the diagram, the angle betwixt the ray from a perfect plane and the ray from a curved diagonal, will obviously be an angle of 1° at both A and at B. The distance from A to C is exactly equal to B to D, and the two rays from point A will be separated exactly the same distance at C, as the two rays from B will be at D; and while the focus of ray from curved diagonal at A will be lengthened from F to F_1, the focus of ray from B will be lengthened to F_2. Obviously, rays from every intermediate point of the curve will come to a focus, with the central ray at points intermediate betwixt F_1 and F_2, and, instead of a focal point we have a focal line to deal with. It appears to me that in this case a section of the cone of rays, inside or outside the focal point, would be an ellipse. Therefore, any deviation from a perfect plane, however regular the curve, necessitates distortion. I have had a plane in use which gave me the very results I have arrived at here. The section of cone of rays was elliptic, and a star in focus was elongated in the direction of length of diagonal, and no amount of adjustment appeared to alter it.



Edwin Holmes.

DYNAMICAL PROBLEM.

[20558.]—I observe in a recent number a letter from "A. S. L." apropos of the above query, and, although the two cases are entirely different, I wish to make the following remarks upon them.



Let M be the mass of the weight E, and M and M^1 those of G and H, M being the greater. Then, as "A. S. L." says, G descends, H ascend, and although the sum of the masses of G and H, $M + M^1 = M$ the mass of E, yet C descends and D ascends. This, he says, will be apparent on a little reflection.

I, however, think it much better to supply a rigid solution, as it is, apparently, very paradoxical.

Let T be the tension of the string connecting G and H over the pulley when the weights G and H are moving. The resultant force on G downward is $m\,g - T$, and the acceleration produced by this $= g - \frac{T}{m}$. Similarly the acceleration of H up is $\frac{T}{m^1} - g$; and since the string is always supposed to be tight these accelerations must be equal

$$\therefore g - \frac{T}{m} = \frac{T}{m^1} - g.$$

$$\text{or, } \frac{T}{m} + \frac{T}{m^1} = 2g, \; T = \frac{2gmm^1}{m + m^1}.$$

∴ the resultant force downward on the rod C D at D is $\frac{4gmm^1}{m + m^1} = \frac{4gmm^1}{M}$.

Now, if $m = m^1 = \frac{M}{2}$ this $= Mg =$ weight of E, i.e., as it should be, if $m = m^1$ there is no motion whatever; but we know that if $m + m^1 = M$ then mm^1 is always greatest when $m = m^1$ ∴ when it is not so the force down at D is always less than Mg, and ∴ C descends and D ascends.

B. A., Cantab.

[20559.]—Both your correspondents, "Scotch Working Mechanic" and "G. B. T.," are entirely wrong in their theories of the working of the apparatus in 20170. As to the former's: the tension of the rope in his example will be that of the lightest man only when the action of pulling him up is stopped and he hangs in the air; the tension is different when motion is going on. The true tension will be found in my letter, which, I presume, will be published with this one, as it was not last week.

Surely "G. B. T." can see that the resultant action on the axis of the pulley D will be just the same, whether G or H is lightened, and in both cases, of course, D ascends. My other letter will give the true tension of the string round the pulley.

B. A., Cantab.

FEET AND SHOES.

[20560.]—At a recent meeting of the Hygienic Congress, at Geneva, Colonel Ziegler, who is Chief Surgeon of the Federal Army, read a paper on the evil effects of badly-made shoes, with special reference to hygiene and the marching powers of soldiers, which some of your readers may like to hear of. Colonel Ziegler mentioned that the Swiss examining surgeons are compelled to reject every year 800 recruits—the strength of a battalion—for malformation of the feet, resulting from badly fitting shoes. The foot is in reality a bow, so elastic that at every step it contracts and expands, lengthens and shortens, and a line drawn through the centre of the great toe intersects the heel. But shoemakers, who are generally utterly ignorant of the anatomy of the foot, do not give room enough for the lateral extension of the great toe. They crib, cabin, and confine it until it is forced against the other toes. Hence arise frequent inflammations of the great toe, corns, ulcerations, and sometimes veritable articular inflammation. Another evil, which Col.

Ziegler ascribes in great measure to bad shoeing, is flat-footedness, whereby the arch is converted into a straight line, and prolonged walking and marching rendered impossible. Another cause of this defect is the habit of carrying heavy weights at an early age; but in most instances, Col. Ziegler contends, perfect shoes would restore the foot to its normal condition. The first obstacle to a reform in the shape of shoes lies in the fact that it would involve a great expense in the shape of new lasts, an expense that shoemakers are naturally loth to incur. Fashion has also its lasts, and shoemakers consider themselves bound to conform to the prevailing mode. A test of a perfect pair of shoes is that, when placed together, they should touch only at the toes and the heels; the soles should follow the sinuosities of the feet, and to give room for their expansion should exceed them in length by 15 to 20 millimetres. As for military foot gear, the Colonel asked, without answering, the question whether soldiers should wear shoes, "lace-ups," or "bluchers." That is a matter of opinion. Although the principle of the "normal" shoe has been accepted in Switzerland, it is so far without result, for Swiss soldiers shoe themselves at their own expense. The question is, however, being taken up by the Confederation, and a new regulation on the subject is about to be introduced. The only armies in which the normal shoe has been adopted are those of Germany and Italy. In 1876 the government of Baden organised a shoe exhibition, in which the Italian model carried off the honours. The French army is shod on the old vicious principle. The Russian shoe is about as bad as it can be. The ordering of this important article of military clothing should be assigned to the medical staff. The shoeing of children is a matter of great importance, and shoemakers' apprentices should be instructed in the theory of their calling. As further means towards a reform, the Colonel recommends that in all establishments controlled by the State the normal shoe be made compulsory, that military shoemakers be properly instructed, and that in every country there should be a model shoe factory for the making of "physiologic shoes." After Colonel Ziegler had read the paper, Dr. Roth, of London, produced an English-made shoe, which answered to the conditions laid down by the Swiss surgeon, and he contended that for the prevailing defects in foot-gear the indifference of the medical faculty was quite as much to blame as the ignorance of the shoe-making fraternity. Dr. Jeger, the great German authority on clothing and hygiene, called attention to the materials of which shoes are made. The leather, in ordinary use, he considers, has quite as many sins to answer for as the shoes into which it is converted. Instead of tanned and blackened leather, he would have wool, felt, and, above all, deerskin. Of all these he showed specimens, "which appeared rational." After a discussion on the cause of flat feet, Dr. Vallin, of Paris, admitted that in France shoes, for the most part, are abominably bad, and the feet of their wearers almost invariably deformed. The shoes worn by Parisians are, however, not quite so contrary to nature as those worn by Parisiennes, whose aim seemed to be to make their feet resemble in shape the hoofs of horses. In summing up, Dr. Ziegler expressed his regret that fashion was allowed to have so great an influence on the shoeing of human kind, and that in this, as sometimes in other matters, husbands should live under their wives' slippers. J. T. L.

TOBACCO AND BLINDNESS.

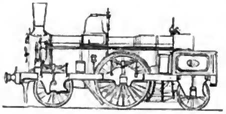
[20561.]—AT the annual commencement of our Hospital College of Medicine, Prof. Dudley S. Reynolds recently delivered an address to the graduating students, in which he took strong grounds against the use of tobacco, which I should be glad to have discussed by some of my English fellow readers. Prof. Reynolds said:—"It is a well-known fact that tobacco deranges the digestion and poisons the nerve centres of a majority of the male members of the human family. A species of blindness, not complete, but partial blindness, sufficiently great in extent to destroy the reading of ordinary type, results from the continued and excessive use of tobacco. Careful investigations have led to the discovery that that form of tobacco habit known as smoking produced the so-called amblyopia. This form of amblyopia is precisely identical in all respects with that produced from the excessive use of alcohol. Both are incurable. I know a number of persons in Louisville who are now practically blind from the excessive use of tobacco. A lady in Portland was forced to admit she had been a secret smoker of tobacco for thirty years. On abandoning the habit, the further progress of her dimness of vision ceased, though there is little or no hope of her regaining that power of perception which she had already lost. She may be considered fortunate in the possession of enough vision to go about and attend her ordinary household duties. Smoking tobacco has never been known to result beneficially to any person in the world. It always lessens the sense of smell and taste; it always contaminates the breath; it always creates an unsteadiness of the muscles, through its irritating effect upon the nerves; and I know from personal experience it diminishes the capacity for mental labour."

Louisville, Ky., September 7. Ky. Sub.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[44505.]—**S.E.R. Single Express Engines**—Having noticed in a back number an article referring to a sketch of these engines, I send one, together with a few particulars, which I hope some correspondent will supplement. I am not aware of the builder of No. 81; but some of the others were built by the Vulcan Foundry Company, Warrington. There is a smaller class of single engines on the S.E.R.; the wheels look about 6ft. in diam. No. 81 has cylinders 16in. by 22in., drivers 7ft. diam., leaders 4ft. 6in. diam., trailers 3ft. 9in. diam. Heating surface. firebox 132·31 sq. ft., tubes 973·01sq. ft.; total 1105·32sq. ft. The engine is fitted with Smith's vacuum brake. I believe the engine use to burn coke; but of this I am not certain.—CLYDE.



[46744.]—**Marble.**—To "MURANO."—The Irish green marble is found in the Co. Galway. Black marbles in Carlow and Kilkenny, and tradition tells us of a vein of white marble, pure as the finest Carrara, lying below the surface, plough deep, in the Co. Wicklow, the proprietor of which will neither use nor sell his rights—thus fully supporting the character of the Irish for ignoring the many sources of wealth and fame which Nature has bestowed upon that lovely "Green Isle."—H. O'B.

[47001.]—**Bread.**—Let me assure this correspondent that what he calls the corrosive poison hydrochloric acid, and the bichromate (meaning bicarbonate, a very different thing) of soda, form, when mixed in the proportions used in bread, the harmless substance, chloride of sodium, or common salt.—F.R.C.S.

[47004.]—**Bread.**—Without expressing an opinion on the different species of bread, there is a remark on the hardness of the bread-crust in the letter of "Du Pain," which I think deserving of more than a passing consideration. I have long been of opinion that the premature destruction and decay of teeth are due, in most instances, to the daily practice of masticating hard crusts of bread which, when continued for years, must have an exceedingly injurious effect upon them by reason of the wear and tear it produces. But this effect cannot be so apparent, because it comes on so very gradually as not to have any assignable cause. Nature has supplied us with teeth only capable of grinding food of a certain degree of hardness, and if we surpass that degree in constant practice, we cannot complain if she sometimes takes vengeance on us by inflicting that very refined species of torture, the toothache. My advice to those habitually troubled with the toothache is to avoid altogether the use of hard crusts and the like, not only when troubled with the teeth, but at all other times, for the toothache is an ailment that very frequently ensues from injuries to the teeth inflicted a very long while previously.—INCISOR.

[47136.]—**Light and Air.**—"J. B." does not state whether A.'s windows have overlooked B. for a period of twenty years or not. If not, B may build right up to them, and any height he likes, no right to light having been acquired; but if so, no obstruction to existing light is allowed whatever. I do not know of any rule with respect to distance; each case has to depend on its own merits. If there is any doubt, an express agreement authorising certain definite obstruction to light had best be entered into, even if compensation for loss of light has to be paid; otherwise heavy legal expenses might very possibly be incurred in fighting a difficult question.—G. A. T. MIDDLETON.

[47239.]—**Deafness.**—I have referred back to this question. If "Politzer" has not tried the effect of repeated small blisters behind the ears, I should advise him to do so.—F.R.C.S.

[47239.]—**Vegetarianism.**—To lessen your bulk, limit the quantity of sugar in your tea, coffee, &c.; avoid sweet pastry; and the less you take of malt liquors the better.—MELIORA.

[47239.]—**Vegetarianism, &c.**—Nay, "Nemo," do not name me! Not I, but a previous paragraphist, asserted that vegetarians were "thin, spare people." I neither deny nor affirm it, because I observe that of my acquaintances who diet themselves after that fashion about an equal number are "stout" and "spare," but I always consider that the latter class have the advantage of greater wiriness. However, this does not depend upon the kind of diet adopted, but on the fact of eating just enough to supply the wants of the individual's system, all the food so taken being assimilated, and none left to form superfluous fat. I do include milk and eggs in vegetarian diet. My experience is not the same as Edwin Holmes. I have, in a fairly prolonged life, met with many young children who do not relish animal food, but eat it under visible protest because they are told to by parents or caretakers; besides which they are very noted imitators, and mostly adopt the habits of adults by whom they are surrounded. Many housekeepers who are not vegetarians ought to thank "M. B." for the useful hints given about cooking nice, tasty little dishes, such as are often required to fill a corner; but when I hear talk of "a tin of tomatoes," I am ready to query if fresh ones are not better? A sea-captain told me that he had, on a long voyage, proved that "tinned" (or "canned") vegetables were not of the least use as ship stores, and did not prevent attacks of scurvy; since when I have always been suspicious of them, and never try nor recommend them. I have been told that the green peas served to us in eating-houses in London are really "tinned," and therefore not nourishing. And to C. L. Hart still further thanks are due for his recipes; but for one who exhibits so much good sense in this direction I am surprised to find him a "beer-drinker." In these enlightened days he should, years ago, have learned the fact asserted by a brewer in Lancashire fifty years back, that the notion of beer containing nutriment was "a great delusion," and asserting that a gallon of his "best" would not be found to give more strength to a working man than a pennyworth of bread! If Sir Wm. Gull is satisfied with drinking "Water! yes, my lord, London water," why cannot others follow his example? [See his examination before the Special Committee of the House of Lords on Intemperance.] May I entreat this, "our" correspondent, to take a glass of hot milk at lunch instead of beer or ale, and a cup of Liebig, hot, as a "nightcap" instead of his wonted allowance of brandy? But why should any diner in London be at a loss for a palatable and wholesome meal so long as the market is supplied with fish? We country folks stand aghast at the waste of valuable food at Billingsgate nearly every day whilst the toiling and over-worked men (and women) of business are suffering for want of just the very, very nutriment which fish—*white fish*—supplies to the brain and nervous system! Will C. L. H. take this hint, and let "ours" have the benefit of his experience in a month hence? I do not know London well enough to say that there is no "good vegetarian cooking" to be found there—in fact, I have never yet taken the trouble to try. A non-resident like me seldom has much spare time there. Incidentally, I may remark that I have found more than one place where they do know how to cook sole, &c. Improving upon the Farringdon-street "vegetable-marrow roast goose," my sister-in-law, whose house is my present home, prepared a dish (No. 911, p. 17) next day, to wit, a vegetable marrow, one end cut off to get seeds out, replacing them with a very fine mince of sage, onion, crumbs of bread, and bits of butter, nicely seasoned, then baked the whole. We all partook of the "roast goose"; and if the dish did not find itself ticketed with a "first prize," it certainly did deserve to be "highly commended." We are promised another one some day soon, to be first half-boiled, then browned in the oven, to ascertain which way is best. Let us not forget that useful root the turnip, the which, though so watery, when properly cooked, that is, just enough and not too much done, either by boiling or steaming, possesses several valuable properties. The raw turnip (I believe a nice Swede is best) cut into slices and well sugared, is a speedy cure for a cough—it may be eaten without regard to either quantity or time—only use enough. I cannot see any connection between vegetarianism and "deafness"; and think the latter subject very properly passed over: inasmuch as the ear is the most delicate organ of the body, therefore best not meddled with. However, I may safely recommend a good steaming over a vessel of boiling-water, repeated successive days, from fifteen to twenty minutes at a time; then a sponging with cold water, and a good, vigorous, yet gentle, dry-rubbing with a fine towel.—H. O'B.

[47345.]—**Boomerang.**—Some years since I made numbers of boomerangs, and after a little practice did not find any difficulty in throwing them. The only thing I found wrong was that the wood broke at the elbow if it struck the ground in its flight; but this I got over, and will now give our friends the information, as they are very easily made, and afford great amusement, and I may say astonishment, to watch their flight. Take a piece of say ⅜in. board—deal will do if close-grained; cut out to shape of boomerang, then cut a groove ⅛in. deep all round edge with a saw; into this groove insert a piece of steel wire, music wire is best, drive a small tack at, say, every inch, round off the edges and make them ¼in. thick; then give over all a good coat of glue; if properly done the steel wire will take all the strain, and boomerang will stand any amount of rough usage.—Marlow.

[47374.]—**Varicose Veins.**—A properly applied bandage, either elastic or otherwise, with a small pad of wet linen over the vein if ulcerated, is required. Standing still is the worst of all positions for this state of things.—F.R.C.S.

[47401.]—**Coil (U. Q.)**—The paper tube described in my coil (March 10th, 1882, p. 15) is correctly fixed to insulate the primary from the secondary wires, and should not be fixed around the wire bundle, as "W. R. C." mentions. The wire bundle only projects through the ends.—J. N. Andrews, Plymouth.

[47459.]—**Silvering Looking-Glasses.**—I regret that I am unable to describe the process followed commercially for silvering with pure silver. It is a trade secret. In the question of cost I refer both to actual cost and to charge made; but as this varies with different sizes, and both as done by and for different people, and also as it is in "charge made," a trade question, I must ask "J. T. M." to excuse my replying more definitely.—E. Holmes.

[47459.]—**Silvering Looking-Glasses.**—As this question seems to be of considerable interest to some of your readers, I send you a description of a simple method of silvering which forms the subject of a patent granted this year to Mr. J. E. Pratt, of Flodden-road, Camberwell. No special solution is described, any of the ordinary solutions being suitable. The success of the process depends upon obtaining a regular deposit over every part of the glass, and the method of doing this at present is to have a large and perfectly level table, upon which the glass to be silvered is placed. Round the edges of the glass are placed rails of wood to confine the liquid, whilst the silver in it is being deposited upon the plate. So important is it to get an equal deposit, that means are used to ease up by wedges any hollow part of the glass lying on the table. Tables have been used which were supported on a frame with trunnions on a suitable stand, so that the liquid could be rocked to and fro, but the expense of the process was too great. A much better deposit can be made, much more quickly and with very greatly increased economy in the manual labour, by the following method. A fixed incline of about 1in. in a foot inclination is covered with the usual covering; upon this is placed the glass to be silvered; the sides of the inclined bed are raised to prevent waste of liquid, and at the bottom of the incline is a trough with an inclination to one of the lower corners of the incline, so that the liquid escaping over or running down the incline can be brought to this corner, or nearly so, and a small outlet in the trough will conduct the liquid into a jug placed there to receive it. The incline bed is heated by steam, or other suitable means, and the glass to be silvered being placed upon it, the workman takes a jug of the prepared liquid and rapidly pours it over the top edge of the glass plate, the object being to cover all parts of the plate as quickly as possible. As the liquid escapes by the outlet described, it is caught in the jug, which is then taken by the workman and replaced by the now empty jug first used, and so alternately. In this way an almost constant stream of liquid is flowing over the surface of the glass plate, and the deposit of silver takes place quickly and evenly. It is said that there are very great economies resulting from this invention. 1st. In the quantity of solution used for covering the plates. 2nd. In the more evenly distributed film of silver, and in the greater solidity and firmness of the deposit. 3rd. In the saving of manual labour employed; and, 4th, in the saving of time; a few minutes sufficing to complete a very large plate. It will be seen that the principle of success in this invention depends upon the fact of giving the plate such an inclination that the solution flows over rapidly, and can be caught quickly and repoured over the plate. The deposit forms quickly, evenly, and with little labour. It is evident that these conditions could be secured by the glass being held at the required inclination, or suspended in a frame, means being taken to prevent the liquid escaping over the sides, and the under side of the glass could be warmed by steam or warm air or water, by jets or otherwise. Can any of your readers say which would be the best solution to use with this process, and how many times it would be worth while pouring the same jugful over the glass?—S. G.

[47486.]—**Euclid's Axioms.**—If Mr. Romanes will write out in full his algebraical proof for deducing axiom (3) from axiom (2), I think he will find that he is assuming the following axiom: "If to each of two given quantities equals be added, and the results are equal, then the given quantities are equal." Consequently he is not reducing the number of axioms.—C. W. B.

[47486.]—**Euclid's Axioms.**—The $A + B = C + D$ of my reply on p. 18 should have been, $A + C = B + D$. Mr. Romanes seems to forget that algebra is based on axioms as well as geometry. "Since we do not know the truth of axiom (3), nor can it be applied?" That is exactly what I maintain. Mr. R. fails to see that; nevertheless, he does apply it in his proof.—A. J. Smith.

[47553.]—**Problem in Dynamics.**—"Who shall decide when, &c.?" Mr. Romanes makes the ball descend; "Dubliniensis" and "Vesuvius" think it would ascend, while "Tam O'Shanter" and "Scotch Working Mechanic" will have it that it would remain at rest. Surely, at all events, the last and "G. B. T." both propound Dynamical heresies in their letters on p. 39. For, if G and H be unequal masses, will not the tension of the cord on each side of D be $= 2\,G\,H / G + H\,g$; and therefore the total downward action, always through D, be $= 4\,G\,H / G + H\,g$, which is less than $(G + H)\,g$, and therefore by assumption less than Eg?—A. J. Smith.

[47573.]—**Model Locomotive Boiler.**—I should make the connection between a flat top outside firebox and boiler thus: Get a piece of sheet copper, the same shape as the back-plate, and flange it on the top and sides in the same way to fit inside top and sides of box; then cut out a hole at the top about ½in. less in diameter than the barrel of boiler, and flange this in the opposite direction, so that the barrel will fit inside (see sketches). If you think it is too difficult a piece of work, you could make a pattern of it, and have it cast in brass; the circular flange could then be turned in the lathe to fit the barrel exactly. It is a pity you cannot get the ⅝in. tubes of the proper thickness, ⅜in. or 7-16in. would do, if not more than 1-32 thick; but you will have to sharpen the blast a little to get a good draught.—E. L. P.

[47575.]—**Electric Pendulum.**—You can easily make an electric pendulum; but first of all you must determine the size of clock you wish to fit the pendulum to. Let me have full particulars of the clock you have or intend making, then I will give you all the information you want as to size of bobbin, wire, connections, &c.—W. J. Lancaster.

[47589.]—**To Mr. Lancaster.**—The revolving discs are, of course, the principal feature in machines of the Holtz type, of which there are many; but as to its practical application, this is another question altogether. If you mean for the production of the electric light in any form whatever, this form of electricity is useless. You may charge Leyden jars, fire fuses, and do a lot of experimental work with the electricity produced by frictional machines; but this is altogether different to the voltaic or dynamic electricity one wishes to use in so many different ways.—W. J. Lancaster.

[47604.]—**Bicycle Tires.**—I put on tires in the following way:—Take a piece of cement and hold in the flame of a candle, and keep dabbing in the groove until it is fairly covered with cement; then allow it to cool; then put on the tire, taking care that it is equally stretched all round; next take a spirit-lamp, with rather small flame, and warm the felloe all round, bit by bit, until the cement oozes out, if there is sufficient of it to do so. When cool, trim off the cement which has oozed out with a warm knife, and the thing is done.—T. H.

[47633.]—**Bird-Stuffing.**—The best way to relax skins is to wrap them in a damp towel; but, perhaps yours have been badly preserved, especially as you say they go rotten when made soft enough in damp sand.—M. T.

[47643.]—**Spiders.**—Sir John Lubbock is, I have no doubt, occupied too intently watching out some of the functions of the bee, wasp, or ant, to be able to notice any query in the English Mechanic. I have watched spiders, and have passed many an hour with them, until I almost could believe they knew me, and that they had much more intelligence than people gave them credit for. I have seen them fly, as some people call it, and this is the way they do it. The spider can determine the direction of the wind, and he can foretell the weather (by the bye, better than the weather bureau in London). In the early morning of a fine day, he may be seen climbing the side of a tree to leeward, and when he has reached a position sufficiently high to fly his kite-string (but no kite), he will spin a very fine thread, and I believe from only one of his spinnarets, and I also think that the thread contains very few filaments compared to his usual thread. This thread floats on the wings of the wind, and is lengthened slowly by the spider until he feels that he has a bite; in other words, the end of the thread has attached itself to something in its way. The spider then pulls it to see or rather feel that it is firm; he then runs along it, thickening it with some extra filaments. If the spider has no firm base to work from, he will spin a short line and hang on this while he sends the thin line out, and he will hang apparently motionless until he has succeeded in making an attachment, when he will traverse the new line.—W. J. Lancaster.

[47652.]—**Faure Accumulator.**—You have them about the right distance, but, if carefully insulated one from another, they may be closer. Perhaps the opposite plates are connected in some way, as "lead trees" are apt to form across if there is the slightest flaw in the flannel cover. Several forms of accumulator have been described in back volumes.—E. G. M.

[47652.]—**Faure Accumulator.**—I have given up accumulators as a bad job. I cannot make them succeed as I would wish, and to lose 50 per cent. of current in storing is more than I care to lose when there are other and simpler ways open for the generation of electricity. Still, you should get 50 per cent. of the current out that you put into the accumulator, and you should not lose the charge so quickly as you seem to have done. The accumulator should work better the longer you keep it in action until it gives out its maximum, which I have never found more than 50 per cent. of the current put into it.—W. J. Lancaster.

[47656.]—**Woollen and Worsted.**—Is not the difference between these just simply that between short and long staple wool? In the former case the wool is short, and is milled and fulled; in the latter it is long, and is drawn out and spun.—T. P.

[47659.]—**Tricycle.**—Inferior metal, weakened at the screw. The wires may be 10, but if a screw is cut into them they are very much smaller, unless the ends have been upset sufficiently to take the thread.—Coventry Rotary.

[47660.]—**Metallophone.**—There is nothing in the market to exactly suit M. P. Robin, but he might have instruments constructed on the plan of the piano harp, or real harmoniums with the percussion action, using only the latter for the pianoforte practice.—Organon.

[47661.]—**De-alcoholised Wine.**—Boiling will drive off the alcohol from wine, and also the flavouring ethers. In fact it would simply spoil it. "G. T." will derive more benefit from the use of unfermented wine, if he can get it, but it will puzzle him to keep grape juice unfermented for long. The statements quoted are, of course, rubbish.—T. P.

[47665.]—**Government Inspector of Mines.**—This querist should procure some of the text-books or crambooks used by the teachers of classes and their pupils. Also copies of examination papers. There is, I believe, a very good school at Bristol.—Cambria.

[47672.]—**Limelight.**—You will require air-tight bags, capable of bearing a pressure of 500lb. on each bag, although 180lb. will be the utmost you would use on them; still, they ought to be strong enough to bear three times as much. Then you will require a jet with platinum nozzle, pressure boards, and tubing, retort and purifier. These will take you some time to make, and would, I am afraid, prove useless when made, unless you had someone with you to give you hints and assistance. I shall be pleased to help you, if you wish to make the apparatus.—W. J. Lancaster.

[47674.]—**Electrotyping.**—No doubt you have succeeded in doing what you wished to do. If not, let me know, and I will tell you a simpler method than the one you have tried.—W. J. Lancaster.

[47675.]—**Vacuum Gauge.**—To Mr. Lancaster.—You can make a vacuum gauge out of a piece of glass tubing one-eighth inch bore, and before being bent 14in. long; then in a Bunsen's flame bend the top part down at a point 4in. from sealed end. Having bent this to form a U, then bend the other part up again, so that you will have two bends and, of course, three tubes close together. The open end must be firmly cemented into a brass screw, fitting air-pump plate. Then fill the terminal leg of gauge with mercury and gently heat the tube until you have, by repeated tapping, removed all air-bubbles. Now screw into air-pump plate, and if all is sound the mercury will fall in closed leg and rise in the other until both surfaces are level.—W. J. Lancaster.

[47698.]—**Bunsen Battery.**—To Mr. Lancaster.—The white crystals are sulphate of zinc. Wash out the cells with warm water, and put porous cells into boiling water, leaving them in for some hours. Clean the zincs well in hot water, and scrub with sand until nearly clean, then wash and amalgamate them. If you scrub the zincs well with sand and warm water you will save a lot of mercury and really preserve the zincs, the dirty spots won't amalgamate, and so become centres again for decomposition when battery is again charged.—W. J. Lancaster.

[47743.]—**Discharge from Egg-shaped Sewers.**—I am obliged for some of the information given by Mr. C. H. Romanes in answer to my query respecting the discharge in egg-shaped sewers; but surely if the formula given by me $Q = 19{\cdot}32\sqrt{d^5\frac{f}{l}}$ be correct for litres per second, that given by Mr. Romanes as discharge in cubic feet—viz., $35\sqrt{d^5\frac{f}{l}}$ must be wrong. I fail to see why the formula should alter, as in the first case the diameter, fall, &c., would be in metrical measurement, whilst in the latter in feet, therefore the coefficients should be the same. I must confess, between the two, I am more in the dark than ever. By perimeter of large end, Mr. Romanes evidently means "lower end," for that of the larger one would be half the circumference of larger diameter, or 1·57079.—Etna.

[47757.]—**Manganese.**—"M." is, of course, perfectly right about the oxides of Mn. My error (which I detected immediately I saw it in print) was one of the eye, not of the brain, and few persons with any knowledge of chemistry would be misled by it. What I intended to have said was that all the higher oxides of Mn are reduced by a red heat to MnO (not MnO_2). I am quite aware that MnO_2 is the highest, and Mo_2O, the lowest mineral oxide. But since "M." expresses a doubt as to the practicability of obtaining the metal in the manner I mentioned, I feel bound to describe the process more fully. It is supported by Profs. Roscoe and Schorlemmer, and is given as the best method of preparing the metal by Hugo Tamm, who has made a large number of experiments on the preparation of the metal on a large scale, and a description will be found in the *Chem. News*, 1872, III. A flux is prepared of 20 parts of soda-lime glass and 7 of fluor-spar; 6 parts of this mixture are then added to 1 of lampblack and 11 of MnO_2. The mass is heated in a plumbago crucible lined with a mixture of 3 of graphite and 1 of fireclay, and this is then intensely ignited in a wind-furnace. A green slag, termed "green flux," is obtained in this operation, together with metallic manganese, and this flux serves for a fresh operation. This impure manganese, termed cast manganese, when fused with half its weight of $MnCO_3$, yielded a product possessing the following composition:—

Manganese	99·910
Iron	0·050
Silicon	0·015
Carbon	0·025
	100·000

—C. Harris.

[47867.]—**Magnetic Sands.**—I observe Mr. Allen's reply (p. 15) about titaniferous magnetic sands, in which he says they are "wholly useless for making steel or any similar purposes." I find that the use of the titaniferous steel sand of Taranaki, in making triple alloys, has been patented in this country by Mr. G. Scott (No. 620, 1882). In the specification it is stated that the economy and advantage in the method of manufacture is effected by using the titaniferous steel sand of Taranaki and other places in New Zealand where such quality of sand may be found, instead of ordinary iron reduced to a granular state, the process of granulating ordinary iron being both troublesome and costly, whereas the titaniferous steel sand is supplied by nature in the required form for the manufacture of spiegeleisen and ferro-manganese, and the cost and trouble of granulating iron is avoided. The titaniferous steel sand is used instead of granulated iron, combining the same with manganese and carbon. The several constituent parts being reduced to a granular state are mixed in proportions regulated by the actual amount of metallic manganese contained in the peroxide of manganese, the actual amount of metallic iron or steel contained in the titaniferous sand used in forming the alloys either of spiegeleisen or ferro-manganese with a proportion of carbon. The mixture of these constituent parts having been effected, the same is placed in graphite or plumbago crucibles or similar vessels, the surface being covered with powdered glass or silicious sand or other like substance. In this state the contents are submitted to the action of a furnace, and raised gradually to a high temperature sufficient to effect the fusion of the mixture. The employment of the titaniferous steel sand in the place of granulated iron reduces greatly the cost in the manufacture of both spiegeleisen and ferro-manganese. An adhesive carboniferous solution may be made of sufficient consistency to combine by admixture the constituent materials of manganese and the titaniferous steel sand into a substance capable of being moulded after the manner of a brick, then dried and afterwards submitted to a furnace for fusion. Perhaps Mr. Allen will say, for the benefit of the original querist, whether there is a probability of using the sands indicated in the way described, of course with commercial success.—An Old Colonial.

[47878.]—**Electro-Gilding.**—To "Os."—A hot solution will certainly soften shellac varnish; but as gilding requires a very short time, I think it can be done without the varnish coming off, especially if the scratch-brush is not used till the operation is finished. The varnish can be removed with methylated spirits if the shellac will not do. Try black japan well baked on. This can be removed with turpentine.—Os.

[47879.]—**Silversmiths' Work.**—The hammering or facets I speak of are put on after they have been into the polisher's hands. It is the new style of ornamentation. I have done it with a small round-faced hammer, but it looks like so many dents. I have some work shown me manufactured in France, of the same finish, which looks neat and regular, the same inside as out, and the article is not put out of shape by finishing. The work consists of bag fittings (tops).—George Eversley.

[47892.]—**Pianoforte Hammer Covering.**—The slip of felt should be first prepared by slightly shaving the edges with the trimming-knife; this will cause it to fit more neatly into the nick at the top of the hammer-head, and also facilitate the bending over. It should then be cut into strips a little wider than the hammer (perhaps about ¼in. in width), and the end intended for the nick glued in first, fastened with tape, and so continued throughout. The lower part should then be glued, carefully missing the portion just under the blow, the felt tightly pulled over, and a few turns of tape passed round while it is held in its position with the fingers. As the success of the operation depends almost entirely on the firmness of the covering, too much care cannot be taken that it does not slip at this time through the fingers; should it do so, it is better to begin the pulling again, as no after process will make up for a flabbily-covered hammer. The hammers first covered will, on their completion, be ready for trimming with a thin sharp-bladed knife. If a decent quality of felt is employed the toning needles will scarcely be required; but if the tone is found to be a little hard in parts, it may be softened by a few straight pushes of the needles just at the round of the hammer. This will soften the felt without tearing it, and is the only way of producing a lasting mellow tone. The treble portion will often need brightening by the use of a hot iron; but in this, as in the softening, the taste of the operator will be the best guide.—W. H. Davies.

[47902.]—**Preventing Silver from Tarnishing.**—I should use a saturated solution of the hyposulphite of soda—i.e., as much of the soda as a given quantity of water will dissolve. Use water—not spirit.—J. W. Bond.

[47902.]—**Preventing Silver from Tarnishing.**—Use a saturated solution—that is, as much of the salt as the water will dissolve. It does not say it will prevent the tarnishing, but implies that the tarnish can be easily removed, and that, consequently, there is little trouble in keeping the things bright.—T. P.

[47904.]—**Thorough Bass.**—I should recommend "Musician" to get Hamilton's "Catechism of the Rudiments of Harmony and Thorough Bass," published by Messrs. R. Cocks and Co., Princess-street, Hanover-square, at 2s. You can obtain it at any good music-seller's. There are several books by the same author on counterpoint, melody, and several subjects for the pianoforte student, which will be necessary for you to study if you wish to understand the subject thoroughly.—J. W. Bond.

[47907.]—**Problem in Co-ordinate Geometry.**—Would "Milverton" kindly favour me with at least the principal steps in his investigation? Would not the equation he obtains assume a simpler form if the origin were taken as I suggested at the point where P meets OO'? I should have said more explicitly at the point between O and O' where P meets OO'; the other meeting points lie in OO' produced. The curve would then pass through the origin. Or course, in the particular case supposed, this point would be the middle point of OO'. Could "Milverton" further oblige me by showing what value of l (in the particular case) would make the deviation of the looped part of the curve from a straight line least—would in fact most nearly realise Watt's parallel motion, d and r being given?—A. J. Smith.

[47907.]—**Problem in Co-ordinate Geometry.**—The results given by "R. E. B." and "Milverton" are very interesting, especially the former, as the equation is symmetrical in all its details; but whether the curve could be drawn from this equation is another matter. Unless we can get the explicit value value of x in terms of y, we could not do so, except by a process of trial and error. Am I right in saying that there is no known method of obtaining explicit values of x or y from an implicit function when the higher powers of these symbols are involved? There is one problem to which this equation might be applied with some prospect of solution, I mean the "Funicular Polygon." This is a favourite problem of mine, and about fourteen months ago I wrote a paper on the subject, which was printed in this journal. The simplest form of the problem may be illustrated with a piece of string of known length, the ends of which are attached to fixed points of known distance apart. Two known weights are then suspended to the string at known distances from each other, and from the fixed points, and we require to find the position of the whole when at rest, either by finding the angles or ordinates from a fixed point. Now, it will be seen that if we find the centre of gravity between the two weights, and set the whole arrangement swinging from side to side, the centre of gravity will describe a curve, and the equation to this curve will be that which has been arrived at by "R. E. B." and "Milverton," the origin being half-way between the points of support. When the string and weights have come to rest, the centre of gravity will be at the lowest point of the curve, or at its furthest point from the axis of x, and, therefore, y will then be a maximum, and by the differential calculus $\frac{dy}{dx} = 0$. Also, if all the terms of the equation be brought to one side, and the expression called u, then $u = 0$, and $\frac{du}{dx} = 0$. The equation given by " "R.E.B." is not a difficult one to differentiate, and I am therefore in hope that some result may be arrived at by working with the original equation and its differential; but whether it is possible to find the value of x or y from these two equations remains to be seen. Will "R. E. B." or "Milverton" kindly look into this, and say whether anything definite could be arrived at?—M. I. C. E.

[47909.]—**Engineering.**—I beg to inform "Theta" that he will find "Civil Engineering," by Henry Law, M.Inst.C.E., including "A Treatise on Hydraulic Engineering," by Geo. R. Burnell, M.Inst.C.E., sixth edition, revised, with large additions on "Recent Practice in Civil Engineering," by D. Kinnear Clark, M. Inst. C.E., author of "Tramways; Their Construction," &c., a capital book for the purpose required. It is published by Messrs. Crosby, Lockwood, and Co., 7, Stationers' Hall-court, London, E.C., price 6s. 6d.—F. Everitt.

[47913.]—**Electric Bath.**—The bath need not be copper, the Rufford (pot) is preferable. Salt is all you require to put in the water, if you use a voltaic battery; if a Faradaic battery use water only. The cost of batteries depends on the size and kind. Most good medical batteries are fitted with a disturber and reverser, so as to change poles without disturbing the patient; the current should be shut off before reversing. The Leclanché is the best medical battery. If "Au Revoir" will advertise his address in the English Mechanic, I will write him and give him full particulars.—James Reynalda.

[47916.]—**M. R. Engines.**—The tank engines which "Camomile" mentions as having steam-brakes only, are also fitted with the Sanders injector for working the vacuum brake with a train, but the vacuum brake is not applied to the engine wheels. Can "Camomile" say if Smith's vacuum has been removed from tank engines 786, 789. Most of the 800 class have been rebuilt with cylinders of different sizes. The original engines have cylinders 17in. by 24in. Nos. 801, 806, 808, 809 (rebuilt 1875); 802, 22, 60, 65, 138, 139, 165, 169, 810, 817 (1876), have cylinders 18in. by 24in. Nos. 800, 804, 805, 807, 811, 813, 814, 816, 818, 819 (1877); 803, 815, 829 (1880), have cylinders 18in. by 26in. Will Camomile" state if Nos. 62, 64, 167 (rebuilt 1882), have had their cylinders enlarged? "Camomile" has omitted Nos. 165 and 166, There are 43 engines of the so-called 890 class. 23 engines were built at Derby in 1872-4 of this class. They differed from 890—909 in the trailing splashers. Their Nos. are 92, 148, (1872), 7, 48, 72, 120, 124, 125 (1874), 46 (rebuilt 1875), 41—45, 47 (rebuilt 1876), 2, 5, 12, 19, 21, 40, 49, 95, and 131 (rebuilt 1878.) I have given 24 engines; either 46 or 148 ought to be omitted. No. 148 has Mr. Johnson's dome and valve, but the date is 1872.—Metron.

[47920.]—**Westinghouse Brake.**—The stop-cocks at the ends of the vehicles are used to open or close the main brake-pipe: they must always be opened after the hose-couplings have been united, and closed before they are separated. Before starting from a terminus, after adding to a train on the journey, or when another engine has been attached, the rear guard must ascertain if the couplings have been connected and the taps opened by the porters, by applying the brakes from his van and seeing that they are released by the driver from the engine. He should also observe the pressure gauge.—Clement E. Stretton.

[47921.]—**Brake Trials upon the Midland Railway (1870 to 1877).**—The following table I have compiled to give the information desired by

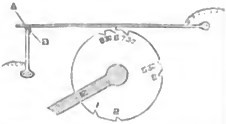
"A Driver." Several of the experiments I witnessed, and shall be happy to furnish any further details. In addition to trials made with special trains, some of the brakes have been tested in ordinary working between Bedford and London, Bradford, Leeds, and Skipton, &c. :—

DATE.	NAME OF BRAKE.	WHERE TRIED.
April, 1870 ..	Wilkin and Clarke's	On the Lickey Incline, Birmingham and Gloucester Line.
March 18, 1873	Westinghouse Air	Between Melbourne and Trent.
March 21, 1873	" "	" Chellaston and Castle Donnington.
March 21, 1873	" "	" Melbourne and Trent
March 22, 1873	" "	" Melbourne and Trent.
May 21, 1873..	" "	" Hendon and St. Alban's.
April 10, 1874 .	" "	" St. Pancras and Bedford.
March 13, 1875	Clarke's Hydraulic........	" Derby, Trent, and Castle Donnington.
March 15, 1875	" "	" Derby, Trent, and Castle Donnington.
June, 1875....	Westinghouse Automatic .. Barker's Hydraulic ...... Clarke's Hydraulic........	The Newark Trials — between Newark and Thurgeton.
Aug. 26, 1875.	Barker's Hydraulic	Between Chellaston and Castle Donnington.
Sept. 16, 1875.	Westinghouse Automatic ..	" St. Pancras and St. Alban's.
Sept. 21, 1875.	Chatelier's counter pressure and hand brakes	Derby, Castle Donnington and Trent Line.
Sept. 22, 1875.	Kitson's steam, and ordinary hand brakes	Derby, Castle Donnington and Trent Line.
Feb. 9, 1876 ..	Kitson's steam, and ordinary hand brakes	Derby, Castle Donnington and Trent Line.
March 14, 1877	Smith's Vacuum	At Derby.
March 15, 1877	" "	Derby, Trent and Castle Donnington Line.
March 16, 1877	" "	Derby, Trent and Castle Donnington Line.
March 20, 1877	" "	Derby, Trent and Castle Donnington Line.
May 10, 1877..	Westinghouse Automatic..	At Derby.

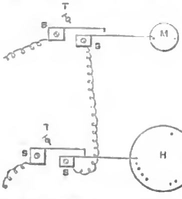
—CLEMENT E. STRETTON.

[47925.]—**Electric Engine.**—You have nothing to do but attach one end of a beam to an armature, and the other to a crank turning a flywheel. The armature is pivoted at one end, and is pulled down by the magnet, and, at the instant of contact, the circuit is broken, and the flywheel brings up the armature again.—T. J. P.

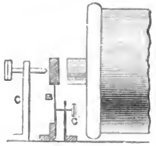
[47927.]—**Electric Time Signals.**—You want a disc, about 2in. diam., fastened on to the shaft of hour-hand, so that it revolves once in 12 hours, and notched about ⅛in. deep, to allow the pin of contact-rod to drop, and make contact at A B. Divide the disc into 12 equal parts for the hours, and half the spaces for the half-hours, and number them as shown in sketch; and when fixed, the centre of hour-hand should always be over the figure 12. Carry the wire from battery to contact-rod as shown, and not through the joint. Of course, this will ring bell all through the night; but you can switch it off after 7.30 p.m., and on before 8 a.m. But if this is unsuitable, you could make the disc revolve only once in 24 hours, and you must divide and notch to suit, so that more than one half of disc would be blank. The contact-rod you must shape to circumstances, and make the minute and hour hands coincide.—WALLINGTON.



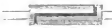
[47927.]—**Electric Time Signals.**—If "Time Keeper" will put two pins in his minute-wheel and le them lift a light spring, he will then have a contact maker every half-hour, and on his hour-wheel put a pin to suit the hours he wants signal for. Let him count the teeth and divide that number by 12. He will then have so many teeth for each hour. Mark one tooth and call it 12, and then at equal distances, say, 1, 2, 3 up to 12 again. Miss pins at the hours he has no use for, and when he wants half-hour signal he must have another pin half-way between that and the next hour. I send sketch, which will, I think, give him all he requires, providing he has a little knowledge of clock-making and electricity. M, minute wheel, with its 2 pins; H hour wheel, with its pins; S are light brass springs, to be lifted by the pins in wheels; T are adjusting screws. He must, of course, insulate his spring studs from his clock-plate.—J. T. S., Sheffield.



[47934.]—**Induction Coil Failure.**—Cannot you pass a current through your primary at all? If not the wire is disconnected somewhere, and must be unwound. You appear to have over-insulated the work. Sketch of contact breaker inclosed. A, core; B, armature and spring; C C₁, two regulating screws; screw C stops spring B from breaking contact too soon.—H. STOOKE.



[47937.]—**Electro-Motor.**—Commutator is two short pieces of brass-tube, filed half away, for ⅞ths of the length, fitted tight on wooden cylinder. Connections—entering at top S. hole in diagram to top N. pole, then to lower N. pole from lower S. pole to commutator-spring, through armature and out at other spring. Wire, No. 26 cotton. The rule has been given often as to amount of wire for good magnet. It must lie as deep as diam. of magnet. The F.M.s being flat, it must be as deep as their thickness.—CONRAD.



[47940.]—**Mathematical.**—In questions (i.) and (ii.), which are the same, we have $ax + bx^3 + \ldots = \log. \tan. (\frac{1}{4}\pi + \frac{1}{2}x) = \frac{1}{2} \log. \frac{1 + \sin. x}{1 - \sin. x} = \sin. x + \frac{1}{3} \sin.^3 x + \ldots$; hence, assuming an imaginary angle θ, such that $\sin. x = i \tan. \theta$, where $i^2 = -1$, which relation gives also $\tan. x = i \sin. \theta$, we obtain $u = ax + bx^3 + \ldots = i (\tan. \theta - \frac{1}{3} \tan.^3 \theta + \ldots) = i\theta$, by Gregory's theorem. This process reversed gives $x = \tan. x - \frac{1}{3} \tan.^3 x + \ldots = i (\sin. \theta + \frac{1}{3} \sin.^3 \theta + \ldots) = i (a\theta + b\theta^3 + \ldots) = au - bu^3 + \ldots$, as we see on replacing x by θ in the first identity and then substituting for θ its value u/i. The proof is longer if exponentials are directly introduced, instead of indirectly in the assumption of Gregory's series. Further, the first identity gives $ax + bx^3 + \ldots = (x - \frac{1}{6} x^3 + \ldots) + \frac{1}{3} (x - \frac{1}{6} x^3 + \ldots)^3 + \ldots = x (1 - \frac{1}{6} x^2 + \ldots) + \frac{1}{3} x^3 (1 - \frac{1}{6} x^2 + \ldots)^3 \ldots = x + \ldots$, which shows that $a = 1$, and also, since the second set of brackets contain only *even* powers of x, that in the expansion of u only *odd* powers of x will occur. The logarithms are all Napierian. In Question (iii.) the arcs A A′, B B′, C C′ obviously pass through the pole P of the circle A B C when produced. If Q is any point on the sphere distant by a quadrant from A′, then the triangle Q P A gives cos. Q P A′ = − cot. P Q cot. P A′: hence the condition that A′, B′, C′ lie on a great circle is the co-existence of the three equations :—

$$\begin{aligned} \text{Cos. } QPA' &= -\text{cot. } PQ \text{ cot. } PA', \\ \text{Cos. } QPB' &= -\text{cot. } PQ \text{ cot. } PB', \\ \text{Cos. } QPC' &= -\text{cot. } PQ \text{ cot. } PC', \end{aligned}$$

Q being the pole of this circle, and the mathematical form of the condition is the result of eliminating from these equations all terms containing Q. Now

$$\text{Cot. } PA' \text{ sin. } B'PC' = \text{cot. } PA' \text{ sin. } (QPC' - QPB')$$

$$= \text{cot. } PA' \text{ (sin. } QPC' \text{ cos. } QPB' - \text{cos. } QPC' \text{ sin } QPB')$$

$$= \text{cot. } PQ \text{ cot. } PA' \text{ cot } PB' \text{ cot. } PC' \text{ (tan. } PB' \text{ sin. } QPB' - \text{tan. } PC' \text{ sin. } QPC'),$$

and, as this is of the form $k (\beta - \gamma)$, we have by symmetry:

$$\text{Cot. } PA' \text{ sin. } B'PC' + \text{cot. } PB' \text{ sin. } C'PA' + \text{cot. } PC' \text{ sin. } A'PB'$$
$$= k (\beta - \gamma + \gamma - \alpha + \alpha - \beta) = 0,$$

and this condition, since P A, P B, P C are quadrants and A B C a great circle, becomes

$$\text{Tan. } AA' \text{ sin. } BC + \text{tan. } BB' \text{ sin. } CA + \text{tan. } CC' \text{ sin. } AB = 0.$$

In Question (iv.) we have—

$$\frac{a - 1}{a + 1} + \frac{a^2 - 1}{2 (a + 1)^2} + \ldots.$$

$$= \left\{ \frac{a}{a + 1} + \frac{a^2}{2 (a + 1)^2} + \ldots. \right\} - \left\{ \frac{1}{a + 1} + \frac{1}{2 (a + 1)^2} + \ldots. \right\}$$

$$\log. \left(1 - \frac{1}{a + 1}\right) - \log \left(1 - \frac{a}{a + 1}\right) = \log. a$$

using Napierian logarithms, and, on substituting x^n for a and writing $n \log. x$ for $\log. x^n$, we get the required identity.—R. E. B.

[47945.]—**Cotton and Leather Belting.**—I can give you one instance in my experience proving the superiority of cotton over leather for machine belting. I had a machine to which I wished to transmit 20 h.-p. direct from the crank-shaft of engine. The machine was intermittent in its action, causing the belt to jerk violently with each variation. I used a 10in. leather belt, and in a month there were thirty joints and new pieces in 98ft., the length of the belt, besides the loss of time occasioned by stopping to repair, the product of the machine being considerably impaired in value by a stoppage while in action. We replaced this by a cotton belt of the same size; the first cost was less, and, after it had stretched, it ran for eighteen months without a break, day and night. In using cotton belting, which I have constantly done since, it requires some attention at first, as it stretches considerably; but after a couple of days' running this will cease, if it be taken up as occasion requires. After this, should it get slack, it should be moistened well upon the back with crude castor-oil, when it will resume its tightness and flexibility. Cotton belting must be preserved from changes of the weather as much as possible, and, if thrown off and left for any time, cannot be put on without letting out. I am of opinion that the manner of joining belting has all to do with the useful life of the belt. I use clips of thin iron and small bolts about 1½in. pitch. The clips should be filed rounding on the edges touching the belt.—FRED. WALKER.

[47946.]—**Failing Sight.**—No mere mechanical appliance can do you any good to strengthen your sight, which physical occupation, advanced age, and failing health are naturally threatening. If you give me your address, with the description of the present mode of your living, and write to "Urbanus," 5, Westbourne-terrace North, London, W., I will give you in a private letter the necessary advice how to support the strength of the optic nerve by proper artificial means.—AGE 71.

[47947.] — **Land Reclamation.**—The term "warping" in connection with the above is applied to the process of letting in water upon embanked land when the water is well charged with sediment, so that during the time the water is still the sediment may be deposited upon the land and the clear water let off. By continuing this process the land is raised, and a fertile soil provided for cultivation.—Epurm.

[47947.]—**Land Reclamation.**—Warping means flooding land with water containing alluvial matter in suspension, allowing it to deposit the suspended matter, running it off, and replacing it by more water of the same kind, and repeating the operation. The water should be let on the land when there is a flood or fresh in the river, and the first flood of autumn is generally the most beneficial, as in most cases it brings down the greatest quantity and best quality of alluvium to be got from any particular river. Warping will in some places raise the surface of land very considerably in a comparatively short space of time; the rate of rise of course depending on the amount of alluvium brought down by the river, and the beneficial effect in a great measure on the nature of the country through which the river flows, and the consequent nature of the deposit left by the water. When the river is a mountain torrent cutting away its bed of barren subsoil it may be even positively injurious, while in other cases the deposit may be the richest possible manure, and in any particular case it may be either of those extremes or anything between them; so that in all cases the nature of the deposit should be carefully examined before any expense is incurred to warp land. Warping is usually practised on low-lying land, banked in from a river suitable for the purpose: it can also be often very beneficially practised on land reclaimed from the sea or the tidal estuary of a large river when a suitable river discharges itself through or by the reclaimed land, the water being admitted by sluices from the river at the upper side, and discharged from sluices at the lower side, and if the sewage of a town should be discharged into the river at all near the warped land, it adds greatly to its value. In general, warped land is used as meadowing, and the warping is practised during the autumn and winter months, the water not being left on sufficiently long at a time to kill the grass.—G. J. H.

[47949.]—**Power Wanted.**—There are many good vertical boilers and engines combined, now being made cheap and good, with feed-pump and feed-water heater included. I should certainly recommend you to send to one or two manufacturers of these specialities for their lists, and choose one of the most suitable. You will require a 6in. cylinder and 1ft. stroke, and will work up to 45lb. or 50lb. per square inch. Such an engine and boiler will cost you about £85, inclusive of all fittings to both engine and boiler. The advantage of this type of engine is that it requires no built foundation nor fitting up; the boiler requires no building in, flues nor shaft, and it is easily adapted to any workshop, and takes very little floor room.—Fred. Walker.

[47952.]—**Agricultural Chemistry.**—Prof. S. W. Johnston, "How Crops Grow"; Prof. J. F. W. Johnston, "Elements of Agricultural Chemistry and Geology"; and Prof. Church, "Laboratory Guide." The attentive study of the above will give you a good grasp of the subject; but endeavour to get a course of practical chemistry in a first-class laboratory, such as that of the Pharmaceutical Society, under Prof. Attfield.—James Foster, M.P.S., Carlisle.

[47955.]—**Solar Eclipses.**—"F. B. A." does not say at which point of the earth's surface the duration is required. He had better consult *Whitaker's Almanack*, or some astronomical or nautical almanacks for those years.—B. A. Cantab.

[47958.]—**Chloride of Silver Batteries.**—(*a*) Cut a plate of zinc two inches long and ¾in. wide, procure also a similar plate of silver foil and some chloride of silver. Melt the chloride over the silver over a hot flame. The case to contain this small battery is constructed as follows:—Turn a boxwood cylinder 3in. in length and 1in. in diameter (interior) closed entirely at one end, and at the other by a screwed cover, going into the case; paraffin the interior, fix to the inside of the cover, angle pieces of copper, to which solder the silver and zinc plates, with about ¼in. space between them; fix in the cover from outside, a pair of the smallest binding-screws procurable and make them communicate metallically with the plates. Saturate a few layers of blotting paper, to form a thick pad, with a strong solution of chloride of zinc and press this pad in between the two plates, the melted chloride of silver being opposite to the zinc. If the box is tight, evaporation will have no effect upon the cell. This form of generator will supply a powerful rush of current as soon as the circuit is closed, and will work until the silver chloride is exhausted. The circuit should never be closed until the instant of requiring the current for the coil. (*b*) Another form:—A perfectly-constant cell may be constructed in which zinc and silver are the two metals, the zinc being immersed in chloride of zinc, and the silver imbedded in a stick of fused chloride of silver. As the zinc dissolves away, metallic silver is deposited upon the + pole just as the copper is in the Daniell's cell. Electromotive force 1·059 volt.—B. D. Williams.

[47959.]—**Gauges of Continental Railways.**—Barry, in his "Railway Appliances," gives the following: France, North Germany, Holland, Belgium, Austria, Hungary, Turkey (Europe?), Switzerland, Italy, Sweden, Denmark, 4ft. 8½in.; Norway, 3ft. 6in. and 4ft. 8½in.; Russia, 5ft.; Spain and Portugal, 5ft. 6in.—R. G.

[47960.]—**Bright Boots.**—The recipe given on p. 601 makes quite as good an article as any of the advertised preparations; but, having once tried it on a pair of boots, I shall never do so again. It does well for the heels and round the edges of the soles—in fact, is capital: but I should never put it on the uppers again. There is nothing like good blacking and a little elbow-grease to bring up the polish.—Nun. Dor.

[47972.]—**Metal-Work.**—The old repoussé work was, I believe, done by punching the metal at the back while it is laid on a wax block. The cheap work of the kind is done by stamping with punch and die. In this case the artistic work is in the punch and die, the others being mere mechanical reproductions. The metal must be soft and thin—about 1-24th of an inch; but, obviously something depends on the size of the article.—Chaser.

[47973.]—**Barium Compounds.**—They are prepared by dissolving the native carbonate (witherite) in hydric nitrate and hydric chloride respectively. When the carbonate cannot be procured, baric sulphate, a much more abundant mineral, is reduced to powder, and heated with one-third of its weight of ground coal until it is reduced to sulphide (BaS). This latter is then taken, instead of the carbonate, for decomposition by the acid: thus in the case of nitric acid $BaS + 2\,HNO_3 = Ba(NO_3)_2 + H_2S$, and in the case of hydrochloric acid $Ba_2S + 2HCl = BaCl_2 + H_2S$. I am sorry I cannot supply you with illustrations; but I think that any kind of reducing-furnace will suit you.—B. D. Williams.

[47974.]—**Question in Dynamics.**—Let G. B. T. suppose his frustrum to be a perfect cone, then on setting it a-rolling, the apex being a point having no magnitude, its revolving could not move it (the apex) through space, and all the other parts would describe circles round it as a centre. Now, the circumference of the 3in. end will be distant from the apex, or where the apex would be were it a perfect cone, 9·12in., and that of lesser end, 3·04in.; consequently, will describe circles with these radii. "Querist" will perceive these circles are in the same ratio as the ends of the body being rolled; and when the size is altered to 2in., the circumference of greater end will be 12·04in., and that of lesser, 6·02in. from where apex would be; consequently describing circles with these radii. "Querist" will see that these circles are also in same ratio as ends, otherwise this answer would not be correct, as of course the paths must be in exact ratio of circumferences rolling on them, or all parts of the body could not be moving in circles.—Scotch Working Mechanic.

[47975.]—**Testing Lightning Conductor.**—The only way of testing a lightning conductor on a lofty chimney stalk or steeple, is by getting a steeple jack to carry an insulated wire from the bottom to the top, and after filing the conductor clean, connect the wire to it, when the test can be made in the usual way. The latest form of conductor is made specially with a view to its subsequent testing, without the cost of a special climb up the shaft, to attach a wire.—S. V.

[47976.]—**To P. Vallance.**—I do not at present see how the system of loading guns and lighting the powder in front, described on folio 13, can be applied to breech-loading. In the experiments referred to the powder was poured into the mouth of the barrel and shaken into the mouth of the cone until full, the charge poured in being the exact central of the cone, and the touch-hole opposite the mouth of the cone. The large shot-gun was fired by a copper cap on a nipple placed at the mouth of cone. The bullet was put down the barrel, as in all muzzle-loading guns. The elevation was no greater than that of the same barrel when loaded with 8 drachms of powder for the same distance, so that the range would be the same. But the most interesting part of the experiment was that in which these brass tubes were made to give such a velocity to the shot without bursting, proving the strain on the barrel to be so small. For measuring small alterations in atmospheric pressure (query 47985) would not a large airtight vessel, having a tube descending from it with a glass siphon containing a small quantity of fluid indicate a very small alteration of pressure? I some years ago had a large glass carboy so connected, and the siphon fixed in my sitting-room, and it was extremely sensitive, the opening or shutting any door in the house affecting it.—Philip Vallance.

[47977.]—**Water Power.**—Only an approximate answer can be given, because it is not stated what is the width of the overflow weir—or thickness, if that is better understood—over which the water falls. But, supposing it to be of considerable thickness or width, the quantity at ½in. deep might be 8 cubic feet per minute, and at 2in. deep 80 cubic feet per minute; and, consequently, with 10ft. fall the power would be one-tenth of a horse-power in the one case, and 1-horse-power in the other, reckoning upon a useful effect of two-thirds of the power expended.—C. S.

[47979.]—**Locomotives.**—L. and N. W. Princess Alexandra, No. 618, is a 7ft. 6in. single. Full dimensions of this class given in back volumes (XXVII. and XXVIII.). 2240 is a four-coupled (driving and trailing) side-tank engine, cylinders 17 by 20, driving and trailing-wheels 4ft. 7½in. dia. Midland. 60 (see answer to query 47916 this and last week). 132, single-framed passenger engine, cylinders 17 by 24, driving-wheels 6ft. 8in.; full dimensions and drawings in Vol. XXVII. No. 204 is an outside cylinder side-tank engine with a leading bogie, built by Beyer, Peacock, and Co., 1868, for the Metropolitan Railway; cylinders 17 by 24, driving and trailing wheels 5ft. 9in. No 402 is a six-coupled goods engine, leading, driving, and trailing-wheels 5ft. 2in., cylinders originally 16 by 24, if rebuilt, 17 by 24. 695 is a double-framed bogie tank, built by Beyer, Peacock, and Co., 1869. 761 is a six-coupled goods engine, built by Dübs and Co., 1870; cylinders 17 by 24, driving-wheels 5ft. 2in. 798 is a double-framed bogie tank, built by Dübs and Co., 1870; cylinders 17 by 24, leading and driving-wheels, 5ft. 2in. No. 890, given in back vols, see also query 47916 this week. No. 1272, given in back vols., single-framed bogie tank, built by Neilson and Co., 1875; cylinders 17 by 24, leading and driving-wheels, 5ft. 6in. 1128 and 1394 are shunting tanks, the wheels are 4ft. 6in. dia., but I do not know size of cylinders. 1398 is a four-coupled express passenger driving and trailing-wheels, 6ft. 8in., cylinders 18 by 26, built by M. R. Co., 1879. 1441 is a six-coupled goods engine, built by Stephenson and Co., 1880, cylinders 17½ by 26, driving-wheels 5ft. 2½in. It is fitted with steam-brake.—Meteor.

[47986.]—**Parrot.**—Parrots should never be fed with meat of any kind; it is invariably found to produce, sooner or later, the effect which our correspondent complains of. Hemp-seed and sopped bread, with a few nuts occasionally, are all that need be given.—C. Harris.

[47986.]—**Parrot.**—The food is the cause of the parrot pulling out her feathers. Meat, butter, and hemp-seed all have a tendency that way, the rest of the food is all right. Do not give hemp-seed at all, or butter, and for the present no meat; after a while you may give a very well-picked chicken bone to amuse her; while Indian corn is very good for parrots, and they are very fond of it, and the shelling and grinding of it gives them employment for their beaks; if too hard, steep it in hot water. A lump of sugar occasionally is a treat, and I do not believe it is any harm; apples and most kinds of fruit are good, and would be particularly so at present.—G. J. H.

[47988.]—**Violin-Making.**—The most serviceable tool for cutting the *f*-holes will be a small hand fret-saw. They are very easily obtained, and are cheap. Look up the advertising columns.—B. D. Williams.

[47988.]—**Violin-Making.**—I think you will not improve upon the knife for cutting the *f*-holes of violins, although they could be cut out roughly with a fret-saw, and then finished with the knife and file. But the operation is a delicate one, and the tone as well as the beauty of an instrument is so dependent on the accuracy of this part of the work that I think by far the safer plan is to cut out the *f*'s *entirely* with the knife, which in my opinion is a more wieldy tool than the saw. An ordinary penknife you will find too thick. Small surgical knives answer the purpose admirably. They should have the keenest possible edge.—A. E. T.

[47988.]—**Violin—Making *f*-Holes.**—These can be cut out with small saw; but you would split the soundboard. Better use sharp knife, and finish off with wood file. Mark out the figure, cut within the mark; get the smallest rat-tail and flat files, about 2s. worth, and the work is easy enough. You will notice that when using the little files there will be a great noise: in fact, you will be moving the soundboard so as to produce all the sound it is capable of; but if you use the file on the face of the soundboard the noise will be minute; it won't make your head ache, or set your pugging-tooth on edge. Take a lesson from a file, or from the well-known fact that sawing a piece of wood across the grain will sound more than with the grain. And don't make your violin according to the old form; but move the soundboard the right way at once, it is much easier. While you are cutting out your *f*-holes I could almost make a new-shaped violin, without a sound-post, to sound louder and quite as clear as any ordinary violin. When you stain your violin you may use aniline dye with advantage; but more like paint, i.e., not too wet, or you are ruined.—Fiddler.

[47990.]—**Asphaltum.** — Insoluble in water, with difficulty soluble in alcohol (spirits of wine). It is heavier than water, and readily soluble in nephtha, and the solution forms a good varnish.—B. D. Williams.

[47990.]—**Asphaltum.**—No, it is not soluble in spirits of wine. Absolute alcohol extracts from it about 5 per cent. of a yellow resin; but the solvents for asphaltum are mineral naphtha, turpentine, benzole, the fixed oils, and solutions of caustic alkalies, with the assistance of heat.—Essar.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last J. N. Andrews has replied to 47401.

47379. Model, p. 436.
47381. Wildbad and its Cures, 436.
47389. Engine and Carriage Spring Furnace, 436
47390. Foundry, 436.
47398. Lewis' Incandescent Gas-Lamp, 436.
47401. Coil. To T. N. Andrews, 436.
47409. Circular Bead-Cutter, 436.

47629. Compensating Lever, p. 532.
47634. Organ Stops, 532
47635. Home Study, 532.
47637. Locomotive, 532.
47643. Spiders, 532.
47645. Measuring Railway Curves, 532.
47650. Annual Loss of Life by Fire, 532.
47662. Circulating Decimals, 533.
47666. Construction of Maps, 533.
47672. Limelight, 533.
47675. Vacuum Gauge, 533.
47676. Magnetic Exploder, 533.
47677. To Unsize Paper, 533.
47679. Induction Coil, 533.

Patents for Inventions in 1881. — The annual report of the Commissioners of Patents for the year 1881 has just been issued. It states that the number of applications for letters patent for the year was 5,751, being 234 more than for the preceding year. The number of letters patent sealed was 3,948, of which 68 lapsed in consequence of the patentees having neglected to file final specifications in pursuance thereof, leaving 3,880 in force. Of this latter number final specifications were filed in respect of 3,621, complete specifications being filed in respect of 259. Applicants failed to seal their patents in 1,798 cases, opposition was offered in four cases, and one application stands over through the decease of the applicant. A table is given showing that about 65 per cent. of the applications for patents from 1852 to 1881 became valid patents, that of the valid patents obtained upon the applications from 1852 to 1874 nearly 30 per cent. paid the third year's stamp duty of £50 and continued in force until the end of the seventh year, and that about 10½ per cent. paid the seventh year's stamp duty of £100, and consequently remained in force for the full term of 14 years. The descriptions of inventions deposited and filed in the office under the new law from October 1, 1852, when the Patent Law Amendment Act came into operation, in relation to 113,379 applications for patents have been printed and published with drawings in outline. The specifications of patents under the old law from the earliest period at which specifications were enrolled, 13,561 in number, have been printed and published in like manner. The old and new law specifications amount together to 126,940. Abridgments of the specifications of patented inventions are prepared and published in classes, each confined to one subject or group of subject, in order to facilitate the searches of inventors who are desirous of ascertaining if their inventions are novel. This series of work, which will consist of about 110 subjects, when completed to the end of the year 1876 will afford in a compact form a key to the inventions patented under each subject between the years 1617 and 1876. Thenceforward the volumes of abridgments will be published for decennial periods. Copies of the Commissioners' publications are sold at cost price at the Sale Department, 38, Cursitor-street. The receipts from the sale of these publications during the year 1881 amounted to £2,912 4s. 4d. The Patent Museum at South Kensington has been visited, from its opening on the 22nd of June, 1857, to the end of the year 1881, by 5,257,000 persons. During the year 1881 there were 282,121 visitors. During the year 1881, 91 ornamental and 137 useful designs were provisionally registered, and complete registration of 15,176 ornamental and 128 useful designs was effected. There were also three designs registered for sculpture.

QUERIES.

[47991.]—**Photographic.**—Will some one tell me how the names of a view are so neatly printed on some prints?—J. H.

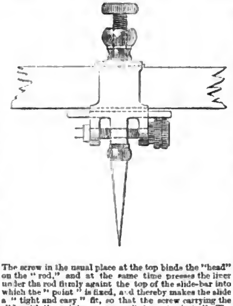
[47992.]—**Commutator for Small Dynamo.**—To Mr. Lancaster.—I have made a small dynamo, but wish to know how to insulate the commutator plates from each other on the armature shaft. Can you please inform me?—Tyro.

[47993.]—**Manganiferous Ore.**—To Mr. Belcher.—Will you kindly state how you get 44 of CO_2 to equal 43·5 of MnO_2? Why do you multiply by 50 to find the MnO_2 in the sample of ore?—One Who Cannot Understand.

[47994.]—**Tinning Iron.**—Will any practical reader say if steel or iron is perceptibly weakened, or in any way injured, by the process of tinning? I wish to apply the process to my bicycle, for which purpose I think it will be preferable to nickel-plating for the following reasons—viz.: 1. The same amount of labour in cleaning and polishing will produce an equal polish. 2. The tinned article will have vastly more "wear" than the veneer of nickel, because the tin permeates the substance of the iron or steel. 3. The cost of the tinning will be less than the nickel-plating. Any objections by your readers would greatly oblige.—W. H. G.

[47995.]—**Margate—The Grotto, or Cavern.**—I shall be glad to have good and reliable information respecting the grotto, or cavern, made of shells, underground, in Margate, and said to be very old. It is a very curious place. Does any one know how old it is, for what it was used, and when and how it was discovered?—Ruralite.

[47996.]—**Trammel Head.**—In the hope that my "idea" may be recognised as a simple and effective way of fitting up an adjustable trammel-head, I send you the accompanying drawing and description for insertion.



The screw in the usual place at the top binds the "head" on the "rod," and at the same time presses the liner under the rod firmly against the top of the slide-bar into which the "point" is fixed, and thereby makes the slide a "tight and easy" fit, so that the screw carrying the slide with the point, can move it to a "nicety." The advantage that I claim for this, over those generally sold with mathematical instruments, is, that any amount of wear will not affect the tightness of slide (the operation of fixing on rod making the slide a tight and easy fit at all times), whereas, any that I have seen wear loose in the slide by use, and, therefore, the point is shaky.—James Uas, Pattern-maker, B. Bridge.

[47997.]—**Black and Tan Terrier.**—Will some one tell me how to cure my dog's eye of a white film which has been growing over it for some time, and I fear will destroy the sight? The dog is nine years old.—Julia.

[47998.]—**Legal.**—A. dies and leaves a copyhold cottage to B. to enjoy during his life, and if he has issue his children shall share and share alike at his death; but if he has no issue, then the property goes to a third party, that third party being one of the executors. B., at the time the property was left him, was a minor, and when he attained his majority he applied to the executor for possession of his bequest. He got possession of the cottage, but could not prevail upon the executor to deliver up the writings, the executor informing him that he had no right to them, seeing that the cottage would be his (the said executor's) in case of B.'s death. The executors are now both dead some years ago, and B., having issue, is very anxious to obtain the writings. How should he proceed, and what would be the probable cost? Will dated 1860; B. got possession 1864.—One in a Fix.

[47999.]—**Electric Locomotive Engine.**—To Mr. Lancaster.—I have a frame of solid brass fitted with four locomotive wheels, and want to fit a motor to the frame to be worked by electricity, and so drive the locomotive on a circular railway. The frame is 10½in. long, by 4½in. broad. The wheels are 6½in. apart, and are 4½in. diam. Will some gentleman kindly give instructions for making the best form of electric motor to drive it? The weight of the frame and wheels is 7lb. 9oz.—T. N. A.

[48000.]—**Discharge of Pipes under Water.**—Would some of your readers kindly give a formulæ and example worked out? What fall or head in feet of pressure would be required to flush out a pipe 600 yards long, 9in. diam., and 20 or 30ft. under water, and what difference would there be between fresh and salt water?—J. L. W.

[48001.]—**Heating Soldering-irons.**—To "Jack of All Trades."—I was interested in your reply 47810, but should be glad of a fuller explanation. I have one of the oil stoves you refer to, but cannot manage to heat my irons. What is a waggon tilt and baffle-plate?—J. H.

[48002.]—**Heating Soldering-irons.**—I am much obliged to my brother-reader, "Jack of All Trades," for his reply to my query relative to the heating of soldering irons; but why should I go to the expense of a stove costing 10s., when smaller and cheaper ones can be purchased with 2in. wicks? I can purchase a stove about 5in. high and about 3½in. diameter, with a wick 2½in. long, for 4s., and would not this one answer my purpose as well as one costing 10s.? Would "Jack of All Trades" recommend me to use meth. spirits instead of a mineral oil? Is not the heat given out by the former more intense than of the latter?—T. J. O'C.

[48003.]—**Gas-engine.**—I am now a reader of our Mechanic for a great many years, and I have never seen instructions given in its pages for the construction of a model gas-engine. As I am most anxious to make one this winter, perhaps some kind reader would give the necessary instructions as to how to make one?—T. J. O'C.

[48004.]—**Shaping Machine.**—To W. S. Brown.—On looking over articles on "Motive-Power for Amateurs," Jan. 7, 1881, No. 824, I observe a handy little shaping machine, of which I would wish a more detailed explanation if not too much to ask. Is it intended to be attached to lathe—if so, how? Please state dimensions and as full particulars as possible. Could I obtain working drawings?—Amateur.

[48005.]—**Compressed Air.**—I am about to make a refrigerator, and would be pleased to have a few hints from readers of ours concerning same. If I pump air into the receiver up to 65 or 70lb. to the sq. in., what temperature will the compressed air in the receiver rise to? And if the compressed air be cooled to 65° or 70°, at what pressure may I expect it to issue from the receiver?—that is, what is the usual loss of power in the air, comparing the power absorbed in compression with that which the compressed air will develop during expansion?—One in a Fix.

[48006.]—**Starch and Blue Manufacture.**—I want to make the above from potatoes, wheat, or rice—which of the three materials is the most economical, the plant and machinery required, and all particulars? I have read that when making it from wheaten flour, it is best to have it made from "whole meal," or the wheat as it comes from the mill-stones. Any method will be thankfully received. It is to be made for sale. How is laundry blue made?—Alexander.

[48007.]—**Boiler.**—I should be greatly obliged if some kind reader will inform me how I can utilise a 2-horse boiler I use for chaff-cutting to supply me with a quantity of boiling water to scald malt-dust I use among the chaff. Would an injector do, and if so, what sort, or in what other way? The pump will not supply fast enough.—T. E. C.

[48008.]—**Boomerangs and other Projectiles.**—Letter 20469, p. 13, of your No. for Sept. 8 is so interesting, that I should be much obliged to Mr. Philip Vallance if he would kindly give a sketch of the boomerang, and also of the cone-gun which he there describes.—Alfred Harman.

[48009.]—**Integral Calculus.**—Will some of ours kindly show me how to integrate $\frac{x\,d\,x}{\sqrt{1-\cos. x}}$?—An Engineer's Son.

[48010.]—**Oil on the Waves.**—I sometimes wonder if all ships used the oil in storms, what would become of the enormous quantity there would be floating on the sea. Would it decompose, or be eaten?—because it would not be very nice to at last have a film of oil covering the sea.—Edwd. Thos. Scott.

[48011.]—**Astronomical Cycle.**—The cycle of Meton, which depends on the facts that

$$235 \text{ lunations} = 6939{\cdot}69 \text{ days},$$

and that

$$19 \text{ years of } 365{\cdot}25 \text{ days} = 6939{\cdot}75 \text{ days},$$

affords a ready means of determining the dates of new and full moon, and is of service in the prediction of eclipses. If one of our astronomical contributors would kindly give a table of the new and full moons for the 19 years from 1861 to 1880, every subscriber to the "E. M." could then predict these periods with facility, as the dates repeat themselves exactly. A new cycle began in 1881, which year had 1 for its golden number.—Bex.

[48012.]—**Diabetes.**—In No. 910, Vol. XXXV., I observed, under the head, "Scientific News," the note on diabetes, stating that M. Felizet has cured 15 cases of that disease. A friend of mine wishes to know more about M. Felizet, or in some way obtain the help which that gentleman has given to others.—Isaac Foulkes.

[48013.]—**Tricycle.**—Can any of our tricyling friends inform me of any reasons why I should not substitute steel or iron tires for india-rubber ones on my "Express" tricycle, for my present ones are always coming uncemented, and it seems to me iron ones would be better. What sort of brake could I have put on instead of my present one on the hind wheel, which I do not consider powerful enough for a hilly country. Is there any way I can prevent my hind wheel spinning the whole machine half round if it comes against a stone or gets into a rut? Would it be of any use to lengthen the lever fixed to the axis on which the wheel turns, and to the end of which the steering-rod is fastened.—R. C. Hitchcock.

[48014.]—**Paints for Lantern-slides.**—Will "M.I.C.E.," or some other contributor, kindly inform me—1. What water-colour paints should be used for bright yellow, orange, and scarlet, when painting slides for a Sciopticon lantern? 2. Should the bright parts of the slides be painted in oils, or can as brilliant an effect be produced with water-colours? If so, how? 3. What is the best way of remoistening water-colours that have become dry and hard? I should add that I am living in an up-country station in India, and cannot obtain materials not in ordinary use unless I send home specially for them. I have got ordinary water-colours, and some oil-colours in tubes.—Bax.

[48015.]—**Electrical.**—Will any reader kindly furnish an explanation of the following?—A telephone line of three stations was fitted up, A and B the stations at the extreme ends, and C a loop on the line, and situate about three-quarters of the total distance between the ends, from A and, of course, from B. The instruments were fitted with relays for ringing. The end of the line coming from station A was connected to the line terminal in the instrument, that from station B to earth terminal, no earth, of course, being made at C. With this arrangement of the connections the speaking was all right, but although A could ring B and C, C could ring A and B, B could ring A; yet it was not possible for B to ring C; but by altering the joining up and putting the line from station A to earth terminal, and that from B to line terminal at station C, B could at once ring C, and the ringing was right all round. I expect that C being much nearer to one end of line than the other is the real cause of the above, but cannot deduce any satisfactory reasons for the effect.—Electric Typo.

[48016.]—**Mechanical Engineer's Certificate.**—Will any reader kindly give me any information as to the way to proceed to obtain a mechanical engineer's certificate: whether I can obtain a prospectus of what is required, and, if necessary, to join an engineering school, or can the necessary work be done at home? Any information as to the best books to use, &c., will greatly oblige.—Enthusiast.

[48017.]—**Coating for Pipes.**—Will any of "ours" kindly help me in the following difficulty?—I have put iron pumps into three deep wells for the use of the village; but the water is so red with rust sometimes that it cannot be used, and as I have two to put in yet, I shall esteem it a great favour if any of "ours" will tell me what to coat them with, so as to prevent them rusting.—G. Blacksmith.

[48018.]—**Brass Casting.**—Would some correspondent who knows kindly give particulars of above. When I have tried, the castings come full of holes. What flux is used?—Ignoramus.

[48019.]—**Polishing and Cutting Rock Crystal.**—I have a large piece of rock crystal, and I want to cut it and polish it in the shape of an oval polygon. Will some of your readers kindly let me know what tools to use and how to do the job, and much oblige?—W. Artewall.

[48020.]—**Steam Jacket.**—When a cylinder is steam jacketed, is there any particular time when the steam should be let in or kept from going in, as I see some cylinders have a stop-valve for jacket? Also please explain the use of the steam jacket, and oblige—A Working Man.

[48021.]—**Electro-Plating.**—Will some kind contributor give me a little information to help me out of a difficulty? I have a teapot-shaped plate, which I suppose to be Britannia metal, and I wish to give it a coat of copper previous to silvering. I have tried twice, but I cannot get the copper to deposit on some parts of the same, such as the feet, top, and bottom of handle, and the inside. I made my solution according to Mr. Urquhart's instructions, from one of his works. I worked the same hot, and applied two cells of the Bunsen battery one pint each, and I also worked them alternate. An early reply will greatly oblige—B. A. J.

[48022.]—**Concrete.**—Having read with pleasure the statement of "Khoda Bux" in your last issue on the concrete question, I shall be glad if he or any of "ours" would be kind enough to give me a little information. I am about to take up some board-floors in some cottages I own, and replace with concrete. I want to know how to proceed in the matter, and make a good finish. Will broken burnt bricks answer my purpose, as well as rubble stone? I can have a lot cheap. What would be the mean thickness requisite, and how should I finish off?—H. Stephanson.

[48023.]—**Fixing Cylinders and Eccentrics in the Lathe.**—I want to know the proper way how to fix cylinders and eccentrics in the lathe for turning and boring out. I cannot finish them well at all. I should be much obliged, and so would others, if some able reader would give a letter or two on fitting.—Amateur Fitter.

[48024.] — **Water-colour Painting.** — Would "M I.C.E." instruct me a little? I am very fond of water colour painting, but am at a loss to know how they are made to look so very smooth. I use camel-hair brushes for instance. What colours should I use first to draw a bridge with the water running through, light or dark?—Amateur Painter.

[48025.]—**Preparing Insects for the Microscope.**—Can anyone tell me a way of making the limbs, &c., of insects transparent without destroying the internal structures? The usual way of pickling in liquor potassæ is useless if one would study the muscles, &c.—Hereward.

[48026.]—**To Mr. Parkinson.**—Will you kindly say what size grooving I must use for a 12 by 10 double dark slide, and also would it be better to make a square camera? In constructing this size, shall I double the proportions as regards thickness of wood and width of the 7¼ by 4¼, described in your excellent article in "Amateur Work Illustrated."—Camera.

[48027.]—**Legal.**—To Mr. Fred. Wetherfield.—Would you kindly state if it is necessary to take out a license to sell an ointment made by the seller, either retail or wholesale, using the maker's name to the ointment; as, for instance, Holloway's ointment; or whether it would be obligatory to register it at Apothecaries' Hall?—J. C.

[48028.]—**Legal.**—To Mr. Fred. Wetherfield.—I have some shares in a company, and it states on the prospectus that "by virtue of the charter and deed of settlement the liability of the subscribers is limited to the amount unpaid on their shares." Is it quite as safe as if they stated that the company was limited, and that it was incorporated under the Companies Acts from 1862 to 1880 inclusive, as some of them state?—J. C.

[48029.]—**Steam Power for Lathe.**—I am a wood-turner, and work my lathe by foot, and want to know if anyone can kindly inform me if it is practicable to carry a steam-pipe from a large boiler in the next warehouse to a small engine in my shop. I thought I might do without the boiler if I can.—J. T. A.

[48030.]—**Hardening Taps and Dies.**—Could any correspondent inform me as to the best methods of hardening taps and dies in a small smith's shop?—Vulcan.

[48031.]—**Transmitter.**—Can any one describe to me any form of a good diaphragm microphone for transmitting speech? I am told there are some very good ones. I am rather deaf, so I should like a fairly loud one. Could I also have a better receiver than Bell's?—Adda.

[48032.]—**Zinc Cylinders.**—I have a quantity of zinc cylinders for batteries, but I cannot possibly amalgamate them. I dip them in dilute sulphuric acid until effervescence commences, but they will not take any mercury. Can any of "ours" put me on the right path?—Adda.

[48033.]—**Agriculture.**—Will any reader please direct me in my reading for the advanced or honours stages of agriculture in the Science and Art Department's examinations by mentioning a few good books on the subject?—Agile.

[48034.]—**Ammonia.**—Will any chemist or brother-reader who understands the above gas, kindly state its specific heat at atmospheric pressure, as compared with water? Also, what pressure would a cubic foot of ammonia gas exert per sq. in. if heated from 32° Fahr. to 100°, 150°, and 200° Fahr. respectively, starting with atmospheric pressure, and the volume remaining constant?—One in Doubt.

[48035.]—**Legal.**—Will Mr. Wetherfield kindly inform what is the meaning of copyhold, as applied to house property? Also, on what reason is founded the fact that leasehold houses, on expiration of lease, go into the possession of the ground landlord?—A. H. K.

[48036.]—**Shells.**—Will some correspondent give information as to the cleaning and polishing of shells, or the title of any book containing such knowledge?—H. Derby.

[48037.]—**Squeezer Rollers.**—Would some brother reader say which is the best way to put axle in squeezer roller, and also how to bore for axle? What kind of auger would be best, and what kind of chuck to hold auger shank in lathe, and best way to straighten end up before grooving for rings?—J. H. M. H.

[48038.]—**Floor-Cloth Making.**—Could any friend tell me where I could find a good work on the manufacture of floor-cloth, or give some information? I have seen two or three books, but the information in them is very scanty. I have tried stencilling, but it is too slow and uncertain. I find that the printing is done by blocks. How are these blocks made? Is there any place where I could see the process near Leeds?—One in the Dark.

[48039.]—**Friction Brake.**—I wish to ascertain the power of a turbine revolving 1,700 turns per minute. The pulley on the turbine shaft is 6in. dia. Would some one kindly inform me how to rig up and apply a friction brake to this, together with the necessary formula, which, I find, are not given in "Molesworth."—D'Eloo.

[48040.]—**The Distance of the Sun.**—Will "F.R.A.S." kindly explain how the particular observation was made which Mr. Gill went out to the island of Ascension to make; whether the calculations based on his report are finished, and what the result is?—Union.

[48041.]—**Cleaning by Dry Process.**—Would some of our correspondents kindly oblige me with the process of cleaning by the French or dry process?—W. H. B.

[48042.]—**Soaps.**—To Mr. Allen or Other Kindly-Disposed.—What are the usual impurities in soap? How may they be detected and estimated?—W. H. B.

[48043.]—**Dead or Chemical Black on Steel.**—Can anyone tell me how a *dead* or chemical black is formed on rifle sights? Is it by making a coat of oxide by heat and moisture as in Barff's process, or by attacking the surface by some chemical? What I want is a perfect non-reflecting surface similar in character, but different in colour, to a thin layer of electro-deposited silver, or as the surface of ground glass.—J. P.

[48044.]—**Minerals.**—In No. 862, reply 44728, "Dunrod" mentioned some papers on the "Application of Organic Acids to the Discrimination of Minerals." Can he, or any of your correspondents, say where they are to be found, as I have sent to London for them, and am told they cannot be procured?—South Australian.

[48045.]—**Fan for Smith's Hearth.**—To "Jack of All Trades."—Would you kindly give me instructions how to construct a fan for above, capable of welding 1¼in. sq. iron at ordinary speeds? A skeleton sketch would much oblige, as I have no chance of seeing one.—E. Bristow.

[48046.]—**Small Dynamo.**—In making a dynamo similar to the one described by Mr. Tolman, how is the wire wound on the field-magnets? Suppose it is wound as an ordinary magnet; if so, where is the current taken from, as the two outer ends of wire are to be joined to the springs to take the current from the commutator? Also, how is a shunt made, and how used in circuit? If some of our readers will inform me, I shall be very thankful, as I want to try my hand at making one.—P. G.

[48047.]—**Cork Fender.**—I am desirous of increasing the buoyancy of a small half-decked boat—a model of a deep-keeled cutter—11ft. long by 2ft. 8in. beam, by the addition of a cork wale or fender, and shall be glad of any hints as to best way of making such a fender, materials (i.e., besides the cork), shape, and mode of securing to the boat sides as a fixture.—H. Boswall.

[48048.]—**Bichromate Batteries.**—I was much interested in "Sema's" account of his new solution for bichromate batteries (letter 20506, p. 30), and I should be much obliged if he would say what was the strength of the bichromate solution. And, also, whether the proportions he gave were by measure or weight? I think others would like to know besides myself.—B. B.

[48049.]—**Lathe.**—I want to know how to apply Babbitt metal to the bar lathe illustrated in No. 876, p. 49). I know that steel or brass would be better, but I have no lathe, and so prefer to Babbitt it as described in the article referred to. Would ordinary white metal do, and how should it be applied?—Miner.

[48050.]—**Hardening Cast-iron.**—Can anyone tell me how to harden small castings after being bored and planed. I understand how to caseharden wrought-iron, and have tried all the methods I know with these castings, but cannot get them to my mind. I should be much obliged for any information.—J. M.

[48051.]—**Dulcimer.**—What sort of wood should be used, what size and length of wires, for a dulcimer?—One in a Fix.

[48052.]—**Endless Rope Haulage.**—Will some of your readers give particulars of the different kinds of driving pulleys for slow-moving ropes? The clip pulleys are said to destroy the ropes quickly, and the arrangement of one or more pulleys driving by friction is the best.—Mechanic.

[48053.]—**Endless Rope Haulage.**—Will some of your readers give particulars of the best kinds of clips to be used for attaching a train of coal tubs to a slow-moving wire rope working up stiff inclines? The clips to be used either with or without bogies, so that the trains may be attached at one end of incline and taken off at the other without train boys. Also, the best kind of clips to be used with bogies and train boys.—Mechanic.

[48054.]—**Turkish Bath.**—For the last three months, after a Turkish bath, I have noticed a large number of small pimples raise whilst in the cooling-room, which disappear afterwards. What is the cause of this? In the winter I take the Turkish bath once a week; in the summer, every other week. I believe in allopathy and homœopathy, and am now taking china, having taken quarts of sarsaparilla, &c.; take no beer or tea; whisky at night, and live on the best I can. I thought this was best purifier for the blood, after twenty years of Turkish bathing. I fancy there is a trace of eczema. Anyone giving a hint about this will oblige—J. E. Bird.

[48055.]—**Range of Fire-engines.**—How far can the best-known fire-engine throw water horizontally when it has to pump the water out of a reservoir or river? And, what will be the loss from friction when the water has to pass 200ft. through a hose pipe after leaving the engine?—John Watson.

[48056.]—**Japanning Buttons.**—Can any of your readers inform me in what manner buttons are japanned in large quantities? How can the sticking together be prevented?—John Peirce, Providence, R.I.

[48057.]—**Registering Bell Gong.**—Can anyone tell me whether is in the market ready made a registering bell gong capable of being acted upon by a bell pull at about 60ft. from the register. I will tell you what it is for, and you will readily understand what I want. It is for a newsroom: the gong to give signal to the attendant that a visitor has paid, the register to indicate what number of times the gong has sounded up to (say) about ten thousand.—P. M. G.

[48058.]—**Wild Beast Trap.**—What is the best kind of trap or modes of snaring wild beasts, such as hyænas, leopards, porcupines, &c., and where procurable?—Sportsman.

[48059.]—**Grape Wine.**—What is the most approved method of making wine from English grapes, and should the fruit be quite ripe, or can fruit not quite matured be used?—Gardener.

[48060.]—**Melting Temperatures.**—There is a substance which melts at a temperature of 212° at sea level, or the boiling-point of water. The same substance has to be melted at an elevation of 6,000ft. above sea-level, where the boiling-point of water is about 200° only. Will such a substance which at sea-level melted at boiling point of water, melt likewise when exposed to only 200° at the higher elevation?—Himalaya.

[48061.]—**Ferguson's Tables on the Moon.**—Can "F.R.A.S." tell me if the late Mr. Ferguson's tables for calculating the times of new and full moons are to be relied on for the present and future years? And, if not, could he name a cheap reliable work upon the subject containing similar tables?—Virgo.

[48062.]—**Watch Repairing.**—Will some contributor kindly inform me how to time an English lever that has gone beyond the power of the regulator? From the instructions given about two months since I can time a Geneva or Geneva lever very well, but fail to make a hand of the English lever. Also, how watch-jewels are put in, and the necessary tools for them? Do they require the hole to be drilled through, or can they be bought with the hole in them?—J. B.

[48063.]—**Medical Coil.**—I have made a medical coil according to Mr. Sprague's instructions. When four layers of 22 secondary, a slight sensation or shock. I then put on and soldered to No. 22 three layers of No. 26, connecting the end of No. 26 with one pole of bichromate cell—no effect, or only very slight spark visible at contact-break; but on connecting No. 22 and leaving the end of 26 free, a very strong shock produced, very much stronger than when only primary and No. 22 were wound. If the insulation of No. 26 was imperfect, would there be an increase of strength in connecting up with No. 22? I may add that when regulator is pulled three parts out the shock is stronger than is altogether pleasant. What I should feel obliged to know is, should one wire of the primary and the extreme end of No. 26 be connected to get the greatest effect?—A Novice.

[48064.]—**Siphon.**—I wish to drain a reservoir or lake by means of a siphon, and should feel obliged to any correspondent who would kindly give a reliable formula for calculating the discharge under the varying heads. Theoretically, the siphon should carry off the water to a vertical depth of 33·9ft. below the bend, but I fancy in practice it would be somewhat less, as allowance would have to be made for friction in the long line of pipes that will have to be used. If I am wrong in supposing this, I shall be glad to be corrected. It is curious that so little practical information can be found in books on hydraulics or on hydraulic engineering. Perhaps Mr. Lancaster could help?—Erna.

[48065.]—**Counterpoise**.—Some things which seem theoretically true are practically untrue. Suppose a simple wheel, a wooden one, say, on axle, and suppose a small tack driven into the circumference, and then a string just turned over and under the tack in the middle of the string, and the tack then driven close, so that the string cannot run over the tack; then suppose the wheel to be fixed so that the two ends of the string may hang as a tangent from the tack; then suppose one of these to be passed over the circumference so as to hang as a tangent on the other side of the wheel opposite to the tack. Now, suppose a weight, say 10lb., to be attached to the string opposite to the tack. I was asked what weight must be attached to other string so as to counterbalance this when the wheel is set free: I said at once 10lb., but I was told that the proper weight would be considerably less than 10lb. I should be glad of information from more experienced persons. The matter must have been experimentally tested.—G. E. P.

[48066.]—**Verge Watch**.—I should like a little advice on the above. The watch in question keeps good time when going and is in beat, but stops when half or two-thirds of chain is on barrel. A slight shake will start it again for an hour or so, and it will stop again before all the chain is on barrel. I have made a mark on top-plate and one on rim of balance when at rest; when balance is swinging it only moves 3-16 on each side of the mark made on top plate. The pallets of verge are long and the scape-wheel teeth drop on them close up, but not to touch the body of the verge. Are the pallets at too wide an angle?—would closing them give balance more swing?—how can it be done? I have looked through last vol., but see nothing that will help me. In bushing small centre hole, how can I ascertain when it is upright? What is the adjusting-rod used for? In asking the above questions I must say I have had no teaching except through the columns of the "E.M." from the pens of "S. P.W.," "Fellow Workman," and last, but not least, "Alfojoe." Any information will be thankfully received by—Hopeful.

[48067.]—**Silver Watch-case Repairs**.—A few days ago I had a watch-case with joint broken. I removed springs and hard soldered the broken part with silver solder; afterwards I put the case in solution to clean, one part sulphuric acid, two parts rain-water; on removal about an hour after it had a coating of a reddish brown colour, similar to copper, which I had a difficulty in removing. What was the cause of this, and how can it be avoided in future? I did not remove bow and push-piece which was secured with brass screw. Is there a wire sold for the purpose of joint repairs? What sizes would be most useful, as I have others to repair?—Hopeful.

[48068.]—**Eyesight**.—I would like to improve my sight with glasses, but am unable to get what would suit me; in fact, opticians make me try a score of glasses and are puzzled that none of them fit me. My case is this: I can read with my right eye the articles in the "E.M." at a distance of 5½in. I cannot see any distance with it without a double convex lens. My left eye is useless for reading, but I can see in the distance to a certain extent; no glass has as yet been able to improve the sight of my left eye; after reading for some time, lines and letters appear double and I have to stop a little. Could anything be done to equalise the eyes and so read at a more convenient distance? Some useful information will greatly oblige—Nigel.

[48069.]—**L. and N.W. Engines**.—Would any of our readers kindly state the towns at which 409 St. George, 1148 Boadicea, and Nos. 851, 593, 1077, 905, 1121, 1731, 1704, 109, 2047, 975, 606, 1297, and 678 are kept?—Mabez.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* Editor *of the* English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 20, and unacknowledged elsewhere:—

Barnett, Son, and Foster.—J. Evans.—Jas. Quin and Co.—V. White.—Dr. N. B. Siser.—E. S. Hindley.—C. Richardson.—W. H. Numsen.—Pilsen Light Co.—J. C. Frank.—J. Munford.—J. C. King.—Fred. Walker.—Walter Hardie.—Dynamo.—G. J. H.—Jack.—W. D. B.—O. L.—J. A. F.—J. McLellan.—Y. Z.—W. G. Triggs.—Vega.—Evandale.—W. J.—John Bull.—Capt. Cattle.—Milverton.—W. H. E.—Geo. Hunt.—G. Fryer.—Lex.—H. W. W.—Thomas Page.—Semper Fidelis.

A NEW VOLUME.

No. 911 was the first of volume XXXVI. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXV. is published in this number, and cases and bound volumes will be on sale shortly. Readers desirous of making up their sets for binding the past volume are recommended to do so at once, as the back numbers soon run out of print.

Electric. (We do not know, but presume it is merely bichromate of soda instead of bichromate of potash, used in the well-known form of battery.)—Enthusiast. (No. 859, p. 9; but have you not read the "Notes on Dynamos" in the last volume?)—E. T. S. tr. (We should be glad to hear more about your new tricycle.)—Joseph Frost. (Appraisers and house agents have to take out a licence costing £2 yearly; an auctioneers' license costs £10 yearly.)—J. R. T. (Thanks for your suggestion. We tried issuing our index separately for ten volumes, and it did not answer. We do not charge a penny extra merely for the index, as you may see for yourself this week. We give four pages extra of matter into the bargain, and have always done so with every half-yearly index number.)—T. E. Ewis. (Kindly send at your convenience.)—J. J. (The statement need not have alarmed you. Medical journals, we fear, are quite as sensational as their contemporaries. Another medical paper now states, on what authority we do not know, that Prof. Ponfick's experiments were made on the Morchella esculenta, and not on what is generally known as the common mushroom (Agaricus campestris). The Morchella esculenta uncooked must also be pretty largely partaken of before much harm is done, as the smallest quantity that invariably proved fatal was 2 per cent. of the body weight of the animal experimented on. This would represent in a person 150lb. in weight 3lb. of the mushroom in question, a quantity not likely to be consumed by one person at one meal.)—Saccharine. (We know nothing more about it than was stated in the paragraph.)—G. W. B. (The Leclanché or Bunsen's. See the index published this week.)—A Working Man. (See p. 409, No. 797. We cannot repeat information frequently given because querists have not the back numbers. So long as they last our publisher will supply them on receipt of five halfpenny stamps for each number required.)—H. J. W. (Mr. Davies described the method of recovering hammers on p. 332, No. 872.)—R. P. G. (Soak the skins in a mixture of bran and water for two or three days; then, after scraping the flesh side quite clean, rub in a mixture of 1lb. alum and 2oz. of common salt. Leave this on for about a day, and then dry, if possible in the sun, with the hair side outwards.)—Irish Subscriber. (They eat very little in the winter half of the year, but in the summer they devour lettuces, sow-thistles, dandelions, and other milky plants voraciously. Turn it out in your garden. See White's "History of Selborne.")—R. H. (Do you not understand that a clerk has nothing to do with engineering itself? With the acquirements you speak of, you would stand a better chance of getting a higher position, but they would not fit you as assistant to a civil engineer, or for any post in the shops of a mechanical engineer. A general knowledge of engineering would, of course, be of use, even to a clerk in an engineering works.)—A Novice in Machinery. (If you have a water-fall you might use a turbine or a hydraulic engine. If a running stream, perhaps you can use a waterwheel, or you might use a windmill to drive the dynamo, and store the current in secondary batteries to work the electro-motor when required. You will probably find it cheaper to employ manual labour.)—Amateur. (The iron is thoroughly cleaned and dipped in a bath of molten tin. 2. They are brazed or soft soldered, for which see indices.)—Cyclist. (If the tire is broken through, it would be unwise to trust it, however firmly you could cement it. Mere cuts can be filled up by means of a solution of rubber in bisulphide of carbon or mineral naphtha.)—Self-Taught. (The Mastery Series (Longmans), or Ollendorff's. There are many good ones, but as to pronunciation you would learn more from a native in a few lessons than you would ever acquire from books.)—Maltsk. (We do not understand you. The devices worn by members of yachting clubs, officers of shipping companies, &c., are innumerable, and you have, of course, no right to wear one of them unless entitled to do so. There is no "penalty" that we know, except the penalty of contempt incurred by every stupid person who assumes badges and decorations he has no right to.)—Uneascorist. (We entirely agree with you, but the matter is rather one for discussion in the daily papers. Railway companies are generally monopolies, and can, unfortunately, be influenced by nothing but competition.)—S. T. D. (We know of nothing of the kind, but there are plenty of teachers who work up pupils by correspondence. You have science and art classes in your town surely. 2. Study Pitman's system.)—C. Arthur. (Take no notice of it. They are not seen unless looked for, and not then unless the system is a little out of order.)—Beer-Apple. (Has it never occurred to you that full particulars have been given many times? But it is rather a large undertaking for one who apparently does not understand how to commence.)—A. E. V. (You must be apprenticed in the usual way; but only the higher branches are worth anything nowadays.)—Paterfamilias. (Dr. Quain is about to issue his great medical dictionary, and possibly in Messrs. Churchill's catalogue you would find such books as you require.)—Optical. (Not much is known of the subject, which is of importance, for instance, to breeders of cattle and raisers of live-stock generally. In some of the medical journals and in the Transactions of the Agricultural Societies' papers occasionally appear, and it is briefly noticed in works on physiology, but no definite knowledge is to be gained.)—Accentuator. (The cause is not known.)—Ignoramus. (Back volumes it would be, not numbers; but there are several cheap manuals to be had of any bookseller. Natural stones are better than cement, which must be allowed to stand with water some time before the tank is filled with the water intended to remain.)—Signature. (1. See recent back numbers, and the index issued this week. 2. You will find a table on the subject in Vol. XXXIV., p. 336; but, as you have the materials, why not try? The battery named is not suited to the purpose.)

CHESS.

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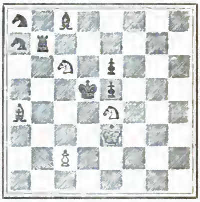
All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXXIII.—By H. F. L. Meyer.

Black.



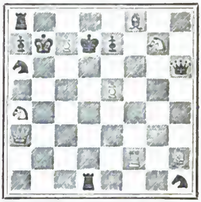
White.

White to play and mate in two moves.

PROBLEM DCCLXXXIV.—By J. A. Miles.

From "Poems and Chess Problems."

Black.



White.

White to play and mate in three moves.

Solution to 779.

White.	*Black.*
1. R to K B 3.	1. Anything.
2. Mates.	

Solution to 780.

White.	*Black.*
1. B to Q B 6.	1. Anything.
2. Mates.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 775, 776, 777, and 778 by Celsus: to 779 and 780 by Schmucke.

H. B. Reynolds, Jun., H. Vivian, E. Barow, and J. Russell.—We have entered your names for the tourney.

We shall be glad to have a few more names to make the game tourney a complete success. We may therefore, repeat that the entrance fee is 5s.: the prizes will depend on the number of entries. Subscriptions must be sent before the end of September to Mr. J. Pierce, Bryn Rhedyn, Llandurog, Carnarvon.

Vaccinal Micrococci.—M. Straus presented to a recent meeting of the Société de Biologie a series of microscopical preparations of the vaccinal pustule from the calf, at different stages of its progress, in which the presence of the special micrococcus could readily be observed. The method of preparation adopted was to place the excised fragments of skin in absolute alcohol, to cut sections and stain them by the method of Weigert, which consists of tinting with methylamine violet, and then discolouring them until only the nuclei, the bacteria, and micrococci remained visible. Under a strong magnifying power, the latter were visible as extremely minute points, tinted blue, about a thousandth part of a millimetre in diameter, and grouped in colonies. They were seen in the borders of the inoculation wound, and in the Malpighian layer, and subsequently could be traced passing into the subjacent cutis, especially in the lymphatic spaces. The multiplication and extension of the organism seemed to coincide closely with the development of the pustule.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 29, 1882.

THE IRON AND STEEL INSTITUTE.

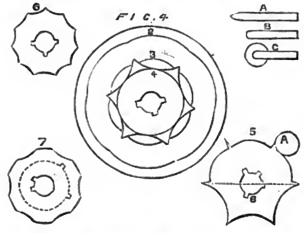
THE autumnal meeting of the Iron and Steel Institute, which has recently concluded in Vienna, seems to have been a decided success; for although the papers were read, or "taken as read," to suit arrangements of a more lively and, perhaps, more pleasing character, there were a goodly number of valuable communications and some useful discussion. The members were most hospitably received by their professional contemporaries, and were welcomed by representatives of the Government and of the City of Vienna. The president was unable to attend owing to the state of his health, and the vice-president, Mr. B. Samuelson, was also unable to be present; so the first business was to elect a chairman, and an able one was found in Mr. I. L. Bell, who has previously filled the office of president. After the ordinary and extra-ordinary introductory speeches, business was proceeded with, and Mr. B. Samuelson, M.P., elected president for the next two years. The first paper read was by Prof. von Tunner, who gave a general description of the iron industry of Styria and Carinthia. These countries are probably the oldest iron-producing districts in the world—certainly in Europe,—but while they possess abundance of good ores, they lack the supply of mineral fuel which has enabled this country to take the foremost place in the industry. Under the fostering patronage of the Government, and with the energetic assistance of the local legislators, Styria has taken a prominent place amongst the iron-producing countries; for, in 1839, a mining school was opened at Vordernberg, which developed into the Mining Academy of Leoben. Carinthian iron is mostly manufactured with vegetable fuel; but in Styria, besides small quantities of an impure coal and of a coking coal, there exists an extensive supply of brown coal and lignite. In no country in the world is the scientific study of iron and steelmaking carried out more systematically, and the very difficulties under which the ironmasters of Styria labour have caused them to make more experiments than were deemed necessary in other countries. The use of brown coal and lignite in the blast-furnace was first carried out in Styria, as was also the gasification of brown coal for melting cast steel in the Siemens furnace. Still, Prof. von Tunner recognises that, after all their struggles to compete with other districts in the matters of quantity and price, the ironmasters of Styria must now, thanks to the advantage which the dephosphorising process has conferred upon their rivals, rely upon the superior quality of their iron and steel. The mountainous nature of the country itself largely increases the cost of production, for, on an average, the expense of transport is quadrupled. The cost of producing the best pig-iron is about 25 per cent. less in England than in Styria, which appears to have several other disadvantages to contend against besides those pointed out. Of one thing the Styrians may be proud—they have always been amongst the first to recognise the merits of new inventions. The next paper read was by Chevalier von Kerpely, of Buda-Pesth, who gave a general description of the iron industry of Hungary—the object of these papers being to prepare the members for what they were to see when they went on the excursions which had been organised. Hungary, like Styria, depends almost wholly on vegetable fuel; but at some of the works they manage to produce 100kilos. (220½lb.) with 4 hectolitres (11 bushels) of beech charcoal. The trade is mainly a local one, and the Hungarian ironmasters are contented if they can supply the wants of their country. The secretary read a paper by Herr Kerzwernhart, the manager of the Teplitz Works, "On the Use of Brown Coal in Steel-Making," which, however, was supplemented by Mr. Gilchrist, who has been visiting several of the works in Germany and Austria where the basic process has been introduced. According to Mr. Gilchrist, the works at Teplitz are turning out more basic steel to-day than they did acid steel two years ago, and that with an old plant. The machinery is less costly than that used in England, but the quality of the work compares well with what is done here. From only two converters, 3,000 tons of steel are made per month, and the bottom is made to last as long as the lining—viz., from 30 to 40 charges! This remarkable result is, it appears, accomplished by making the bottom of bricks. The tuyeres are put in inclined, and two rows of bricks are laid in flat, and one row on end, but following the inclination of the tuyere and the joint. When working the acid process, the Teplitz ironmasters obtained on the average 110 "blows" per bottom, a thing that has never been done in England, or even approached. Herr Kerzwernhart subsequently stated that the average number of charges was between 25 and 30. Another thing which took Mr. Gilchrist's attention was the use made of scrap at Teplitz. In a charge of 6½ tons of steel, from 400 to 600 kilos (in round numbers 8 to 16cwt.) of cold scrap is added by means of a little shoot while the vessel is vertical and blowing, the amount to be added being regulated by the flame. An interesting episode brought the first day's proceedings to a close. That was the presentation to Mr. Thomas of a casket made entirely of the new ingot iron by the Prague Ironworks Company. Mr. Gilchrist received the casket for Mr. Thomas, who was too ill to attend. The casket is surmounted by two figures of phosphoric pig-iron, and the entire work is a valuable testimonal as to the success of the basic process.

On the second day Dr. Wedding, of Berlin, read a paper on "The Royal Prussian Institutes for Testing Materials of Construction." There are three of these institutes: that for mechanical tests has the duty of examining into the strength of iron and other metals, timber, &c.; the institute for the testing of building materials takes care of bricks, cement, lime, &c., while the Chemical Institute makes analyses and assays for the other institutes. The paper contains an interesting description of the method of carrying out the work of testing at Berlin, and, in concluding, Dr. Wedding expressed a wish that the result might be the formation of an international commission of experts from all iron-producing countries to agree upon the conditions which should be universally employed in testing materials of construction. The paper is a valuable contribution to the subject of testing, and with the statistics and tables given in an appendix will doubtless be treasured by many members of the Institute. M. A. Pourcel contributed a paper on the Terre-Noire process, the object of which is to substitue cast steel for cast iron in all mechanical constructions. The process has been successfully worked to a certain extent in England, Sweden, and America, and as an instance of what has been done at Terre-Noire, M. Pourcel stated that they have recently cast some cylinders having a diameter of two metres, a height of rather more than two metres, and a uniform thickness of 50mm. The cylinders were required to support an internal hydraulic pressure of 45 atmospheres without showing any sign of percolation. The external surfaces came out quite as smooth as if made of cast iron, and yet the metal is comparatively soft—containing on the average 0·65 per cent. carbon, 1 to 1·20 per cent. manganese, and 0·25 to 0·30 per cent. silicon. The metal is poured from the top into carefully-dried moulds of loam, pierced with numerous holes to allow the gases to escape—an important point being pouring quickly. The Terre-Noire process has been adopted at many works in this country, and at Crewe, for instance, we believe they now cast locomotive driving-wheels, with balance weights complete, of the so-called steel. The most important part of M. Pourcel's paper was that in which he referred to the cause of blowholes in cast steel. Dr. Müller attributes them to hydrogen; but the general opinion of the English workers is that blowholes are caused by carbonic oxide. It appears that when iron of almost any kind is drilled under water large volumes of hydrogen are liberated, but if the drilling is carried on under mercury no hydrogen can be detected. This simple experiment serves to show that the origin of the hydrogen is not in the iron, and Professor Chandler Roberts pertinently suggests that to prove the pressure of hydrogen it would be better to place the specimens under the air-pump and subject them to heat. The discussion which opened the proceedings of the third day, was followed by a paper "On Comparative Blast-Furnace Practice," in which the author, Mr. I. Lowthian Bell, gave a valuable collection of data in connection with blast furnaces in various parts of the world. Referring to the then near prospect of a visit to the ironworks of the Vordernberg Valley, he reminded the members that they would have an opportunity of seeing iron made with what might appear an incredibly small proportion of fuel; for while we, in this country, have been able, by the use of costly plant, to produce a ton of metal per ton of coke, in Styria and Carinthia they produce a ton with from 12cwt. to 15cwt. of charcoal, notwithstanding the smallness of the plant and the comparatively moderate temperature of the blast. The figures and facts which Mr. Bell gave will be found of much value; and some remarks he made on the extraordinary production of furnaces at the Edgar-Thomson works, near Pittsburg, will put that question on its proper footing. Nearly every expense attending the manufacture of iron bears a direct proportion to the quantity of metal produced, and it is doubtful whether any economy is effected by forcing the furnaces to a high rate of production. Mr. Snelus had a paper "On the Chemical Composition and Testing of Steel Rails," which is, in some respects, a criticism of Dr. Dudley's elaborate papers on the same subject, and is of especial interest to railway engineers. The object of the paper is to initiate discussion, and that, so far as the Institute is conconcerned, was postponed until the spring meeting. Mr. J. Gjers had a paper in which he describes the method of rolling steel ingots with their own heat. In the fluid steel, as poured into a mould, there is a larger store of heat than is required for the purpose of rolling or hammering, and it has, no doubt, occurred to many that the heat might be utilised; but the difficulty is that the interior of the ingot, when newly stripped, is far too hot to be worked into shape, and if it be kept until the interior is in a fit state, then the exterior is too cold for successful rolling. Mr. Gjers has introduced a method of keeping the ingots in such a position that they can be rolled into double-head rails with their own heat, and at the Darlington Steel and Ironworks they now work up about 500 ingots every twelve hours. A number of pits just large enough to receive the ingots easily, are built in a mass of brickwork, and the latter is heated up to a red by the insertion of hot ingots. The soaking-pits as they are called, are then ready for work. The ingots are stripped as soon as possible, and deposited one by one, by means of a crane, in the red-hot soaking-pits, which are then covered with lids. As no heat can escape, the interior heat is conducted to the surface of the ingot, which, after 20 or 30 minutes, is lifted out, apparently hotter than when it was placed in the pit, and in a suitable condition for working at the roller-mill. During the soaking the ingot gives off gas, which is entirely composed of hydrogen, nitrogen, and carbonic acid, and as the gas escapes from the lids, it will be understood that the ingot is surrounded by a perfectly non-oxidising atmosphere. The description of this process excited considerable interest, many of the leading members bearing testimony to its economic value. The papers are printed before the actual meeting, and are often curtailed in actual reading, while others are taken as read, amongst which we note a "New Hot-blast Firebrick Stove," by Mr. T. Massicks, and one by Mr. J. Hartmann, of Philadelphia, on "American Anthracite Blast Furnaces."

ON THE FORMATION OF LOOPED FIGURES BY GEARING.—IV.

FIG. 4 is given to show some of the simpler forms of rosettes to be cast and filed, or cut out of sheet brass, but not of less than 1-16th stuff, and, preferably, of ⅛ to ¼. The circle numbered 1 is merely put as the limiting line of the interior designs. For these the various centres are almost self-evident, none being outside the outer circle. They are, moreover, all formed in six sections, because every circle is so easily divisible into six segments, of which the chords are all equal to the radius. The rosette, of which the outline is marked 2, consists solely of six equal sections, of slight curvature, and is a form easy to delineate and make. The depressions are also very shallow, as is usual in those of an ordinary rose-engine, giving but slight oscillatory movement to the headstock. No. 3, also of six curves of rather deeper form, has, it will be seen, the points of No. 4 rising in the angles between the main curves. These may be left, if desired, and the form of No. 5 will result, the effect of which, when gears are used, will be found very effective, alternating broad and narrow loops of varying length. No. 4 by itself will be like the one numbered 6 below the dotted line. No. 6 has come out in eleven sections instead of twelve, as intended. This is a good form; but, curiously enough, when used with gearing, it does not follow that the hollows of the curves will so come out in the finished design, as the direction of the curves is often reversed. No. 7 consists of alternate curved projections and hollows. These are all of equal curvature. The junctions of the one with the other may be left sharp or rounded off, to become a single, waved outline. One of each will prove how easily a design is varied in practice, as the two will not be alike, though similar, and neither will of necessity be exactly a reproduction of the original. Much will also depend on the form of the rubber, and how far it is able to descend into the hollows of the rosettes. A will produce different results from B; and C, again, will materially alter the design, being a wheel, or roller rubber. This, from its size, would hardly go into the depressions of No. 2, nor of No. 5, where it is represented by A. It will be noticed that I have represented most of the rosettes with two or three key-ways, by which their position on the mandrel, or on a sleeve, can be varied at pleasure, to a certain limited extent. But I shall presently speak of this again. No. 7, however, has a dotted circle within it, to show how another very important modification is made. The whole rosette is made as a mere ring, and is then mounted upon the edge of the plain eccentric disc, in which a screw, temporarily inserted, acts as the feather. This produces most beautiful designs, the waves and loops partaking of the pattern worked on the edge of the rosette, as well as being influenced by the eccentricity of the plain disc on which it is mounted. Supposing that further complication in the pattern is desired than can be got by altering the gear-wheels, there is a very simple form of eccentric chuck, which used to be made, which is, I think, easier to construct, and almost as efficient in use, as the ordinary one with sliding plate; and as we are aiming at simplicity of apparatus for the lathe, I will describe it.

FIG. 4.



The difference in the results of this and the more modern form is, that in the latter the eccentricity takes place in a straight line at right angles to the mandrel; whereas, in the other, the line of eccentricity is curved. Fig. 8 is a profile, and Fig. 9 a plan view. There is, first of all, a plain, circular plate, with a boss and internal screw, for attachment to the mandrel: such a plate is often supplied as a small face-plate with the lathe; but it is easily made. To this is attached the upper plate, about ¼in. thick, for a small 3in. lathe, and ⅜in. for a larger one. It is of the form shown, with a central screw exactly similar to that of the mandrel. At the end is a curved slot, the exact curve being struck from A, where the plate is made to turn upon a centre screw. Another screw and wing-nut holds the radial-plate in any position. Degrees are marked on the foundation-plate, and a reading-line is scratched upon the movable one, so as accurately to mark the degree of eccentricity when the plate is moved in either direction. A superior plan is to rack the curved edge of the top plate, and add a tangent-screw, as in the revolving-plate of the modern eccentric and other chucks. This, of course, would add considerably to the difficulty of home manufacture, which is otherwise very easy to anyone who has a slide-rest. The way to make it is this: First face up the back *a b* of the boss, the flat part of the plate being held down by proper clamps to the face-plate of the lathe. Then bore out and cut screw to fit the mandrel. Mount this plate upon the mandrel by its screw, and face it up true, facing also the back, if it was not done at first, as far as the place where the clamping-screw will come, so that the washer belonging to this may have a level bearing. The movable plate should be cast with the boss, for the screw is one piece with it; but, if preferred, the latter can be attached subsequently without difficulty. The back must be first levelled. If the screw-boss is cast on, it will form a means of holding it in a wooden chuck, or in a bell or other chuck of metal. If the screw is to be attached, the piece must be secured to a face-plate to which it can be attached by a screw at A, and another through the slot. Having faced the back quite level, you can turn the front and the screw after, having mounted it upon the lower plate, which will thus serve as a lathe face-plate for that purpose. The piece will be cast with the slot in it, which must be filed up neatly and squarely. If properly centered, which it must be, the outer edge of the radial arm can be turned with the help of the slide-rest. It should be quite square to the surface. Previous to finishing and screwing, the boss, which is to hold the chuck and work, the hole at A, should be truly drilled and reamed, and its own screw turned out of a bit of steel, such screw having a smooth cylindrical part just below the head for the arm to work upon. The other screw-clamp should be also fitted, and the exact centre-line marked on the division-plate. It must be firmly clamped while the screw B is turned and threaded, because this must be accurately concentric with the mandrel. If the central screw is to be attached separately, it should be cast, or if of iron, forged, like Fig. 10, and secured by three screws, with heads countersunk into the flange. This flange, again, if the piece is mounted on a central screw, may be divided round the edge, racked and worked by a tangent screw, or cut into teeth and used with a spring click as a division-plate. This will be hardly necessary merely for its use with rose apparatus, but it will add to its general capabilities as an eccentric chuck for general use. The whole chuck being capable of formation on the lathe, and having no steel guide-bars and V-grooves, is of peculiarly easy construction.

J. L.

THE ACHROMATIC OBJECT-GLASS.—X.

By W. Bradbury.

(*Continued from page* 28.)

THE general principle of an achromatic combination of two or more lenses requires that one of them, at least, shall be of an opposite character to the rest, in order that the rays dispersed by the one may be united by the other. Suppose we have two or more lenses in contact, then, disregarding any conditions respecting their focal character, we find their compound focus (ϕ) by the following rule:—

$$\frac{1}{\phi} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \&c.$$

Now, if each of these combination foci become slightly altered, evidently the alteration of ϕ will be the sum of the rest, or as it is expressed—

$$d\left(\frac{1}{\phi}\right) = d\left(\frac{1}{f_1}\right) + d\left(\frac{1}{f_2}\right) + d\left(\frac{1}{f_3}\right).$$

But we require that the compound focal point shall remain unchanged, regardless of the alteration in any or all of the components, that is, the left half of the equation must always be zero, for all values of the right half. The sum of positive quantities can never be zero; hence one, at least, of the focal values must be negative; or we may say that in an achromatic combination the chromatic variation of the powers of the lenses must be so adjusted that they mutually destroy each other and leave the compound focus unaltered. Therefore, for two lenses, the first being convex and the second concave, we have—

$$d\left(\frac{1}{f_1}\right) = d\left(\frac{1}{f_2}\right)$$

or for three lenses, first and third convex, second concave—

$$d\left(\frac{1}{f_1}\right) + d\left(\frac{1}{f_3}\right) = d\left(\frac{1}{f_2}\right).$$

We will next determine what are the chromatic variations of the powers of the lenses.

The rule for finding the principal or solar focus of a lens is expressed in terms of the radii and refractive power—

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

Now, suppose that μ is increased by a very small amount $d\,\mu$, then the alteration in $1/f$ will be—

$$d\left(\frac{1}{f}\right) = d\mu\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

Similarly, for a second lens, whose radii are r_3 and r_4 and refractive power $(\mu^1 - 1)$, the alteration in its focus will be—

$$d\left(\frac{1}{f_2}\right) = d\mu^1\left(\frac{1}{r_3} + \frac{1}{r_4}\right)$$

Now, if these equations are equal, which we have found must be the case, in order to produce achromatism in a doublet, there results this proportion:

$$\left(\frac{1}{r_1} + \frac{1}{r_2}\right) : \left(\frac{1}{r_3} + \frac{1}{r_4}\right) :: d\mu' : d\mu$$

This is an expression in which the focal lengths do not directly enter; and in words the rule is: In an achromatic doublet, the sum of the radial reciprocals of each lens, must be inversely proportional to the variations of their refractive powers.

Let us examine this result a little more closely. The quantity $(\mu - 1)$, or the refractive power, is the refractive index diminished by unity. In finding the general focus of a lens, we make use of the mean value of the index, which is taken as the arithmetical mean of the extreme indices. This may not be exactly correct, but it furnishes a near approximation. In achromatic formulæ for combining two colours, we must take the index of the lesser refrangible ray, or generally that of the red ray; and $d\mu$ is the difference between this index and that of the ray proposed to be combined with it. Hence two lenses may be arranged to combine any pair of rays, by making the sum of their focal reciprocals inversely proportional to the difference of the corresponding indices in each substance.

The quantities $d\,\mu$, $d\,\mu^1$, &c., are termed the dispersions of the various substances. As they stand in the above equation, they are independent of $(\mu - 1)$; but we will now embody this quantity directly into the formula.

In the expression giving the chromatic variation of the power of a lens, replace the sum of the radial reciprocals, by its equivalent obtained from the equation immediately preceding, and we have:—

$$d\left(\frac{1}{f}\right) = \frac{d\mu}{(\mu - 1)} \cdot \frac{1}{f}.$$

Here $(\mu - 1)$ is the refractive power: it shows what effect the substance has in changing the direction of a ray; $d\mu$ is its dispersion, that is, it shows, relatively, the extent of coloured space. Therefore, the division of the latter by the former, shows what relation the dispersion bears to the refraction; hence it is called the *dispersive power* of the substance. So that the achromatising rule may thus be stated:—The foci of the lenses must be directly proportional to their dispersive powers.

In the employment of this rule, there is one consideration which must not be lost sight of. When we measure the focus of a lens, we regard the white luminous disc only, or what may be termed the mean focus; but in the formula the index of the red ray is our standard. Now it may seem a matter of indifference whether we calculate the dispersive power, from the lower or the higher index, or from their mean; provided we use the corresponding value for each glass. But in adjusting the mean foci of two lenses, I believe a better result will be obtained by making them correspond to the dispersive power, reckoned from the lower index, rather than from either of the other two values. We thus take the red ray as a standard, and combine the other with it; whereas, by using the mean index, we are uniting the extremes to a ray, whose position cannot be accurately defined, since it is a result of the union of other rays.

In tables of refractive powers of different glasses, where one value only of the index is given, it is generally that of a ray in the yellow part of the spectrum. But, however useful this may be, as an indication of the power of a glass, I do not see that any advantage can arise by computing the dispersive power from it.

We are thus in possession of a rule, by means of which two lenses may be made to combine any two coloured rays, and, at the same time, approximately unite the rest. The term dispersive ratio, is, of course, only a relative one, and a different value may be obtained for each pair of rays. The mean of these may be taken as the true dispersive power of the substance, since it is the ratio which most nearly unites the greatest number of rays.

By means of three lenses, two dispersive ratios can be satisfied—that is, any three rays may be united. Let us now extend our formula to a triplet combination.

Robison's Method.

The following method of computation is that which was used by Professor Robison, and is, I believe, founded on the original theory of Boscovitch.* As the focal notation is still retained by opticians, the description will not be uninteresting. I have altered the nomenclature to make it agree with the preceding modern methods.

Let the crown and flint indices be denoted by μ and μ_1; the four radii by $r_1\ r_2\ r_3\ r_4$; F and f the crown and flint foci producing a compound focus ϕ; distances measured to the right are positive, to the left negative. Also let $^1/n$ and $^1/n_1$ be the sum (or difference) of the radial reciprocals, and $d\mu$ and $d\mu_1$ the differences of the extreme indices for each kind of glass. Then the condition of achromatism between two lenses is expressed by the equation

$$\frac{d\mu}{n} + \frac{d\mu_1}{n_1} = 0$$

As a standard, let us make n equal unity: then we have $^1/n_1 = -\,d\mu\,/\,d\mu_1 = -\,u$,† and $1/\phi = (\mu - 1) - u\,(\mu_1 - 1)$; also let $c = (\mu - 1)\,(\mu_1 - 1)$. These four numbers μ, μ_1, u, and c are our preliminary data, and must always be determined before any calculations can be made.

The fundamental equation of aberration, involving the anterior radius of each lens, is this—

$$\frac{A}{r_1^2} - \frac{B}{r_1} - \frac{C}{r_3^2} - \frac{D}{r_3} + E = 0 \ldots\ldots\ldots (1)$$

in which A, B, &c., are numerical coefficients to be obtained from the known values μ, μ_1, c and u, in the following way—

$$A = \frac{c(\mu + 2)}{\mu} : B = c(2\mu + 1) : C = \frac{u^2(\mu_1 + 2)}{\mu_1}$$

$$: D = 2u(\mu_1 + 1)\left(u - \frac{2(\mu - 1)}{\mu_1}\right) : E = c\mu^2 -$$

$$u^2\mu^2 + u^2(3\mu_1 + 1)(\mu - 1) - \frac{u(3\mu_1 + 2)(\mu - 1)^2}{\mu_1}$$

Having computed these five coefficients, we can assume (within certain limits) any form for *one* of the lenses, or any desired relation between *any* pair of curves. This is equivalent to expressing r_3 in terms of r_1, or vice versâ, and finding the relation between the coefficients under this condition.

Case 1.—When the inner curves are equal and in contact.

To find the relation between r_1 and r_3; for the first lens, $^1/r_1 - {}^1/r_2 = {}^1/n = 1$ (since n is taken as unity); therefore, $^1/r_2$ or in this case $^1/r_3$ also $= {}^1/r_1 - 1$. Substitute for either radius—suppose r_3 is replaced by terms of r_1, then equation (1) takes the form—

$$\frac{A - C}{r_1^2} - \frac{B + D - 2C}{r_1} + E + D - C = 0 \ldots (2)$$

This is a quadratic equation of the form $x^2 + sx + t = 0$, whose solution gives x or $^1/r_1 = -\tfrac{1}{2}s \pm \sqrt{\tfrac{1}{4}s^2 - t}$; in which

$$s = -\frac{B + D - 2C}{A - C} \text{ and } t = \frac{E + D - C}{A - C}.$$

Having thus determined $^1/r_1$, we have $^1/r_2$, and consequently $^1/r_3 = {}^1/r - 1$; $^1/r_1 = {}^1/r_3 + \mu$, and lastly $^1/\phi = (\mu - 1) - u\,(\mu_1 - 1)$.

Case 2.—To find the flint radii when those of the crown are in a given proportion.

Let q denote the give ratio, that is, $r_1 / r_2 = q$ (in which q is a negative number, since the radii of a double convex are measured in contrary directions). Then $1 / r_2 = q / r_1$ and $1 / r_1 - 1 / r_2 = (1 - q) / r_1 = 1$ (since n in the crown is made unity). Hence $1 / r_1 = 1 / (1 - q)$, and this being substituted in equation (1), and the signs all changed to make the co-efficients of r_3 positive, we obtain—

$$\frac{C}{r_3^2} + \frac{D}{r_3} - \frac{A}{(1-q)^2} + \frac{B}{(1-q)} - E = 0 \ldots\ldots (3)$$

This is a similar equation to the previous one, and its solution gives the value of x or $1 / r_3$ in terms of—

$$s = \frac{D}{C} \text{ and } t = \frac{1}{C}\left(\frac{B}{(1 - q} - \frac{A}{(1-q)^2} - E\right)$$

When the crown lens is equi-convex $q = -1$ and the value of—

$$t = \frac{1}{C}\left(\frac{B}{2} - \frac{A}{4} - E\right).$$

Case 3.—To find the crown radii when those of the flint are in a given proportion.

As before, taking q to represent the selected ratio, we have $1 / r_4 = q / r_3$ and $1 / r_3 - 1 / r_4 = (1 - q) / r_3 = 1 / n_1$, which in this case $= -u$; hence $1 / r_3 = -u / (1 - q)$. Equation (1) now becomes—

$$\frac{A}{r_1^2} - \frac{B}{r_1} - \frac{Cu^2}{(1 - q)^2} + \frac{Du}{(1 - q)} + E = 0 \ldots\ldots (4.)$$

The root x of the quadratic gives $1/r_1$ in terms of

$$s = -\frac{B}{A} \text{ and } t = \frac{1}{A}\left(\frac{Du}{(1 - q)} - \frac{Cu^2}{(1 - q)^2} + E\right).$$

If the flint lens were equi concave (which form is not applicable) ‡ the value of

$$t = \frac{1}{A}\left(\frac{Du}{2} - \frac{Cu^2}{4} + E\right).$$

Robison gives the following examples of the use of the preceding formulæ. The crown index $\mu = 1{\cdot}526$, the flint $\mu_1 = 1{\cdot}604$, and the ratio of refraction $d\mu / d\mu_1 = u = 0{\cdot}6054$.

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[*] I am indebted for the materials of this article to the kindness of "J. C. L.," who has transcribed the chief formula from p. 151, Vol. XXI., 7th ed. (1842), of the *Encyc. Brit.*

[†] There may be some difficulty in obtaining the value of u. It is the reciprocal of the number called "ratio of refraction" in Tulley's table. If the indices are tabulated for each of the Fraunhofer lines as in Chance's list, $d\mu$ and $d\mu_1$ are the index differences for the pair of lines which it is considered best to combine, so that in this case no difficulty occurs in finding the number required. But if, as is more likely, the ratio of foci only is known, which satisfies the achromatic condition, some modification of the formula is necessary. The ratio of foci F / f is usually denoted by λ, and it is also equal to u / c; so that in case the index differences cannot be conveniently obtained, u may be found from c and λ, both of which must be known. Hence, we have $u = c\lambda$. Instead of determining u in this manner, it saves some calculation if its equivalent value $c\lambda$ be substituted throughout the expressions containing it. All the alphabetical equations then become divisible by c, which of course reduces the number of arithmetical processes, though it does not alter the values of the final quadratic coefficients s and t. At the conclusion of this paper I give the values of A, B, &c., when λ takes the place of u, and the powers of c are diminished by unity.

[‡] An equi-concave flint lens would produce far too little negative error to counteract the positive aberration of a double convex lens, even when the latter has the form giving a minimum of spherical aberration. So that there is a limit to the ratio which can be employed for the flint curves: the back of the concave must always be shallower than its inner side. If all the curves in the combination are truly spherical, it does not seem practicable to make the outer radius of the flint less than two or three times that of the inner side.

Here we have $(\mu - 1) = ·526$, $(\mu_1 - 1) = ·604$, which gives $c = ·87086$. Applying these numbers to obtain the value of the alphabetical coefficients by means of the expressions previously given, we find:—

$$A = 2·012 : B = 3·529 : C = 1·36 : D = - 0·526 : E = 1·8659.$$

These are constants for the same pairs of glasses.

Case 1.—When the interior curves are alike.

By the specified formulæ for this case, we find $s = - 0·434$ and $t = - 0·0307$, from which the value of x or $1/r_1 = 0·217 \pm 0·2789$, that is $0·4959$ or $- 0·0619$. Of these numbers the first only is admissible. Therefore, $r_1 = 1 \div 0·4959 = 2·0166$. Secondly $1/r_2 = 1/r_1 - 1 = - 0·5041$ or $r_2 = - 1·9837$. Thirdly, since the inner curves are alike, r_3 is also $- 1·9837$. Fourthly, $1/r_4 = 1/r_3 + u = 0·1013$ or $r_4 = 9·872$. And lastly, $1/\phi = (\mu - 1) - u\,(\mu_1 - 1) = 0·1603$ or ϕ 6·2383.

To find the radii corresponding to $\phi = 1$, divide the five preceding numbers by 6·2383, and we have:—

1st lens, double convex.	2nd lens, double concave.
1st radius $r_1 = 0·32325$	1st radius $r_3 = - 0·31798$
2nd radius $r_2 = - 0·31798$	2nd radius $r_4 = 1·5825$

Compound focus = 1.

Case 2.—Let the first radius of the crown be to the second as 5 : 6, that is $q = - 5/6$.

We can find the crown radii at once for $1/r_1 = 1/(1 - q) = 6/11$ or $r_1 = 1·8333$ and $r_2 = r_1/q = - 2·2$; ϕ retains its previous value 6·2383. It now remains to find r_3 and r_4.

By the specified formulæ for this case, we find $s = - 0·3867$ and $t = - 0·39669$, from which x or $1/r_3 = - 0·46546$ (taking the negative value), or $r_3 = - 2·1483$. Next, $1/r_4 = 1/r_3 + u = 0·13994$, or $r_4 = 7·1459$.

Dividing these by 6·2383, we have—

1st lens double convex.	2nd lens double concave.
1st radius $r_1 = 0·2938$	1st radius $r_3 = - 0·3143$
2nd ,, $r_2 = 0·3526$	2nd ,, $r_4 = 1·1474$

Compound focus = 1.

When the crown lens is equi-convex $q = - 1$, and we find s as before $= - 0·3867$, and $t = - 0·4144$. The process gives r_1 and r_2 each equal $0·3206$, $r_3 = - 0·3201$, $r_4 = 1·533$ when $\phi = 1$.

Case 3 may be solved in a manner precisely similar to the above. We compute the flint curves so as to be in a desired proportion, and then by finding s and t, the roots of the final quadratic give the value of $1/r_1$.

When it is convenient to use δ, the ratio of dispersive powers, instead of u, the ratio of refraction (or rather dispersion), the alphabetical coefficients are thus found:—

$$A = (\mu + 2)\,\mu : B = 2\mu + 1 : C = \delta\,(\mu_1 + 2) / \mu_1 : D = 2\delta\,(\mu_1 + 1)\,[c\delta - 2(\mu - 1)/\mu_1] : E = \mu^2 - \mu_1^2 c^2 \delta^2 + \delta\,(\mu - 1)\,[c\delta\,(3\mu_1 + 1) - (3\mu_1 + 2)\,(c - 1)/\mu_1]$$

Robison says:—"In making $r_2 = r_3$, the interior surfaces may be cemented to prevent loss of light; but this condition—by taking away one refraction—obliges us to increase those which remain, and therefore increases the spherical aberration." And that under this condition, "greater brilliancy of the image is found to result, and it is not necessary to *polish* these surfaces to the degree of perfection otherwise required." When the inner sides are not in contact, it is recommended to use a crossed rather than an equi-convex. "By comparing this object-glass (with crown equi-convex) with the former, we may remark that diminishing r_1 a little, increases r_2 a little, and in this respect improves the lens."

Robison's method possesses an advantage over many others—viz., the ease with which the condition of inner contact, or any desired relation between the inner curves is applied. This arises from the fact that the values of both curves are contained in one equation. But, on the other hand, we have to set against this, the unsuitableness of the formulæ for computing tables. The alphabetical coefficients contain the values of both refractive indices, and also the dispersive ratio; so that it is always necessary to compute the numbers from the data attached to the glass employed. This is a tedious process for the coefficients D and E. Taking these matters into account, I do not think the formulæ is so convenient as Coddington's. We might, if desirable, transform the latter into a single equation, but it would lose the elegance and conciseness which are apparent when a separate equation is kept for each lens.

There is an advantage in adopting the focal notation used by Robison. By making the radii decimal parts of a compound focus equal to unity, the requisite curves to produce any desired focus are found by multiplying these decimals by the length in inches of the focus required.

ASTRONOMICAL NOTES FOR OCTOBER, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s. a.m	h. m. s.	° ′ ″	h. m. s.
1	11 49 38·86 ,,	12 30 7	3 16 11	12 40 27·94
6	11 48 7·42 ,,	12 48 18	5 11 9	13 0 10·70
11	11 46 46·12 ,,	13 6 39	7 5 31	13 19 53·46
16	11 45 37·12 ,,	13 25 13	8 57 28	13 39 36·22
21	11 44 42·33 ,,	13 44 1	10 46 11	13 59 18·99
26	11 44 3·58 ,,	14 3 5	12 30 52	14 19 1·76
31	11 43 43·15 ,,	14 22 28	14 10 43	14 38 44·53

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390 of Vol. XXX.

The Zodiacal light may be looked for before sunrise.

But little diminution is perceptible in the evidences of Solar disturbance in the shape of spots, faculæ, and prominences.

The Moon

Enters her Last Quarter at 2h. 17·4m. a.m. on October 4th, and is New at 6h. 1·4m. in the morning of the 12th. She will enter her First Quarter at 11h. 54·5m. p.m. on the 19th; and be Full at 2h. 33·6m. in the afternoon on the 26th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	19·0	3 19·9 a.m.
6	24·0	7 37·6 ,,
11	29·0	11 9·5 ,,
16	4·2	3 4·5 p.m.
21	9·2	7 29·9 ,,
26	14·2	12 3·8 ,,
31	19·2	3 52·6 a.m.

The Moon will be in conjunction with Jupiter at 8 a.m. on the 3rd; with Mercury at 7 p.m. on the 13th; with Mars an hour later; with Venus at 4 a.m. on the 16th; with Saturn at 2 a.m. on the 28th, and once more with Jupiter at 5 p.m. on the 30th.

Mercury

Is an Evening Star up to about the 20th. At 4 a.m. on the 23rd he comes into inferior conjunction with the Sun, and subsequently to this is, of course, a Morning Star. His angular diameter increases from 7″ on the 1st of the month to 10″ by the 20th of it, and as his form continues to become more and more crescentic between these dates, he would be a most interesting telescopic object. Unfortunately, however, his great South Declination places him most disadvantageously for the observer.

Day of Month.	Right Ascension.	Declination. South.	Souths.
	h. m.	° ′	h. m.
1	14 2·0	15 40·4	1 21·3 p.m.
6	14 14·9	17 7·1	1 14·6 ,,
11	14 20·0	17 31·7	1 0·0 ,,
16	14 13·8	16 25·6	0 34·1 ,,
21	14 0·2	14 14·4	11 56·7 a.m.
26	13 35·7	9 50·9	11 16·8 ,,
31	13 26·7	7 29·2	10 43·1 ,,

The curiously-shaped path indicated by the above ephemeris carries Mercury from a very barren region in Virgo into an equally void one in Libra, and back again into Virgo.

Venus

Is an Evening Star, but, as in the case of Mercury, is very badly placed for the observer owing to her great (and increasing) South Declination. Her angular diameter increases from 26″ at the beginning of October to 40″ at the end of it. She presents a beautiful and diminishing crescent now, and, but for her proximity to the horizon, would be a charming object for the observer.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 25·6	22 34·1	2 44·7 p.m.
6	15 44·8	24 0·5	2 44·1 ,,
11	16 3·4	25 14·5	2 43·0 ,,
16	16 21·1	26 15·6	2 41·0 ,,
21	16 37·6	27 3·2	2 37·8 ,,
26	16 52·5	27 37·3	2 33·0 ,,
31	17 5·2	27 57·8	2 26·0 ,,

Hence it will be seen that Venus travels from Libra, across Scorpio and into the Southern portion of Ophiuchus. She will be in conjunction with Antares (9′ South of that Star) at 11 p.m. on the 16th.

Mars

Is invisible.

Jupiter,

In so far as his Southing is concerned, is a Morning Star; but he rises about 9 o'clock at night at the beginning of the month and soon after 7 p.m. at the end of it. His angular diameter, which is 37·8″ on the 1st, becomes 41·4 by the 31st of October. He is now a beautiful telescopic object, and becomes more and more favourably situated for the observer on each succeeding night.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 3·7	22 59·4	5 24·4 a.m.
6	6 4·9	22 59·4	5 5·8 ,,
11	6 5·7	22 59·4	4 47·0 ,,
16	6 6·1	22 59·6	4 27·7 ,,
21	6 6·2	22 59·8	4 8·2 ,,
26	6 5·9	23 0·0	3 48·2 ,,
31	6 5·2	23 0·4	3 27·9 ,,

Starting from a point a little to the West of η Geminorum, Jupiter will thus approach that star; but before reaching it will, as it were, halt and retrace his path in the sky.

Saturn

Souths a little before 3 a.m. at the begining of October, and about 12h. 47m. p.m. at the end of it. As he rises, however, between 7 and 8 o'clock in the evening at the former date, and not long after 5 p.m. at the latter one, it will be seen that he is visible and even well situated for observation during all the later part of the working hours of the night. His angular diameter increases during the month from 17·6″ to 18·2″. His ring system opens so slowly that little or no sensible difference in its appearance will be noted by those who observed it at the beginning of 1882.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 35·8	16 53·4	2 56·9 a.m.
6	3 35·0	16 49·6	2 36·3 ,,
11	3 33·9	16 45·4	2 15·6 ,,
16	3 32·8	16 40·7	1 54·8 ,,
21	3 31·5	16 35·6	1 33·8 ,,
26	3 30·1	16 30·2	1 12·8 ,,
31	3 28·3	16 23·5	12 47·4 p.m.

Saturn will describe the short retrograde arc indicated above, in that blank region of Taurus to the S. and slightly to the West of the Pleiades.

Uranus

Continues, for the observer's purpose, invisible.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	ω¹ Tauri	6	4 42 a.m.	Bright	122	143	5 48 a.m.	Dark	247	280
2	ι Tauri	5½	4 42 ,,	Bright	136	143	5 36 ,,	Dark	223	245
2	χ¹ Orionis	6	11 22 p.m	Bright	84	43	12 22 p.m.	Dark	282	240
3	χ² Orionis	6	3 48 a.m.	Bright	66	44	5 2 a.m.	Dark	287	285
6	B.A.C. 2872	6	1 7 ,,	Bright	122	83	1 51 ,,	Dark	216	176
7	ω Leonis	6	5 25 ,,	Bright	92	60	6 37 ,,	Dark	225	203
22	κ Aquarii	5	10 25 p.m.	Dark	51	72	10 53 p.m.	Bright	2	26
23	B.A.C. 8152	6½	5 5 ,,	Dark	170	135	5 38 ,,	Bright	237	204
23	15 Piscium	6½	11 22 ,,	Dark	73	95	12 11 ,,	Bright	338	7
24	λ Piscium	5	†3 2 a.m.	S.S.E.	20	59				
24	51 Piscium	6	11 49 p.m	Dark	173	192	12 26 p.m.	Bright	236	262
26	ν Piscium	6	2 47 a.m.	Dark	141	177	3 38 a.m.	Bright	252	291
29	B.A.C. 1651	6½	‡6 32 p.m.	Bright	96	64	7 21 p.m.	Dark	272	236

† Near approach. ‡ Star below the horizon.

Jupiter's Satellities.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
2	I	Sh I	3	50	A M	12	II	Ec D	3	42	40 A.M.	21	*III*	*Tr I*	8	8	P.M.
2	I	Tr I	5	9	,,	12	*I*	*Sh E*	8	56	P.M	21	III	Tr E	10	43	,,
3	I	Ec D	1	2	0 A.M.	12	I	Tr E	10	12	,,	22	II	Oc R	12	40	,,
3	I	Oc R	4	34	,,	13	II	Sh I	9	56	,,	25	I	Sh I	4	0	A M.
3	*II*	*Sh I*	6	5	,,	13	II	Tr I	12	28	,,	25	I	Tr I	5	9	,,
3	I	Sh I	10	18	P.M.	13	II	Sh E	12	39	,,	25	III	Ec D	5	17	25,,
3	III	Oc D	10	33	,,	14	II	Tr E	3	12	A M	25	*I*	*Sh E*	6	15	,,
3	I	Tr I	11	37	,,	15	II	Oc R	10	13	P M	26	I	Ec D	1	10	51,,
3	I	Sh E	12	33	,,	17	I	Ec D	4	48	54 A.M.	26	I	Oc R	4	32	,,
4	III	Oc R	1	7	A M	18	III	Ec D	1	18	48,,	26	I	Sh I	10	29	P.M.
4	I	Tr E	1	52	,,	18	I	Sh I	2	6	,,	26	I	Tr I	11	35	,,
4	I	Oc R	11	2	P M.	18	I	Tr I	3	19	,,	26	I	Sh E	12	44	,,
5	II	Ec D	1	6	25 A.M.	18	III	Ec R	3	37	52,,	27	I	Tr E	1	51	A.M.
6	II	Tr I	10	0	P.M.	18	I	Sh E	4	21	,,	27	*I*	*Ec D*	7	39	13 P.M.
6	II	Sh E	10	4	,,	18	I	Tr E	5	34	,,	27	I	Oc R	10	59	,,
6	II	Tr E	12	43	,,	18	*III*	*Oc D*	6	7	,,	28	II	Sh I	3	5	A.M.
9	*I*	*Sh I*	5	44	A.M.	18	I	Ec D	11	17	17 P.M.	28	II	Tr I	5	19	,,
10	I	Ec D	2	55	26,,	19	I	Oc R	2	43	A.M.	28	II	Sh E	5	48	,,
10	*III*	*Ec D*	9	20	20 P.M.	19	*II*	*Ec D*	6	18	48,,	28	*I*	*Tr E*	8	18	P.M.
10	III	Ec R	11	38	6,,	19	*I*	*Sh I*	8	35	P.M	28	III	Sh E	9	53	,,
10	I	Sh I	12	12	,,	19	I	Tr I	9	47	,,	28	III	Tr I	11	46	,,
11	I	Tr I	1	29	A.M.	19	I	Sh E	10	49	,,	29	III	Tr E	2	20	A.M.
11	III	Oc D	2	23	,,	19	I	Tr E	12	2	,,	29	II	Ec D	10	13	9 P.M.
11	I	Sh E	2	27	,,	20	I	Oc R	9	10	,,	30	II	Oc R	3	5	A.M.
11	I	Tr E	3	44	,,	20	II	Sh I	12	30	,,	31	II	Tr E	9	13	P.M.
11	III	Oc R	4	57	,,	21	II	Tr I	2	55	A.M						
11	*I*	*Ec D*	9	23	48 P.M.	21	II	Sh E	3	13	,,						
11	I	Oc R	12	53	,,	21	II	Tr E	5	38	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Neptune

Is in much the same position, as far as the observer is concerned, as Saturn; that is to say, he Souths during the very early morning at the begining of the month, and soon after midnight at its termination; his considerable North Declination, however, rendering him visible through a considerable portion of the night.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 6·0	15 34·7	2 27·1 a.m.
6	3 5·5	15 32·8	2 7·0 ,,
11	3 5·1	15 30·8	1 46·9 ,,
16	3 4·6	15 28·7	1 26·7 ,,
21	3 4·1	15 26·5	1 6·6 ,,
26	3 3·5	15 23·7	12 42·4 p.m.
31	3 2·9	15 21·4	12 22·1 ,,

So that Neptune will travel backwards, in the void part of the sky to the South-east of the constellation Aries.

Shooting Stars

Should be watched for between the 18th and the 21st of October, at which date we annually encounter a well-marked shower. Another, not quite so notable, may be looked for during the first six nights of the month.

Greenwich Mean Time of Southing of Twelve of the Principal Fixed Stars on the Night of October 1st, 1882.

Star	h. m. s. Souths.
Vega	5 51 32·97 p.m.
ζ Aquilæ	6 18 31·90 ,,
Altair	7 3 27·41 ,,
α² Capricorni	7 29 52·36 ,,
α Cygni	7 55 41·61 ,,
α Cephei	8 33 57·01 ,,
α Aquarii	9 17 47·80 ,,
Fomalhaut	10 9 4·09 ,,
Markab	10 16 48·01 ,,
α Andromedæ	11 20 2·43 ,,
α Cassiopeiæ	11 51 30·37 ,,
Polaris	12 34 26·53 ,,

The Method of ascertaining the Greenwich Mean Time of Transit of either of the Stars in the above List for any other night in October, as also that of determining the Local Instant of its Southing at any given station, will be found on p. 392 of Vol. XXXIV. It must be noted, however, that, as previously remarked, the rules there given are not rigidly accurate when applied to Polaris, or any other close circumpolar Star.

PRACTICAL NOTES ON PLUMBING.—XLIV.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page 53.*)

THERE are many of the old cisterns in constant use at the present time which serve a twofold purpose: they answer the original use for which they were formed, and they stand as everlasting memorials of the very highest interest, in many instances pointing out to us the most celebrated cities of antiquity. How little now remains of that city of Persepolis, its columns and its sculptures; they are crumbling and changing into dust, all is gradually disappearing, still the cisterns stand just as of old, defying the ravages of time, and, if not disturbed by artificial means, will remain for thousands of years as monuments, exciting the curiosity of the beholder, and the deep-thinking powers of the future antiquarian. Ephesus is no more, but it will be found that some of the marble sarcophagi, or coffins used for the interment of the dead, are still in existence, answering the purposes of cisterns and watering-troughs for cattle. Again we read, both in sacred and profane history, of enormous metal vases for water storage—for instance, the celebrated Brazen Sea cast for Solomon was 16ft. diameter, and about 9ft. deep, splendidly decorated with cast flowers, lilies, &c. Herodotus mentions cisterns of gold and silver of very large dimensions. In India we find cisterns made of enormous size, also in Egypt (See Deut. c. xi. v. 10, 11); and in Rome, near the Baths of Titus, may be seen to this day, nine large underground cisterns, constructed thousands of years ago. After perusing these few facts, it would be idle to suppose that my readers will take much notice of those cisterns only five or six hundred years old, such as were made of lead at Paddington in the year 1285. Some of these I shall illustrate at the end of this article on cisterns. I shall, therefore, now proceed to explain those of modern make.

The Romans well knew, and so should we also, that cisterns should always be fixed in such a position that they may be protected from the frost of winter, and from the heat of the sun in summer. In some parts of the country where there is no town water-supply, nor wells, brooks, or springs, the source of water storage is a matter of no small consideration. In such districts we have to depend upon the roof for supply: this being so, the cistern should be large, and of sufficient capacity to contain the necessary quantity for a supply for at least 15 or 16 weeks together. It is not generally known that the quantity of rain-water falling upon the surface or roof of a *slated* house, is ample for the ordinary supply of that house. I have on many occasions provided such cisternage, and always with satisfactory results; but, before you can do this, it will be necessary for you to consider and find out what will be the approximate quantity of rainfall during the year. It is easy enough to find a record of the rainfall for each year, and it is a well-known fact that in some parts of England we get more rainfall than in others—for instance, the mean rainfall in England is 31¼in., but in London it is only 25in., Upminster in Essex 19½in. In Stye, at the very head of Borrowdale in Cumberland, the wettest spot in England, the rainfall is 165in. In Manchester 38in., Bristol 32in., Hastings 32in., Ventnor 26in., Lyndon 26in., Chatsworth 28in., Plymouth 46in., Liverpool 38in., Lancaster 40in., Keswick 68in., Coniston 64in. There is also a difference between the rainfalls, caused by the seasons; the average wettest time is: autumn 9¼in., summer 8¼in., winter 7¼in., spring 6¼in. On the average October is the wettest month, and April is the driest, although it is noted for showers.

In England seldom a month passes without rain, little or much; but it must be remembered that several months may pass over without giving any rain available for water supply, and on the other hand more rain may fall within one hour than is required for one month's supply: this is proved by the extraordinary rain of 26th July, 1867, when the fall at Deptford was 3·16in., and at Greenwich 3·07in. The wettest year known at Stye gave 220in., the driest 110in., mean 165—more than six times as much as in London, or eight times as much as in the midland counties; then, again, a cold night and a bright morning will often, by condensation, &c., give water to our slated roofs, which must not be lost sight of. With this, in conjunction with the rain supply, we can make sure of having water sufficient for any ordinary country house, and therefore the cisternage must be made accordingly. Let us suppose the roof of the house to be, as my own, 40ft. by 21ft. = 840ft. super., suppose the rainfall to be 36in. or 3ft. during the year, here we get no less than 2,520 cubic feet of water, which equals 15,435 gallons. Now, allowing one pint to the cubic foot for waste, then we have left 15,120 gallons, to say nothing of the condensed water, which will at times be considerable. Now suppose we make our cisterns to hold sufficient for a three months' supply, or a little over, then the cistern must hold at least 4,000 gallons, or rather over quarter of 15,120. I have always worked to this rule, and have found it to work satisfactorily, and on several occasions have had sufficient water to supply water-closet and farmhouse. Before using lead to line a cistern, you should know whether the water is free from chemicals which have an affinity for lead, or, to simplify matters, in other words, you should find out whether it is of a chalybeate (or what is known in the plumbing world of a Charley Bates) character or not, for with certain waters the lead will quickly corrode away; at other times the tin in the solder will be attacked in a similar manner. In fact I have seen a 7lb lead eaten into holes within twelve months after fixing. I have also seen the solder in the same condition within three months after fixing: in this, the last case, the lead should be burned together, while in the former the lead can be protected by giving it a coat of lime whitewash, or one of cement, fat, or rosin.

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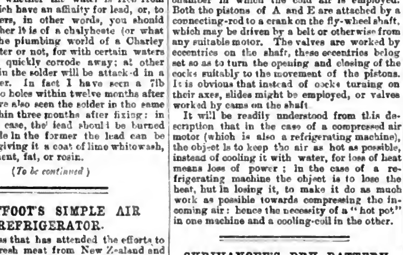
(*To be continued.*)

LIGHTFOOT'S SIMPLE AIR REFRIGERATOR.

THE success that has attended the efforts to bring fresh meat from New Zealand and Australia to this country has naturally attracted much attention, and we have received many queries asking for some simple means of obtaining a supply of cold air by means of a machine. In the accompanying diagram is illustrated a simple and compact form of refrigerating machine, patented by Mr. T. B. Lightfoot, of Fenchurch-street. A study of its construction and the principle upon which it works will be especially interesting at a time when compressed air motors for street railways are about to be introduced to the metropolis, and doubts are expressed whether compressed air can be used to bore a hole through the chalk under the Channel. The principle of the machine is well understood; it consists in compressing and cooling air, and then expanding it while it performs work. On a hollow base containing tubes through which water circulates is mounted a crank-shaft carrying a fly-wheel and driving pulley; to the crank is connected the rod of a double piston working in a cylinder, the front part of which is larger in diameter than the hinder part. At each end of the cylinder on each side thereof are valves which are conveniently made like stop-cocks, and which are worked by eccentrics or cams on the crank-shaft. The machine being driven by a belt from any suitable motor, air is drawn into the front part of the cylinder, and being compressed therein it is discharged into the hollow base, where it is cooled by contact with the water tubes. The cooled compressed air then enters the hinder part of the cylinder where it expands, assisting the piston in its forward stroke, and becoming greatly reduced in temperature, it is discharged and conveyed by a pipe to the chamber where the cold air is required. Instead of driving the machine by a belt, its shaft may be coupled to the shaft of a steam or other fluid-pressure engine, so as to be worked thereby directly.



The illustration is a side view partly in section. A is the air-compressing pump, which takes in air through the upper valve and discharges it compressed through the lower valve and pipe B into the hollow foundation C, through which cooling water circulates in tubes. Behind the pump A and in the same line with it, is the expansion cylinder E, which receives the cool compressed air from C by the pipe F (shown in dotted lines) and through its upper valve. The air expands in the cylinder E, where it assists the forward stroke of the piston and becomes refrigerated, when it issues through the lower valve and passes by the pipe G to the chamber in which the cold air is employed. Both the pistons of A and E are attached by a connecting-rod to a crank on the fly-wheel shaft, which may be driven by a belt or otherwise from any suitable motor. The valves are worked by eccentrics on the shaft, these eccentrics being set so as to turn the opening and closing of the cocks suitably to the movement of the pistons. It is obvious that instead of cocks turning on their axes, slides might be employed, or valves worked by cams on the shaft.

It will be readily understood from this description that in the case of a compressed air motor (which is also a refrigerating machine), the object is to keep the air as hot as possible, instead of cooling it with water, for loss of heat means loss of power; in the case of a refrigerating machine the object is to lose the heat, but in losing it, to make it do as much work as possible towards compressing the incoming air: hence the necessity of a "hot pot" in one machine and a cooling-coil in the other.

SKRIVANOFF'S DRY BATTERY.

A DRY battery capable of furnishing a constant powerful current from a small volume of elements, has been recently patented in this country by Mr. G. Skrivanoff, of Paris. The battery cell consists of three elementary parts—viz., a plate of retort-charcoal, agglomerated charcoal, carbon, or other conducting substance which cannot be attacked by acids; a plate of zinc carefully amalgamated; and an exciting paste applied to the charcoal or carbon. It is the use and composition of this paste which chiefly constitute the novel and distinctive character of the invention. The composition of the paste is as follows:—Chloro-mercurate of ammonium (Hg Cl_2, N H_4 Cl), 10 parts by weight; Chloride of sodium Na Cl, 3 parts by weight.

In order to prepare the chloro-mercurate of ammonium, it is necessary to boil for three hours in a porcelain capsule a concentrated solution of pure chloride of ammonium with oxide of mercury (a quarter of the weight) until the formation of a greyish white precipitate. This precipitate is placed upon a percolator and washed in plenty of water, dried, moulded and coarsely pounded. A perfectly defined salt is thus obtained, durable, unimpaired by the action of either moist or dry air, and easily preserved. To this powder is added a slightly acid solution of chloride of zinc at, say, 50° Beaumé, until a consistent paste is formed, which is carefully triturated in a porcelain mortar with the proportion of chloride of sodium before indicated. This paste may then be moulded into cakes or blocks of any desired form and size. The plate of charcoal or carbon, previously treated with paraffin, is covered with a cake or block of the exciting paste, having generally a thickness of from one to three millimetres (·04 to ·12 of an inch English measure), and being of the same shape and nearly the same size as the zinc. On this cake or block is applied from five to ten thicknesses of Berzelius' Swedish filtering-paper, or of asbestos soaked in a solution of chloride of zinc at 50° Beaumé and chloride of sodium mixed in equal parts by weight, which solution may, if desired, contain a small quantity of glycerine. The edges of the paper are made to adhere to the charcoal either by means of paraffin or in any suitable manner. The other chloromercurates of ammonium or white precipitates of mercury included in the general formula m Hg Cl^2 + n N H^4 Cl (m n being positive whole or fractional numbers) can be used in the preparation of the exciting paste, and the use of them for this purpose is included in the invention. By applying the zinc to the charcoal or carbon, prepared in the manner already described, a very constant electromotive element is formed. The difference of potential is about 1·5 volt. The interior resistance of the element is very weak. The chemical actions which take place in the element are various. There is one, however, which dominates, and that is the decomposition by the zinc, of the chloromercurate of ammonium, with the formation of double chloride of zinc, ammonium, and a small quantity of oxychloride of zinc. The free mercury returns partly on to the charcoal or carbon and partly on to the zinc in the form of amalgam. The chloride of sodium which enters into the composition of the paste plays the part of a chloridising agent and prevents the production of protochloride of mercury (mercurous chloride). The battery can be constructed and arranged in different ways according to the various applications for which it is required. By way of example, for telegraphic purposes, each element is formed of a charcoal or carbon tube, into which is introduced a rod of zinc; the annular space between the charcoal and the zinc is filled with the exciting paste. A number of these elements may be joined in tension or in quantity. In another arrangement, adapted for telegraphic, telephonic, and medical purposes, the charcoal and the zinc are in the form of plates in a suitable oblong box or casing. In a double form the double plate of charcoal or carbon is covered with the exciting paste on both faces, against which are applied the two plates of zinc, the whole being contained in a box or casing of suitable form. The battery can be made in the ordinary form, with a hemispherical cover provided with a push-knob, for electric-bell apparatus. The modifications possible are, it will be understood, very numerous.

CART AND WHEEL-MAKING.

By J. Charles King.

(*Continued from page 562, Vol. XXXV.*)

AS an ordinary blacksmith would hardly attempt to make carriage springs, an amateur could not be expected to venture to do such work; so that the following details, which, while illustrating technical details of spring-making, will interest the amateur, may serve the purpose of guiding the ordinary smith to the best and simplest processes of steel working, proportioning of parts, tempering, and for the end in view—*i.e.*, to make a spring which admits of being bent from a concave to a convex curve, without any permanent alteration of its original shape. Bow-springs for carts are subjected to this test before being fixed to the carriage of a cart. Elliptic, or double bow-springs are subjected to a test not so severe; they are weighted or sprung down, so as to make the top and bottom halves quite straight, and, if well-made and tempered, they will resume their true curves and elliptic form when unweighted. It will be asked by a learner why steel by elasticity can be curved so much, and by action of certain forces within it, regain its set curve again? The theory is that the action of "tempering" produces a peculiar crystallisation, which admits of the extension and compression of its molecular structure without alteration. Thus a carriage-spring has been known to have been in use with heavy weights always on it for a century, and yet has been unaltered, and perhaps would remain so for many centuries if kept free from rust.

The experienced cart-spring maker will turn out many hundred springs with almost unerring certainty that every spring shall sustain the violent concussions to which they are exposed over rough roads.

To effect this, keen technical knowledge is requisite, yet failure is almost unknown: unlettered tact succeeds where science, if it essayed to formulate guiding theories for workers, would fail often from divers causes, as difference in the qualities of steel, the fuel used for heating, the shape of the spring, the adjustment of the plates, the interception of non-vibrating media at the spring fixings, and many other simpler matters for the worker's consideration, more or less likely to lessen elasticity or increase brittleness. It may be as well to comprehend how serious a matter the breakage of a spring of a cart becomes, as the springs are the ties to fix the axle to the shafts, and, with a restive horse, may lead to personal injury to the cart riders. To obviate a complete breakdown, springs are made of a succession of plates, so that if one fail, the others sustain the weight and connection of parts.

At starting a job of spring-making, experience of steel is essential. Though steel known as spring-steel is specially made, care is requisite in selection, taking care to reject steel with scales, or fine cracks in the edge, and to test it by cutting a piece, which, when half cut through, should not snap off brittly by a blow of the hammer, but resist a heavy blow or pressure over the edge of the anvil, and when broken, should show a close grained whitish texture. If of large silver-shining crystals, it will be found brittle to work—it had better show the silver-grey fibrous texture of good iron; just as the steel grain shows the working and tempering must be regulated, to produce desired results. If the steel shows a plumbago hue, reject it: it will be sure to fail.

A spring-maker's forge should be about 30in. high, with a water "tew-iron," that is a water cistern, at the back of the fire, through which the nozzle of the bellows is inserted into the projecting boss of the "tew-iron." This boss should be about 6in. out towards the middle of the bed of the forge. The anvil should be well fixed on an oak or elm block, let into the ground 3 or 4ft., and always to the right of the forge, and well forward for plenty of elbow-room. The anvil leaning slightly out of horizontal away from the worker or spring-maker towards the striker, as the mate is called, who works the sledge on the opposite side of the anvil. The anvil must be smooth and flat to insure good work, also the faces of the hammers.

The mate or striker must not be a lad or a learner but with strength and experience at this particular work—which needs the quick eye, steady hand, nimble foot, and decisive grip or opening of the fingers, all without a passing word, or often even without a sign from the master worker. Talk, about the work on hand, would be out of place—at this work silence is sense. I hardly know any work which so fully illustrates the meaning of the word "technics," about which so many mistaken or frivolous interpretations are given by writers in the general press.

With spring-makers, both master and mate, it is the "trained touch" which shall, on the instant, regulate the force of the blow, the pull, or the pressure, from a hundred weight to a fraction of an ounce; that shall know the proportion to be duly given to the fraction of an inch, and the concurrent action and reaction of yielding forces inherent in material alternately ductile and brittle under varying actions of temperature, as is spring-steel.

Bars of steel suitable for dog-cart springs run from 12 to 20ft. long, 2in. wide, 5 1-16in., ¼in., 3 1-16in. thick, with gradation of 1-32in. between these thicknesses.

The bars of steel are never made hot to cut off to lengths of plates, but always cut cold, and then always only cut partly or slightly and broken—this is to learn, by the fracture, what is termed the nature of the steel to be worked, and tempered accordingly.

The cutting is done with a cutter or heavy chisel held in the twist of a hazel or willow-rod, as shown by Fig. 1. A is a ring slid up the doubled-up hazel rod to keep it tight on the chisel. The rod, though often dry and brittle before bending round the chisel, is made flexible and tough by soaking a little while in water where it is to be twisted, and then holding for a few seconds in the flame of the forge fire, this fills the grain of the wood with steam, then while one end of the rod is held in the vice, the other is twisted round on its own axis six or eight times, for about five inches of its length, so as to produce a spiral grain to the fibres of the wood, this little job takes about as long to do as to describe the doing, but it is essential to be known, as so many spring-making tools are held by rods wound round them. Sometimes iron-wire is used, but wood is less fatiguing, does not heat, jar, or cramp the hand, and is lighter to grip during a long day's work.

FIG. 1.

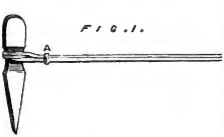
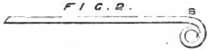
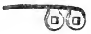


FIG. 2.



The eyes of springs are rolled up as B, Fig. 2, or made with "open-heads," as Fig. 3, to take the scroll-iron or swinging-shackle bolts.

FIG. 3



(To be continued.)

BEFORE IT HAPPENED.

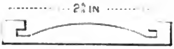
AT 9 a.m. on Wednesday, September 13th, the correspondent of a Press agency despatched a telegram to London with the intimation that the great battle at Tel-el-Kebir was practically over. It may possibly astonish not a few of our readers (says a writer in the *Echo*) to learn that this message reached the Metropolis between 7 and 8 o'clock on the same morning; and, in fact, had an unbroken telegraphic wire extended from Kassassin to London, Sir Garnet Wolseley's great victory might have been known here at 6.52 a.m., or (seemingly) at a time when the fight was raging and our success far from complete. Nay, had the telegram been flashed straight to Washington in the United States, it would have reached there something like 1h. 4m. after the local midnight of September 12. Paradoxical as this sounds, the explanation of it is of the most simple possible character. The rate at which electricity travels has been very variously estimated. Fizeau asserted that its velocity in copper wire was 111,780 miles a second; Walker that it only travels 18,400 miles through that medium during the same interval; while the experiments made in the United States during the determination of the longitudes of various stations there still further reduced the rate of motion to some 16,000 miles a second. Whichever of these values we adopt, however, we may take it, for our present purpose, that the transmission of a message by the electric telegraph is practically instantaneous. But, be it here noted, there is no such a thing as a *hora mundi*, or common time for the whole world. What is familiarly known as longitude is really the difference in time, East or West, from a line passing through the North and South Poles of the Earth; and the middle of the Great Transit Circle is the Royal Observatory at Greenwich. If, in the latitude of London (51° 30′. N.), we proceed 10 miles and 1,383 yards either in or an Easterly or Westerly direction, we find that the local time is respectively either one minute faster or one minute slower than it was at our initial point. Let us try to understand the reason of this. If we fix a tube rigidly at any station on the Earth's surface, pointing to that part of the sky in which any bright Star is situated when such star is due South (or, as it is technically called, "on the Meridian"), and note by a good clock the hour, minute, and second at which it crosses a wire stretched vertically across the tube, then, after a lapse of 23h. 56m. 4·09s., will that Star be again threaded on the wire. If the Earth were stationary—or, rather, if she had no motion but that round her axis—this would be the length of our day. But, as is well known, she is revolving round the Sun from left to right; and, as a necessary consequence, the Sun seems to be revolving round her from right to left; so that if we suppose the Sun and our Star to be both on the wire together to-day, to-morrow the Sun will appear to have travelled to the left of the Star in the sky; and the Earth will have that piece more to turn on her axis before our tube comes up with him again. This apparent motion of the Sun in the sky is not an equable one. Sometimes it is faster, sometimes slower; sometimes more slanting, sometime more horizontal. Thus it comes to pass that Solar days, or the intervals elapsing between one return of the Sun to the Meridian and another, are by no means equal. So a mean of their lengths is taken by adding them up for a year and dividing by 365; and the quantity to be divided to or subtracted from the instant of "apparent Noon" (when the Sun-dial shows 12 o'clock), is set down in the Almanac under the heading of "The Equation of Time." We may, however, here conceive that it is noon everywhere in the Northern Hemisphere when the Sun is due South. Now, the Earth turns on her axis from West to East, and occupies 24h. in doing so. As all circles are conceived to be divided into 360°, it is obvious that in one hour 15° must pass beneath the Sun or a Star; 30° in two hours, and so on. The longitude of Kassassin is roughly speaking 32° East, so that when the Sun is due South there, or it is Noon, the Earth must go on turning for two hours and eight minutes before Greenwich comes under the Sun, or it is Noon there, which is only another way of saying that at Noon at Kassassin it is 9h. 52m. a.m. at Greenwich. It is this purely local character of time which gives rise to the seeming paradox of our being able to receive news of an event before (by our clocks) it has happened at all.

THE RACIAL CHARACTERISTICS OF MAN.

ON Monday last, Dr. Zerffi, F.R.Hist.S., delivered the first of the inaugural lectures in connection with the opening of the Crystal Palace Company's School of Art, on "The Racial Characteristics of Man Scientifically Traced in General History." He complained that the study of man from a scientific point of view, especially in history as enacted by him, was mostly neglected, although it ought to be—nay, would and must more and more become—our most important subject, as forming the only real basis of all our higher culture. History was undoubtedly a deductive science, but it could be verified and put to the best uses by the purely inductive study of facts. Any change, whether progressive or retrospective, in the social, political, or religious condition of men would be a fact. The acting forces were men of whom there were on the globe more than a thousand millions, all endowed with three principal faculties—of receiving impressions, which produced sensations, and were reflected in their intellectual consciousness. But neither in comparing individuals with one another, nor race with race, were these faculties equally developed. They varied with a race's average facial angles and lines, its amount of brain, the colour of its skin, and its general organisation. The facial angle of the black races might be taken at 85°, and the number of cubic inches of brain might range between 75 and 80. In an ethnological chart hung behind the lecturer, the main body of the Nigritian races, which was made up of the Asiatic and African negroes, was credited with 83 cubic inches of brain as a general statement. It was remarked, however, that the brain was very small relatively to the body, while the cerebellum formed a very large portion of the organ. The statical and dynamical forces of the intellect were said to be undeveloped, the animal propensities predominating. The long extinct American Toltecs, ranking as one section of a subdivision under this head, figured for 79 cubic inches of brain. In both directions the intellectual forces were marked as undeveloped, but the Toltecs were credited with great imitative powers. The other section, comprising the Hottentots and Australian black fellows, were allowed but 75 cubic inches of brain, or not more than 10 above the highest anthropoid apes, and in neither did the statical or dynamical intellect pass beyond a transitory stage of the lowest degree. The typical facial angle of the yellow or Turanian races—the bulk being Chinese, Mongols, Finns, Turks, with Malay, Gangetic, Lohitic, Tamulic, and American tribes—was given as 87½ degrees. In cubic inches, the brain ranged between 83 and 95. In the chart the figure given was 83½. Here, too, the statical or conservative energy of the intellect was made the great characteristic, the dynamical or progressive developing for the most part in technical products only. The tendency was to become herdsmen, farmers, and traders. As a subdivision were classed the aborigines of India and of Egypt, with an average 80 cubic inches of brain, a very large cerebellum, and a cerebrum comparatively small. Their intellect was as characteristically statical as that of the other yellow races, the dynamic impulse manifesting itself only in symbolism, mysticism, and the like. At the head of all stood the white races, Aryans for the most part, but with the Semites—Chaldeans, Phœnicians, Hebrews, Carthagioians, Arabs—as a subdivision. Ideally, their facial angle was 90°—the right angle—and their cubic inches of brain ranged from 92 to 120, rising in individual instances—the lecturer named Byron—as high as 150. The number in the chart for the Aryans—Sanskrit-speaking Indians, the Greeks and Romans, the Goths, Kelts, Slavs and their progeny—was 92, and for the Semitic peoples, 88. The Aryans were credited with a due balance between the dynamical and statical energy of their intellect, to which they owed nearly all the great inventions and discoveries, and with all the systematic development of science. They brought forth the philosophers, moralists, engineers, sculptors, musicians. The Semitic intellect was predominantly statical, being but little developed in the creative or dynamical direction, and then mostly in theological thought. They produced, however, musicians, traders, and conquerors.

SIMPLE APPLIANCE FOR MOUNTING CARTE PICTURES.*

IT is my opinion that the convenient and easily-constructed apparatus about to be described will prove of real practical utility to the photographic printer. The tendency of recently-mounted pictures to curl inwards on drying causes considerable inconvenience in several ways, but more especially during burnishing or rolling; and in order to overcome this, I construct grooved wooden slats or strips of moulding, having a section as shown in the diagram, each slat being a trifle over two feet in length. The cards to be used are pushed into the grooving, six end to end in each slat, so that they become arched with the face outwards. After the pictures are attached, the cards are once more slid into the grooves and allowed to remain until nearly or quite dry. The set or curve thus given to the cards quite counterbalances the tendency of the print to distort the mount; but if the pictures are allowed to become quite dry in the grooves, it sometimes happens that a permanent curvature is given in a contrary direction to that usually taken.



DRAWING-ROOM PHOTOGRAPHY.

THE following remarks on the above subject are extracted from an article in the *British Journal of Photography*:—

Amongst the examples we have received are some which would certainly do credit to any professional artist, alike for the posing, lighting, and general treatment; indeed, we may say that some of the poses are of a high artistic order, and quite a relief from the conventional positions and accessories so frequently seen in professional work. The expressions secured are also, as a rule, unusually pleasing and natural. This is, no doubt, in a great measure due to the sitter feeling more at ease in the amateur friend's drawing-room than in a stranger's studio. Particularly is this the case in some excellent work—full-length pictures—sent from the other side of the Atlantic, and taken in a room of very modest dimensions, and with only one window. Among the failures (if such they may be called) the chief fault lies in the lighting and from either under or over-exposure—the former chiefly arising when a landscape lens was used, and the latter when a portrait combination was employed. Some correspondents also complain of the long exposure that, in their case, had been imperative; but, curiously enough, with all the successful pictures a very brief exposure has always been mentioned, and generally with an exceedingly small window.

With a view to the further assistance of those who have met with difficulties we recur again to the subject of the lighting, for upon this must entirely depend the success or failure in producing satisfactory results; and, as we explained in previous articles, unless proper *chiaroscuro* is secured on the model, it will be impossible to obtain it in the picture. The chief defect in this respect has been either that the light has been too abrupt, and consequently the high lights are very white and the shadows heavy, giving the pictures an under-exposed appearance, or the face is devoid of shadow, one side being as light as the other; hence it lacks the roundness necessary to constitute a good picture. In most instances the former defect has arisen from the reflecting screen not being properly placed so as to reflect back the light in the right direction, or it has been too far from the model; hence it has lost the greater part of its value. It should be borne in mind that the nearer the sitter is to the source of light the nearer the reflector must be to him, and also that at whatever angle the light falls upon the reflector it is always thrown off at a corresponding one.

Now, supposing that the light falls upon the model at an angle of (say) 40°: we shall have to place our reflecting screen at somewhat the same angle, and the nearer it is approached the greater will be the effect produced. If the sitter be placed very close to the window and the reflector a long way off, or if it project the light in a wrong direction, it is manifest that in the resulting pictures the shadows will, of necessity, be heavy, and the negative will have an under-exposed appearance however long may have been given, simply because there was no harmony in the lighting of the model. In the case where the picture has been flat it has arisen from the sitter being placed too far back from the window, so that the direct light falling upon him has been to feeble to produce any strong lights, and the reflector arranged so that it received a stronger illumination than the model, then reflecting it on to the latter, quite overpowering the dominant lights. The remedy for this is simply to bring the sitter more forward, so as to obtain a stronger dominant light.

With regard to the time of exposure: we must again impress upon the student the necessity for placing the sitter as close to the window as can be conveniently done, for then he will receive the strongest illumination; and, no matter how strong the shadows which may be produced, they can always be modified sufficiently by the judicious use of the reflector. Of course, in practice there is a limit as to the closeness the sitter can be placed, inasmuch as if too near there will not be room enough for the background. As we have before said, the effective light falling upon the sitter is governed by the amount of direct skylight to which he is exposed. For experiment, let any one seat himself (say) one foot from the window and sideways to it, and note the amount of sky that can be seen from this position, then take a seat six feet within the room, and note it from thence. The difference will be very marked indeed, and it will fully account for the long exposure that some have found imperative.

In our previous articles we directed special attention to the advantage accruing from arranging the sitter in such a position that he received as much direct light as possible, so that it practically helps to soften the shadows; hence the sitter should be placed so that he is turned as little away from the source of light as will enable the desired view of the face being obtained. That this may the more advantageously be done the camera should always be placed as close as possible to the side wall in which the window is situated. As an experiment illustrating the advantage of this: let a camera be placed close to the wall, then the sitter arranged so that from that point of view a three-quarter face is obtained, and it will be be noticed that there is very little need of the reflector at all. Let a negative now be taken, and the camera brought (say) five feet into the room, and the sitter, without changing his seat, turned round until a similar view of the face is obtained from that point. It will now be seen that the shadows are very much deeper than before, and the reflector will have to be brought pretty close in order to overcome them; nevertheless they may be obtained quite as soft and harmonious as in the former case. Let a second negative now be taken, giving the same exposure as before, and it will be found that if the first one were correctly timed the second will be considerably under-exposed. Yet the sitter was at the same distance from the window in each case.

This shows the advisability of utilising all the direct light it is possible to do, and thereby leaving as little as we can to be accomplished by the reflector. When the sitter is arranged to the best advantage at a window of ordinary size, fully exposed pictures can generally be obtained with a portrait lens (full opening) in fairly good light, on moderately-sensitive plates, with one or two seconds' (or even less) exposure. If a longer exposure than this be necessary, it may fairly be assumed that the lighting has not been properly managed.

THE SPEED OF RAILWAY TRAINS.

THE following comparison of the speed attained on various European railway lines, has been recently published in the *Verkehrszeitung*. It comprises only German, Austrian, Belgian, French, and English lines; in other countries the progression is slower.

Of trains which do an entire stretch of more than 500km., the quickest is the London, Sheffield, and Edinburgh express train. It has 669·34km. to cover (reckoning the English mile at 1·609km.), and takes 0·91 minutes per kilometer. (Here, as in all other instances, the stoppages are included). Next to this train comes the Berlin-Cologne express. It takes 1·01 minutes per kilometre of the journey of 570·26km. Then follow the rapid trains Paris-Bordeaux (558km.), and Paris-Lyons (525km.) with 1·03 minutes per kilometres each; then the rapid train Paris-Marseilles (863km.), 1·08; and the express train Bodenbach-Vienna (540km.), with 1·19 minutes per kilometre; lastly, the rapid train Paris-Toulouse (751km.) with 1·27; the courier-train Berlin-Eydskuhnen (741·9km.) with 1·29; and the express train Strasburg-Paris (501·90km.), with 1·33 minutes per kilometre.

Of the trains which do a total stretch of 400 to 500km., the two quickest are the courier train, Cologne-Bremen-Hamburg (446·90km.) with 1·12, and the express train Cracow-Vienna (413km.), with 1·37min. per km.

The trains with a total stretch of journey from 300 to 400km. rank in speed as follows: Express train London-Salisbury-Plymouth (370·07km.), with 1·00min. per km; express train London-Bristol-Plymouth (397·42km.), with 1·02min. per km.; express train Paris-Longuyon (334km.), with 1·18min. per km.; courier train Hamburg-Cassel (347·40km.), with 1·21min. per km.; Holzminden-Aachen (327·70km.), with 1·25min. per km.; Mayence-Basle (352·03km.), with 1·26min. per km.; Berlin (Kohlfurt)-Breslau (359·90km.), with 1·27min. per km.; Munich (Nurnberg)-Hof, (387·90km.), with 1·40min. per km. The slowness of this last is due to the many necessary stoppages and the unfavourable nature of the ground.

The trains, with journeys between 200 and 300km. long rank as follows:—Express train Paris-Boulogne-Calais (297km.), with 1·01min. per km.; Berlin-Hamburg (285·70km.), with 1·06min. per km. Rapid trains, Paris-Rouen-Havre (228km.), and Paris-Le Mans (211km.), each with 1·13min. per km. Express train Bremen-Magdeburg (262·23km.), with 1·18min. per km.; Brussel-Calais (215km.), with 1·22min. per km.

A somewhat higher rate of speed is presented by the following trains, which make journeys between 100 and 200km. long:—The express train, London-Sittingbourne-Dover (125·50km.), with 0·837 min. per km.; and London-Tunbridge-Dover (105km.), with 0·86min. per km.: the courier-train, Berlin-Juterbog-Dresden (187·75km.), with 0·98; the express train London-Norwich (183·82km.), with 1·01; the courier-trains, Dresden-Zoffen-Berlin (174·17km.), with 1·03; Cassel-Frankfort (198·79km.), with 1·10; Breslau-Oderburg (180·90km.), and Berlin-Leipsic (162·98km.), each with 1·15min. per km.; lastly, the courier-train, Stargard-Stettin-Berlin (169·03km.), with 1·18min. per km. A less degree of speed, on the other hand, comparatively, is manifested on the South-German stretches, Darmstadt-Heidelberg (60·70km.), with 1·07, and Mayence-Aschaffenburg (74·60km.), with 1·23min. per km.

It will be readily understood that many of the above trains have different speeds on particular parts of the whole stretch. A comparison of these shows the following portions to be traversed most quickly:—Stendal-Lehrte (134·17 km.), with 0·83; Spandau-Stendal (92·17 km), with 0·86; Hannover Dehisfelte (88·04km.), almost 0·86; Berlin-Falkenberg (111·94km.), Jüterbog-Berlin (62·83km.), and Frankfort-Guben (48·38 km.), each with 0·91 min. per km. Then come Neustadt on the Dosse-Spandau, with 0·93; Berlin-Luckenwalde (49·61km.), with 0·95; Stettin-Angermünde (68·76km)., with 1·00; Hannover-Cologne (327·82km.), with 1·04; and, lastly, Berlin-Küstrin (82·70km.), with 1·05min. per km.

From all these data it appears that the quickest trains on long stretches are London-Edinburgh, with 0·91, and Spandau-Cologne, with 1·01 min. per km. The quickest trains on stretches of mean length are Berlin-Jütebog-Dresden, with 0·98; London-Salisbury-Plymouth, with 1·00; and Paris-Boulogne-Calais, with 1·01 min. per km. The short stretches most quickly traversed are London-Sittingbourne-Dover, with 0·837; and Stendal-Lehrte, with 0·83min. per km. Thus, the quickest trains in the world (in America the railway travelling is much slower) are, according to the above-named paper, in Germany and England.

HYDRAULIC MACHINERY.—III.

By Prof. Perry.

IN taking up the subject of hydraulic presswork in my first lecture, I tried to give you exact notions on the subject of pressure in fluids not in motion. We supposed, and shall suppose for a short time, that the weight of the fluid itself was insignificant, and we found that the pressure on each square inch of surface touched by the water, and on each square inch of interface separating two portions of the fluid, was everywhere the same. One of the best methods of observing the pressure, anywhere, is by inserting a pressure gauge, such as the one you see before you. The gauge indicates the pressure per square inch at the part of the liquid to which a communicating little gauge tube penetrates. It always does so when there is no motion of the fluid at the point in question; but, unfortunately, when there is motion there, the introduction of the tube alters the motion there, and, more or less, falsifies our measurement.

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* By C. Keuchel, in *Photographisches Archiv.*

* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

Pumps.

A pump is a machine which gives energy to water; that is, it can raise water to a height, giving it potential energy. It can force water into a vessel under great pressure; that is, it can give water pressure energy. It can set water in motion; that is, give it kinetic energy.

1. A pump must be efficient; that is, it must do nearly as much work on water as the pump itself receives from an engine or labourers. But it must be remembered that the best pumps used for different purposes have very different efficiencies. Forty per cent. would be regarded as a reasonable efficiency for reciprocating-pumps of low lift, whereas it would be regarded as rather poor for pumps of high lift.

2. Pumps must not be liable to get out of order, and they ought to be readily examined, as their caretaking is usually entrusted to unskilled persons.

Pumps are either reciprocating, rotary, or centrifugal. Reciprocating-pumps are either lift-pumps, or force-pumps, or combinations of both. The peculiarity of reciprocating-pumps is that, when there is no slip, there is the same quantity of water passed through the pump at every stroke. If we know the size of everything, then the speed of the pump tells how much water is delivered, and if we know the height to which it is delivered, we know the work done.

Now, in a centrifugal-pump everything is somewhat different; with a given speed of pump, we may have very different quantities of water passing. The work which has to be done does not merely depend on the speed of the pump, then; it depends on the speed and the quantity of water. We may have the pump running at a certain speed, and no water being delivered, and very little work being done, only frictional work in fact. Now a slight increase of speed may cause an abundant flow of water, and a tremendous increase in the work being done. Strange to say, if this speed be now diminished to what it was at first, it does not follow that the water will cease to flow.

We have here before us a number of small and large specimens of centrifugal pumps. In all of them you observe that there is a central wheel, with vanes, which can be rotated very rapidly. Water can enter the wheel on both sides at its centre from these two supply pipes, which meet in one pipe below. The water filling the space between the vanes and being whirled round with great velocity, tries to get away at the circumference of the wheel, because of the centrifugal force, and it flows out into this casing, which gradually becomes the discharge-pipe of the pump. So much you were all already aware of, but we must now consider the flow of the water more carefully.

What occurred when the pressure in the pump of the hydraulic press became greater than the pressure of fluid in the press? There occurred a flow of fluid. The fluid was set in motion from pump to press. Remember, then, that a difference of pressure between two places which communicate with one another means a tendency to produce motion.

In the hydraulic press the flow is intermittent. Why? Because the pressure is intermittent. You may be sure that when you have a certain difference of pressure between two places, and this is always the same, the flow of fluid is perfectly steady; and we saw in our last lecture that work is then done on the fluid with perfect uniformity. We also saw how to tell what work was done. The work done on a fluid in a minute is simply the difference of pressure per square foot which causes the flow, multiplied into the number of cubic feet of water which flow per minute. This gives the answer in foot-pounds.

I am coming now to something which it has rather puzzled everybody to explain in any simple fashion—a puzzle to all hydraulic engineers—and, as I think it explainable, you will please try to follow my lead with some care.

Suppose that with pumps, or in any other way, I establish a difference of pressure between a place A and a place B, and suppose I know that my pumps and other arrangements will not break down—in fact, that the difference of pressure between A and B is really a fixed thing on which I can depend—you know perfectly well that the flow of water from A to B will be perfectly the same at all times, and that the same amount of work will be done upon it every minute. If, now, we leave out of our minds all consideration of how that constant difference of pressure has been produced—merely think of the two vessels A and B—you are perfectly certain that this difference of pressure which has been established is really a store of energy. What enables us to call it a store of energy? The fact that we know it will not be suddenly destroyed.

Suppose you know that a man has a certain income paid, say, by Government, and suppose you are perfectly certain that this income is constant, you can regard the certainty of the man's income as a store. To say that a man gets a sovereign a-day is not of much importance, but to say that a man has a regular income of one pound a day makes him a respectable member of society, and a store of social energy.

A man may be sitting in Parliament, but this in itself does not make him a store of political energy; but if you know that he is certain to sit there for a length of time—that a general election or general vote of the House is unlikely to unseat him—you can regard him as possessing a store of political energy.

Similarly, a pound of water in the vessel A, at rest, possesses more energy than a pound of water in the vessel B, at rest. How much more engergy has it? If the difference of pressure is p lb. per square inch, then it has 2·3 p foot-pounds of energy; not in virtue of its own intrinsic worth, but because it is where it is, and because we know that if it flows into the vessel B, nothing will alter in the pressure conditions of the two vessels till it gets into the vessel B. You understand, then, that a pound of water, subjected to a pressure of p lb. per square inch, may be said to have a store of 2·3 p foot-pounds of energy, if we know that the motion which is occurring in the water is steady, and is not altering capriciously.

Thus a pound of water at the pressure of the atmosphere, 14·73 pounds per square inch, possesses, in virtue of this pressure, 2·3 × 14·73, or 34 foot-pounds of energy. It would possess the same energy if it were at the pressure 0, the pressure in a vacuum, but were 34ft. higher than it is in position.

Suppose that A is a closed box, and that it is filled with water, under great pressure. Now, suppose I open a valve and let the water escape. Although there was a tremendous pressure, p, just for an instant; and, therefore, a rapid flow of water just for an instant, this almost instantly dies away, because the pressure in A is almost instantly diminished. Every pound of the water did not then have a store of 2·3 p foot-pounds of energy, and yet it was at the pressure of p pounds per square inch. It is the certainty that the state of pressure in A will continue constant that gives to pressure its significance, and gives to us the liberty of regarding pressure as a store of energy.

It now becomes necessary for us no longer to neglect the weight of the fluid itself. Suppose that we have, anywhere, steady motion of water. Consider a pound of the water. What is its total store of energy?

1. It is h feet above some datum level. Then if one pound of water ever were allowed to fall to the datum level, it would do h foot-pounds of work in falling. Remember that the mechanical energy stored up in a miller's dam is simply the weight of the water, multiplied by the height of the water through which it can fall. Of course, if any other volumetric force acts on the pound of water, this will constitute another store of potential energy. I am supposing that the weight of the water is the only volumetric force.

2. As the motion is steady, if the water is at a place where pressure is p pounds per square inch, it possesses, in virtue of the fact that the motion is is of a steady character, the store 2·3 p foot-pounds of energy.

3. As the water is in motion, if v is its velocity in feet per second; as its mass is 1 ÷ 32·2, we know that its kinetic energy, or energy of motion, is 1-64th of the square of the velocity.

The following table shows the relative values of h and p and v, if we wish to convert one of these forms of energy into another. Thus the energy due to a difference of level of 2·3 feet is equivalent to that due to a difference of pressure of 1lb. per square inch, or to that due to the velocity of 12·18 feet per second.

Difference of level.	Pressure.	Velocity.
2·3 ft.	1lb. per sq. in.	12·18ft. per sec.
16·1 ,,	7 ,, ,,	32·2 ,, ,,
34 ,,	14·73 ,, ,,	45·7 ,, ,,
64·4 ,,	28 ,, ,,	64·4 ,, ,,

Now, I shall not suppose that the pound of water has any other stores of energy than these. Remember that, as it is compressible to some extent, it may have a store as the mainspring of a clock has. This store must always be taken into account when the fluid is air or any other gas. It may also be electrified or at a high temperature, or it may have other stores of energy which I am neglecting. Merely think of these three stores. Potential energy due to height above a datum level. Pressure energy due to the unchangeableness of things. Kinetic energy due to its actual motion. Now, what I want you to remember carefully is the fact that this pound of water retains all of this energy except what it loses in friction. It is only when water has part of its energy in the shape of kinetic energy—only when it is in motion—that it loses any part of its total store.

Consider a lake of water at rest. Consider a point A, and somewhat below its level another point B. A pound of water at A has the same store of energy as if it were at B. In neither case is there any energy of motion. The store of energy at A is merely due to height above some datum and the pressure per square inch at A. Now, if a pound of water gets from A to B, it loses potential energy h foot-pounds, if the difference of the level is h feet, and it ought to gain an equivalent of pressure energy, and the gain of pressure is, as we have already seen, simply h / 2·3 pounds per square inch. Thus, if h is 34ft. and p is the gain of pressure, then there is a gain of pressure energy of 34 foot-pounds; that is, there is a pressure at B of 34 ÷ 2·3, or 14·73lb. per square inch greater than the pressure at A. This is an increase of pressure called one atmosphere. In still water there is an increase of pressure of one atmosphere for every 34ft. of descent.

(To be continued).

TESTING BATTERIES OF LOW RESISTANCE.[*]

THE practical difficulties which are found to exist in carrying out the ordinary battery resistance tests, when these tests are applied to the measurement of batteries or accumulators of low resistance, are being continually experienced; some method, therefore, of overcoming these difficulties may prove useful. One fruitful source of error is no doubt imperfect connections from the terminals of the various cells not being properly cleaned or screwed up, whilst the resistance of the connecting wires themselves may introduce an error which cannot be ignored when the resistance of the cells is excessively small; for instance, the resistance of a single cell of an accumulator may be as low as ·001 ohm, that is about the resistance, of 12 inches of copper wire of No. 13 B.W.G. or 1-10th in. diameter. Supposing, however, that the proper precautions have been taken so as to avoid such errors as the foregoing we are confronted with other difficulties. It is pretty generally known by those who have had to make practical measurements that in order to take battery tests with anything like accuracy, it is necessary that one measurement be made with the battery connected to a resistance approximately equivalent to the resistance of the battery itself; thus in the well-known "half deflection" method we first connect the battery to a galvanometer of very low (and consequently negligible) resistance, and then having noted the deflection, we introduce into the circuit a resistance sufficient to reduce the deflection to that point which indicates that the current flowing in the circuit has been halved in strength; when this is the case the resistance added in the circuit is the resistance of the battery. Instead of reducing the current to one-half strength, it is sufficient to introduce sufficient resistance in the circuit to produce a decided diminution in the deflection, and then from the true deflections observed, and the resistance added in the circuit, the resistance of the battery can be determined by a simple formula.

Another well-known method is to charge a condenser from the battery, and then to note the discharge; a second discharge is then taken with the battery shunted, and then the resistance of the battery is determined by a simple formula. Now, in order that any of these methods may be accurate, it is very necessary that the reduced deflection be a decided one. For instance, if the first deflection (on a Thomson's galvanometer, say) be 200 divisions, then the reduced deflection should not be less than 150 divisions, and preferably it should be as near to 100 divisions as possible. Assuming, however, that 150 divisions is sufficient, then this will mean that the battery is shunted by a resistance equal to three times the resistance of the battery. Now, supposing we tried to test a single cell of an accumulator having a resistance of ·001 ohm by this method, then when the shunt is inserted we should have a current flowing through the latter equal to

$$\frac{2 \text{ volts}}{\cdot001 + \cdot003} = 500 \text{ ampères},$$

a current sufficient to fuse, or at least seriously heat (and therefore change the resistance of) a resistance coil, even if the latter be very massively constructed, and be only connected to the battery for a very short period of time.

In order to reduce the strength of the current flowing in the circuit, either the resistance in the latter must be increased or the electromotive force must be diminished. By the following simple expedient we can effect the required result: Take 11 cells, say, of the battery or accumulator to be tested, and divide them in two sets of 6 cells and 5 cells, and then connect up the two sets in series, but in such a way that the negative pole of one set be connected to the negative pole of the other set, then by this arrangement, since the two sets oppose one another, the electromotive force of the whole combination will not be that of 11 cells, but of 6 − 5 or 1 cell. Thus we have a battery with a resistance of 11 cells, but with an electromotive force of 1 only. If we make a test with such a battery or accumulator in the manner last indicated, then the shunt which would be used would have a resistance of 11 × ·003 = ·033 ohms, and the current flowing through it would be

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[*] By H. R. Kempe, in the *Electrical Review*.

$$\frac{2 \text{ volts}}{{\cdot}011 + {\cdot}033} = 45{\cdot}5 \text{ ampères.}$$

BELTS.*

As leather belts and iron pulleys are the most extensively used, the remarks in this article are confined to them. The driving power of a belt, independently of mere strength of material, depends simply upon the resistance to slipping, or to the friction between the belt and the pulley rim, and this resistance depends in turn very largely upon the character and availability of the surfaces of both the belt and the pulley. The surface of the belt must be sufficiently true, or flat, to insure as nearly as practicable a bearing over the entire area supposed to be in contact; the belt surface must be elastic enough to admit of its clinging to the best advantage to the pulley surface, and the elasticity in the direction of the strain must be small.

For cast-iron pulleys there is no surface so good as that left by the broad tool coarse feed process, the pores of the iron being left as free and open as possible. On such a surface the belt is given an opportunity to take a much better hold than upon a polished surface. No pulleys have such a brilliant polish as those upon which the belts have been running for a long time; the pulley face finally becoming literally burnished by the slight but inevitable slip inherent in the belt system; the slip increasing gradually as the pulley becomes smoother. It would pay to put these bright pulleys into the lathe and run a coarse light cut over them, when they begin to exhibit a mirror-like surface.

Allowing that we have a proper belt and a desirable pulley, the friction or resistance is governed mainly by two things—viz., the angle of contact, and the pressure caused by the tension of the belt. There has been considerable discussion, from time to time, concerning the angle of contact; but I will rest my case in this direction upon the assertion that the driving power of a belt varies as the square of the angle of contact with the pulley. In regard to the pressure caused by tension, the question between wide and narrow belts comes in for a settlement, and I shall settle it (for myself) by deciding that, with diameter of pulley and speed the same, the wide belt will drive the most, simply because a belt 2in. wide will pull twice as much as a belt 1in. wide. In other words, two 1in. belts running side by side, or one 2in. belt running alone, will afford twice as much pulley contact, twice as much pressure upon the pulley, and twice as much section to pull with as a 1in. belt, the strain per unit of width being, of course, the same in each case.

The accompanying table sets forth a simple manner of calculating the power that can be transmitted by different leather belts.

Width of Belts. in.	Leather.	Resistance per sq. in. of Contact. lb.	Least Diam. of Pulley desirable. in.
6	Single	·70	12
8	,,	·70	16
10	,,	·65	20
8	Double	·90	30
10	,,	·85	30
12	,,	·80	30
14	,,	·75	36
16	,,	·70	36
18	,,	·65	36
20	,,	·60	40
22	,,	·58	44
24	,,	·56	48
26	,,	·54	52
28	,,	·52	56
30	,,	·50	60
36	,,	·48	72
40	,,	·45	80
48	,,	·45	96
56	,,	·45	112
30	Treble	·50	72
36	,,	·50	72
42	,,	·50	84
48	,,	·50	96
56	,,	·50	112

The figures in third column express in decimals of a pound the resistance to slipping, or angular friction per square inch of contact. The figures are given for a speed of from 2,000 to 4,500 feet per minute. The same results in power could be obtained at 800 or 1,000 feet per minute, by increasing the tension of the belt so as to produce three times the resistance, but this would be found to be unprofitable by reason of rapidly increased belt wear, and also of additional friction upon the journals. The tension necessary to produce the friction indicated in the table, is so moderate in extent that the 6in. and 8in. belts could be "thrown on" by hand; and it would only be necessary to tie, or to use belt clamps upon the larger ones on account of their weight. With a reasonable distance between centres of shafts, say, from 30ft. to 60ft., the belts will furnish sufficient working pressure by their weight alone, if drawn up within a few inches of a straight line when at rest. When operated under conditions implied by the table, the larger belts, if horizontal, may be made endless, and will run for years without any perceptible wear.

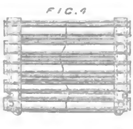
To estimate from the table the power transmitted by a belt, first ascertain the area of the surface of contact between belt and pulley, by multiplying the length in inches of the arc of contact around the pulley-rim by the width of the required belt; this gives the square inches of contact. In the third column from the left, opposite the belt under consideration, we find the resistance in decimals of a pound per square inch of contact; multiply this figure by the square inches of contact already found, and the result will be the *force* moved by the belt; multiply this force by the speed of the belt in feet per minute, and we have the foot-pounds transmitted, which divided by 33,000 will give the h.-p.

FIG. 1

FIG. 2

FIG. 3

FIG. 4



It will be observed in the third column, that the resistance per square inch of contact decreases as the belt is widened. This is because it is calculated to run the wide belts a little slacker than the narrow ones, on account of the general fact that with most materials the larger the piece the less the proportionate value. The wider the belt cut from hides, the more chances there are of weak places; and the wider the joints at the laps (not length of lap), the more chances against a good job.

The fourth column indicates the least desirable diameter of pulley to use with each width of belt. The 6in. or 8in. belts, for example, might be strained up to drive upon pulleys of 6in. diameter; but, in order to obtain the driving force upon so small a pulley necessary to operate such belts up to what they should be capable of, they would have to be strained up too tightly. In this connection the idea suggests itself that, if fan and blower manufacturers could devise some means of getting their blast wheels up to speed without employing such small pulleys, they would confer a blessing upon manufacturers generally; but I suppose they will argue that people ought to buy larger blowers. They provide means for using two belts, but two belts driving the same shaft are not very desirable. If the work is light enough to enable them to work smoothly and continuously, one belt will probably do the work, and there will then be one less belt to care for. If a pair of belts are working hard, the difference in their elasticity will cause more or less trouble and loss of power, and the chances of stoppage of the machines are greatly increased. All things considered, the best belt practice is decidedly in favour of large pulley diameter, and comparatively narrow belts running at high velocities.

There is a loss of *positiveness* of motion of probably not less than two per cent. under the best conditions, due to slip and elasticity of the leather, so that, in calculating speeds through several lines of shafting driven one from the other, allowance must be made by adding the percentage of loss, as determined by the circumstances, to the required speed in each successive line. It is impossible to run the driven shaft up to 100 per cent. of the driver, for the reason that the belt goes on to the driven pulley in a slack state, and comes from it in a stretched condition, owing to the difference in strain between the pulling and the slack sides of the belt, so that the belt leaves the driven pulley at a surface-speed a trifle greater than that of the rim of the pulley, and goes on to the driver, if no slip occurs, at a speed equal to that of the driving rim, but leaves it at a trifle slower speed. This effect is aggravated by excessive elasticity in the belt, so that the more rigid in substance a belt can be, and still retain sufficient elasticity to prevent shock, the better.

In calculating power transmitted by a belt it is only necessary to consider the smallest of the two pulleys connected; and for ordinary cases, where no measurements of the arc are made, it may be assumed that the average contact is 4-10th of the pulley circumference. The following formula expresses the operation in which formula:—

D = diameter of pulley; W = width of belt; T = decimal in the table; F = feet travelled per minute.

$$\frac{\frac{4\,D\,3{\cdot}14}{10} \times W.T.F.}{33{,}000} = H.P.$$

If it is desired to be exact, and the angle of contact can be ascertained, whatever fraction represents it, must be used in place of the one given.

SCIENTIFIC NEWS.

The death is announced of Friedrich Wöhler, the distinguished chemist and professor of the science at Gottingen. Born near Frankfort-on-the-Main in 1800, the deceased acted as professor of chemistry in the School of Trades at Berlin from 1827 to 1831, and since 1836 has experimented with great success at Göttingen. He was the discoverer of aluminium, did some illustrious work with Liebig in the field of organic chemistry, wrote several well-known textbooks and treatises on his special science, and for the last 44 years has edited a chemical and pharmaceutical journal.

The death is also announced, at the early age of 43 years, of Georges Leclanché, the inventor of the well-known galvanic cell. He quitted the service of the Eastern Railway Company about 1867 to devote himself to his researches on the peroxide of manganese cells.

The Earl of Aberdeen, General Sir Alexander Gordon, M.P., Dr. Siemens, the President of the British Association, and other distinguished persons, witnessed on Tuesday the operation of laying down the pipes and tanks at the harbour entrance of Aberdeen for the purpose of putting into permanent use the practice of pouring oil on the water to calm it in stormy weather, and thus facilitate the entrance of vessels. It will be some time before all the pipes are laid and the arrangements completed; but the work is being carefully done, as Mr. Shields is confident of its success. The material used is common fish oil, obtainable at a very cheap rate. The only difficulty that presents itself is that the pipes will be an obstruction to dredging operations.

Dun Echt Circular No. 57 contains elements and ephemeris of Barnard's comet, computed by Mr. S. C. Chandler, jun., from observations made on Sept. 13, 14, and 16. T = 1882, Nov. 5·84 G.M.T.; $\pi - ☊$ 235° 11; ☊ 249° 39'; i 83° 27' (mean equinox 1882); log. q 0·07962. Ephemeris for Washington midnight:—

		R.A.	Dec.
Sept.	25	7h. 40m. 16s.	+ 6° 38'
,,	29	7 49	2 9
Oct.	3	7 57 40	− 2 38

It is increasing in brightness.

A telegram received by the Brazilian Submarine Telegraph Co. states that a comet was seen by Captain Markham, of H.M.S. *Triumph*, on the 12th inst., which is probably that announced by M. Cruls. A letter which appeared in the *Scotsman* of the 25th inst. over the initials "C. P. S." contains some remarkable statements, amongst them the announcement that Prof. Lewis Boss has concluded that the comet of "last Monday" (presumably that discovered by M. Cruls) is the comet of 1880 and 1843. Assuming that the comet has thus returned within two years, the writor proceeds:—"Who can say whether it may not be back again from space in a few months; and then, not merely to graze close past, but actually fall into, the sun, which is so evidently increasing its hold upon it at every revolution? Wherefore we may be near upon the time for witnessing what effects will be produced when such an event takes place in the solar system as astronomers have hitherto only distantly speculated on, and no mortal eye is known to have ever beheld."

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* By Chas. A. Hague in the *American Machinist*.

Dr. de Ball discovered a small planet (No. 230) at Bothkamp on the 3rd inst.

It is stated that Mr. Werderman has made a great discovery in connection with electric lighting by means of incandescent lamps. He dispenses with the vacuum because he uses silicium in place of carbon. Silicon or silicium can be obtained in two distinct forms—the amorphous and the crystalline. Amorphous silicon is a powder of a dull brown, which burns brilliantly when heated in air. If heated intensely in a closed platinum crucible, the powder parts with a trace of hydrogen, shrinks considerably, and is changed in a remarkable manner as regards its properties. It is now crystalline silicon, which may be heated even in oxygen without taking fire, and which, unlike the amorphous form, is a conductor of electricity. The silicon can be fused into bars, and in that shape could be heated to whiteness without undergoing any change in air: hence probably its proposed use by Mr. Werderman.

In reference to M. Du Moncel's article on the chronology of telephonic discoveries (p. 584. Vol. XXXV.), our attention has been drawn to the following which appeared in the *Operator* for Nov. 1, 1880, and which can be verified by reference to the records of the the United States Patent Office:—

"April 14th, 1877, Mr. Berliner filed a caveat in the Patent office at Washington, describing the contact telephone, or microphone.

"April 27th, 1877, Mr. Edison filed an application in the patent office on his battery transmitter.

"June 4th, 1877, Mr. Berliner filed his application in the Patent Office for a patent on the same invention previously described in his caveat of April 14th, 1877.

"In December, 1877, Mr. Hughes commenced his experiments; privately exhibited his microphone in January, 1878, and gave his perfected invention to the public in May, 1878."

Experiments with the telephone attached to a diver's head-gear have been made at Sunderland, in one of the docks, and also at the North-east Coast Exhibition in the diving-tank. The length of cable was 600 yards. Conversation was carried on with complete success, as has been demonstrated elsewhere.

We have received a syllabus of the evening classes held in connection with the Polytechnic Young Men's Christian Institute, and find that in addition to a full list of science and art subjects, including vocal and instrumental music, there are a number of practical trade classes and technical classes at which instruction is given to members and non-members for small fees. The institute is for young men between the ages of 16 and 23, who, for a payment of 3s. per quarter, have free admission to the library, reading, chess, &c., rooms, and the concerts and entertainments given during the session.

The inaugural meeting of the sixth winter session of St. Mark's Technical College for Coachmakers, George-street, Grosvenor-square, will be held on Wednesday, Oct. 4, at 7.30 p.m.

At the Social Science Congress, Mr. R. Hamilton, secretary to the Education Department, read a paper "On the Endowment of Research," in which he stated that the method of State grants in aid, dispensed through the agency of existing societies and learned bodies who had earned a title to public confidence, might be most largely developed with the greatest advantage. In the course of the discussion Mr. Walter Wren said that what was wanted was rewards for something done, not payment for something to be done. He regarded the agitation for the endowment of research as a new form of alms-begging or charity hunting. By endowments the door would be opened to jobbery on a most gigantic scale.

In the *American Journal of Science* for this month, Mr. E. Orton says, that in examining with a microscope some fragments of the Devonian and sub-Carboniferous black shales of Ohio, he found many of them covered and filled with translucent discs, ranging from 1-100th to 1-200th of an inch in their largest diameters. The discs have a decidedly resinous appearance, but they yield but slowly, if at all, to ordinary solvents.

Mr. M. K. Jessup has presented the necessary funds to the American Museum of Natural History for making a full collection of the 420 varieties of trees growing in the United States. About 380 specimens have already been collected.

The plans for the new main building for the Hygienic Exhibition in Berlin have been prepared by Herr Kyllmann. The building will be, in outline, much like that destroyed, but considerably larger. It will be thoroughly fireproof, being constructed of iron and glass, and the floor cemented. The structure is to be completed by 1st April, 1883. Applications of intending exhibitors must be made before 15th October next.

In microscopical examinations of metals, especially iron and steel, it is desirable to have an instrument with which large pieces may be examined, as it is often inconvenient to detach small pieces for the purpose. For various other observations, great mobility in the instrument is an advantage. With this view, Herr Martens, of Berlin, has contrived a microscope of the following form: There is a solid square cast-iron base, with a hemispherical object-table, also solid, having a circular plate which can be screwed more or less deeply into it. The hemisphere moves freely, yet sticks easily in any position, in a greased cup in the base. The microscope proper is supported from the side of the base by means of a bent metallic piece, and two ball-and-socket joints, with fixing screws. No illuminating lens is used, as, with the small power employed, it is sufficient to turn the object well to the light, and the arrangement makes this easy. Three magnifying powers are provided, and the object-glass is protected from dust, &c., by a plane parallel glass lens. The instrument (of which an account appears in Dingler's *Journal*) is made by Franz Schmidt and Haensch, Stallschreiber-strasse No. 4, Berlin.

A simple creamer, devised by M. Fouchier, has recently attracted some notice in France. It acts on the siphon principle. An elongated tin vessel, narrowing downwards, holds the milk, and a siphon is supported on the edge so that the smaller branch descends to the bottom. The long branch being stopped, and the skim milk brought into the siphon by suction of an attached tube, the stopper is removed and the flow proceeds. The cream, too thick to rise in the siphon, remains in the vessel. The siphon is easily cleaned with hot water.

Before the adoption of rifled cannon with oblong projectiles, several eminent artillerists conceived the idea that good effects might be obtained with a disc-shaped projectile, having a rotation about its axis of figure, and fired so as to present its equatorial surface to the air. Experiments were indeed made in France not very long ago with a portable arm and discoid projectiles. The chief advantages hoped for were attenuated air-resistance, great stability of the axis of rotation, and consequent accuracy, penetrating power, &c. As these advantages were largely had with oblong projectiles, the matter dropped. In the *Revue d' Artillerie*, however, Capt. Chapel has lately called attention to a new property of these discoid projectiles, and thinks it might, in some cases, prove valuable. This is a tendency in the descending path, *to return*, and to strike the ground at an angle above 90°. In this way, artillery placed opposite a line of defence, would be able to strike the defenders from behind, and the ordinary methods of defence would require modification.

The Gulf Stream has lately, it is known, been a subject of speculation. Some variations in its course have been supposed to account for the shifting about of certain fish species. M. Blavier attributed its recent deflections (as supposed) to lessened power of the polar current to turn it southward. Recently, in a letter to the *Association Scientifique de France*, M. Saco makes the singular prediction that some day the slow but sure work of the madrepore will have connected Cuba and Florida; the result being, to impede the outflow of the Gulf Stream, so that it will hardly reach as high as Portugal. He also thinks the work of this small organism may even, in time, effect a displacement of the earth's axis of rotation. Criticising these views in an Italian journal, Prof. Zona, of Palermo, considers M. Saco exaggerates in respect of the second point, the material accumulated by the madrepore being so light, and not rising above sea-level. He thinks the ultimate junction of Florida and Cuba very probable; but that the Gulf Stream would not, therefore, necessarily be deflected (nor even if the whole of the Greater and Less Antilles were united by the madrepore). A great part of the water of the stream comes from the Equatorial current, which does not enter the Caribbean Sea. If the present direction of the Gulf Stream were regulated by a twist given it in the Gulf of Mexico, it would not bathe European shores, but would traverse the region of the Sargasso direct to Africa. If the Florida channel were blocked the current would not enter the Gulf of Mexico, but issue south of Cuba, or between Hayti and Porto Rico, and then go northwards; or, more probably, it would not enter the Caribbean Sea any more, but flow up the American coast towards Newfoundland, proceeding thence under the name of the Gulf Stream.

The French Association for preventing accidents from machines (founded under the auspices of the Mulhouse Industrial Society) recommends, in its last report, the suppression of all circular saws in workshops, where practicable. The reasons given are:—(1) Circular saws are extremely dangerous for workmen; (2) they require much more force than other saws; (3) they cut a broader line, and, consequently, produce more waste. The only advantage in the circular saw is less cost price than that of the band-saw.

From time immemorial, chemists have used a sand-bath where a temperature is to be obtained higher than that of the boiling of water or of oil. The method is not wholly rational, however, sand being a very bad conductor of heat. Herr Kristalba has lately recommended the substitution of pounded fragments of graphite: they let the heat pass much better, do not oxidise, and do not soil the inclosing vessel. *L'Electricité* commends the method to electricians who have to make researches in thermo-electricity, adding that small shot of iron would nearly serve the same purpose. For more intense heats, it is known, melted lead can be used.

The electric light is likely to render valuable service in submarine operations, as in examination of wrecks, &c. According to *La Lumière Electrique* the apparatus (of the kind) giving the best results is that devised by M. Bazin. A powerful regulator is inclosed in a cylinder having a glass plate below and a reflector above, which gives bright illumination of a circular space at least 30 metres in diameters, but the light extends much further. The spectacle presented in these circumstances is said to be remarkably fine.

The telephone system is now developed to a large extent in Honolulu. A network of wires covers the island, and in the principal town, which has only 14,000 inhabitants, 230 private houses are connected telephonically. The monthly charge to subscribers is only a few dollars, and yet the contractor, who is a German, makes a pretty large income. His intention is to connect the whole archipelago by wire.

A powder-engine has been patented in Germany by Herr Beck (and will be supplied by Quack (!) and Gilles, of Cologne, next month). In it a piston is forced to and fro in a horizontal cylinder by small quantities of powder ignited on either side alternately. Powder-pans are provided on the bottom within, on which, at the proper moment, powder falls through passages from two holders, which rest on distribution-slides. The igniting of the powder is effected by means of spirit or gas-flame from the cylinder cover, drawn in through an oblique aperture by the suction-force of the piston. The access is regulated by slides. The gases of explosion are expelled through holes furnished with slides, on return of the piston. The heavy residues are pushed by the piston into bags, which are emptied at intervals. It is claimed for the new motor that, with small occupied space, it is very effective, and easily set at work. The consumption of powder is comparatively small, and the engine regulates itself. The danger is represented as slight.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more then what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆◆◆

THE EQUATORIAL TELESCOPE.—THE SIMPLEST METHOD OF MOUNTING AND USING IT.

[20562.]—IT is a matter of question whether at any former period in the history of science more facilities were afforded for the manufacture and purchase of equatorial telescopes than those which exist at present; but a difficulty often obstructs in the case of amateurs with regard to their mounting and use. An exaggerated idea seems to prevail that it is absolutely necessary to possess a closed observatory, a sidereal clock, a transit instrument, driving machinery, and other appendages, each of which is very expensive, and none of which, in fact, is essentially requisite; and if to this is added the cost of bringing down a skilled workman rom the maker's just to place the instrument in position, no wonder that many are deterred from prosecuting a study which, under other conditions, they would be very desirous of enjoying. Add to this, the variety of errors of adjustment, which most astronomical works enumerate, and which seem to create continued difficulties, but of which three only (and these very simple and easily rectified) are found of importance to the ordinary observer.

The object of the present paper is to indicate the mode (1) of placing an equatorial in position, and (2) of using it for practical purposes.

The telescope, then, as ordinarily supplied, is furnished with two graduated circles, one for reading the declination, and the other for reading the hour-angle (*i.e.*, the angular distance from the meridian) of a heavenly body. A stand is usually attached; but unless it be sufficiently firm it had better be dispensed with, and in its place a stone pillar be substituted of the shape and size of a common gatepost, but which must be placed on a solid foundation in the ground. This done, and the telescope, with its mounting being attached, the first thing is to place the instrument, by the aid of compass, with its polar axis approximately in the place of the meridian, and elevated as nearly as may be to the latitude of the place.

When this is accomplished, with as much accuracy as such a clumsy plan will admit of, we are ready to proceed to a more perfect adjustment. A good lever watch must now be called in requisition, and it must be set to correct Greenwich time by telegraph at the nearest post-office, and be capable of keeping time well, at least, for a short period. A fine day must be chosen, and when the sun is shining brightly it must be placed (with proper precautions as to shading, &c.), in the field of view of the telescope. A reference to the *Nautical Almanack* will point the sun's declination at that instant to the nearest minute of one; and keeping the sun in the centre of the field, the telescope must be shifted about on its bearings, and by means of its adjusting screws, until the declination, as shown by the declination-circle, is made to coincide with that shown by the *Nautical Almanack.* This suffices for the first part of the process.

The next step requires a little calculation. The hour-angle, from instant to instant, must be computed by the following simple example: To the Greenwich time, as shown by the watch, add or subtract the equation of time from mean time, as shown by the almanac, and to this add the longitude (in time) if east, and subtract it, if west. We shall thus obtain the hour-angle of the sun in time, and, for convenience, it is best to choose the beginning of an hour, and to add the minutes elapsed since, up to the time of observation. Then the sun being kept in the centre of the field let the instrument be again shifted on its bearings until the hour-angle, as shown by the hour-circle, coincides with that shown by the calculation. To make matters sure, let the process be repeated until correctness is obtained—i.e., until the sun retains its position in the centre of the field, when the declination-circle and hour-circle are set to the positions indicated by the almanac and calculation respectively. This operation may seem tedious when expressed in words, but is really less so when carried out in practice.

The instrument having once been truly adjusted, nothing follows but to use it for actual observation. This, of course, is the most pleasurable amusement. Our first attempts at star-gazing must be made in the *daylight.* No closed observatory is required, but the telescope can be removed from its cradle or attached at will; only the blue clear sky above us, and the rich perfumed carpet of Nature spread at our feet. With this arrangement these can be seen distinctly in the full blaze of day, five out of the eight chief planets of the solar system—viz., Mercury, Venus, Mars, Jupiter, and Saturn, when above the horizon. All the first-magnitude stars, and Castor, Almach, Mizar, Algieba, and several more among the doubles. The only difficulty then is—how to find them?

For this purpose, then, let the declination circle be put to that of the body observed, suppose it to be Vega, the bright star in the Lyre. The hour-angle must then be computed as follows:—

	H.	M.	S.
Nearest hour (say).....................	10	0	0
Error of watch (fast)...................		2	10
Greenwich mean time	9	57	50
Acceleration of mean time on sidereal (see p. 478 *Nautical Almanack*)		1	38
Sidereal time at noon	13	8	45
	23	8	13
Longitude W.—sub.		12	1
	22	56	12
Right ascension of Vega.—sub.	18	32	50
Hour-angle at 10h.........................	4	23	22
Time elapsed since (say)		14	
Hour-angle at 10h. 14m.	4	37	22

This hour-angle then being set on the hour-circle, the star Vega is in the field of view.

It is needless to add, that such being the objects to be viewed in the day time, the starry heavens at night will shine forth to still greater advantage, and any newly-discovered comet can at once be recognised when its right ascension and declination are known. **James Pearson, M.A.,**

15th Wrangler, Trinity College, Cambridge,
Fleetwood Vicarage, Sept. 21st.

THE SPOTS ON JUPITER.

[20563.]—THE following are the approximate times of transit of the great red spot and white equatoreal spot on Jupiter in October, 1882:—

Day.	Red spot.	White spot.	Day.	Red spot.	White spot.
	h.	h.		h.	h.
1	17·2	14·2	17	10·4	13·8
2	13·1	19·7	18	16·2	19·3
3	18·9	15·4	19	12·1	15·0
4	14·7	11·1	20	17·9	10·6
5	20·5	16·6	21	13·7	16·1
6	16·4	12·2	22	19·5	11·8
7	12·2	17·7	23	15·3	17·3
8	18·0	13·4	24	11·2	13·0
9	13·8	18·9	25	17·0	18·5
10	19·6	14·6*	26	12·8	14·1
11	15·5	10·2	27	18·6	19·6
12	11·3	15·8	28	14·5	15·3
13	17·1	11·4	29	10·3	11·0
14	13·0	16·9	30	16·1	16·5
15	18·7	12·6	31	11·9	12·2
16	14·6	18·1	Nov. 1	17·7	17·7†

* The two spots are in opposition on this day.

† The spots are in conjunction.

It should be noted that at intervals of 12 days the red spot (after 29 rotations) comes to the central meridian of Jupiter at nearly similar times, and that at intervals of 25 days the transits of the white spot (after 61 rotations) recur at about the same times as before. On alternate nights the red spot transits 1h. 38m. later, while the white spot is presented on the C.M. 1h. 10m. later.

I have found similar tests to the above very useful for my own purposes, and they may be of some assistance to others engaged in these observations.

Bristol, Sept. 22. **W. F. Denning.**

η CORONÆ, μ_2 BOÖTIS.

[20564.]—I CAN quite confirm M. Gaudibert's experience in reference to these stars (letter 20490). in your last number. On referring to my notes, I find the following observations with my Cooke and Son's equatoreal, 8in. aperture:—

"1882, May 10. Tried η Coronæ with all powers up to 880; all but divided with 880. Estimated position 300° or 120°" (I could not say which was the smaller star). Mr. Seabroke measured it in 1879 with the 8½in. Alvan Clarke, at Rugby, thus: Pos. 110·25°, dist. 0·55", "elongated only." 1879·66. On July 8, this year, I looked again at η Coronæ, with the following result: "1882, July 8. Tried η Coronæ; decidedly elongated with power 300, but not satisfactorily divided up to 880. I think it more difficult than Zeta Boötis." Mr. Hall's distance for this latter star in 1878·35 was 0·56". In reference to μ_2 Boötis, I find the following: "1881, Aug. 6 Saw μ_2 Boötis beautifully, with powers 445, 550, best 550, distinctly separated; carefully estimated the position at 140°, not knowing Burnham's measure, pos. 136·2°, dist. 0·68", 1874·41. Mem. R.A.S., Vol. 44, page 209. I see in a letter dated Aug. 18, 1880, in this journal, Mr. Burnham states in regard to μ Coronæ, "that the result of my measures on five nights this year is distance 0·46"." **George Hunt**

Hopefield, Alleyn-park, West Dulwich, Sept. 19.

P.S.—I see in *Monthly Notices* for February this year, Mr. Hall measured μ_2 Boötis, in 1876, and again in 1879, with a distance of 0·73", and Mr. Burnham in 1878 with a distance of 0·68".

FLATS FOR REFLECTORS.

[20565.]—MR. HOLMES (20495, p. 37) says rightly that I could have said more than I did; but I do not see that any good purpose would be served by such an explanation. From a mathematical point of view, the flat should be flat, I know; but I do say that, practically, a curve of 500ft. radius or more, of a perfectly *good* surface, will not produce an error visible under the highest powers; 10ft. radius, of course, would bring the error into the region of actual perception. Mr. H. will say rightly, *that* error is existing in a less degree in the longer-focussed flat (?). Exactly, but we practical people say, the error is gone when it cannot be found. Now as to the sort of error a 10ft. radius would produce. I should expect an elongation of a star disc almost amounting to "a pair of wings." As Mr. H. says, "the irregularity of surface" in plate-glass is its fault: the mode by which plate-glass is polished is enough to convince any optician that no part *can* be perfect optically.

Prismatique.

MIRRORS OF REFLECTING TELESCOPES.

[20566.]—I WILL attempt a partial reply to the letter (20494) of "L. L. L."—a complete one will need the consideration of someone more competent than myself.

The remark of Tulley's is meaningless, for the curves producing "the least possible aberration" are certainly conic sections. Most likely he judged of the correctness of a curve by its effect, and the mere mathematical name was of very little consequence. A parabola is the only suitable surface for the large mirror of either a Cassegrain, Gregorian, or Newtonian: that is, if we require parallel rays uniting free from aberration. But if the small mirror is spherical, their joint effect will need a variation from the parabola; in what way or to what extent, I cannot say. I should have thought that the best way would be, to make the large mirror correct first, and then correct the small one by it. If this were done, I do not think the small mirror would have a spherical curve. A parabola would probably answer better than a sphere for either Cassegrain or Gregorian. The vergent rays from the large speculum are sent converging, really, by the small mirror, but only in a very slight degree; they are very nearly parallel. So that, to a great extent, the same character of surface may be employed for both mirrors. This may indicate the mode of working required, only it must be remembered, the parabola must not be *quite* reached; but the test in combination will show when sufficient has been done.

I have already replied to the query about the alteration due to the point of convergence being behind the large mirror. Can "L. L. L." or any other contributor say whether Short's large specula have been tested and found truly parabolic? He was very reticent about his methods, and is said to have been master of one which gave a true parabola; but it is said the secret died with him. I have seen it stated somewhere that he smashed his best tools, when he had no longer any use for them. **Orderic Vital.**

ACHROMATISM OF EYEPIECE.—TO "W. G. P."

[20567.]—IF "W. G. P." has not already seen it, I think he would feel interested in reading the chapter on this subject in Carpenter's book on "The Microscope and its Uses." The subject is simply and clearly dealt with, and the writer refers to the investigations of Boscovitch as the foundation of his treatment of it. Whether the works of the latter author are obtainable in England I do not know. **A. S. L.**

BREAD—PORRIDGE.

[20568.]—Is there any way of raising bread without the use of yeast, and without use of any chemical which would remain in the bread after firing. I thought of using a little liquid ammonia fort. with the water which is used in mixing the dough. Would the ammonia be entirely dissipated in firing, and would bread so made be wholesome?

I note that Dr. Edmunds strongly insists on porridge being cooked for a very long time. All the meal used in this district is roasted for some hours in process of manufacture, and is seldom boiled more than ten minutes when used for porridge, and it seems pefectly cooked.

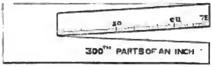
I can thoroughly endorse his remarks as to the care required in storing oatmeal. Careless storage is the reason the meal sold in the shops is so deficient in the true flavour of oatmeal. To those who want oatmeal porridge in perfection I say, buy a few stones at a time direct from the miller, and pack it firmly into a stoneware-jar or hardwood barrel, and keep covered up. If treated in this way it will keep good for six months, but if kept lying about in a bag it will lose its flavour in a few weeks, besides contracting a flavour from other things it may come in contact with. I have used porridge since I was a child, and would not want it on any account. **Highlander.**

HOW TO MAKE A DYNAMOMETER.

[20569.]—A few years ago the Rev. Mr. Berthon brought this little instrument under the notice of the readers of the "E. M."; but as a new generation of readers will have sprung up since that time, perhaps a few remarks upon it may not be out of place.

A dynamometer is a small instrument for the purpose of measuring the power of telescope eyepieces. It is simple, and if carefully used very efficient, and it may be easily and cheaply constructed as follows:—

Take a piece of thin and flat sheet-zinc or tin 3½in. long and 1in. wide (just twice the size of the sketch). Draw a line down the centre from end to end, and make a mark across this line 2½in. from one end. Then cut out a long V whose apex is at this mark, and which will be 2½in. long, and a ¼in. wide at the mouth. One-half must be cut upon each side of the central line. It is scarcely necessary to say that these measures must be made as accurately as possible, and that the sides must be straight.



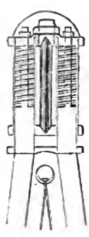
And now for the scale. Cut a piece of paper 2½in. long by ⅜in. broad, and paste or gum it on the zinc along one side of the V, the edge of the paper coming up to the V, but not projecting over. Then mark the inches from the point to the mouth, and divide each inch into as many equal parts as possible. A rule with fine divisions must be used for this purpose, such as a surveyor or architect has. I divided each inch of the one which I made into thirty parts, but some may be able to divide into forty or fifty. Let us suppose it is divided into thirty, then each division represents one three-hundredth part of an inch. Thus a wire which will pass up, we will say, as far as No. 7, would be seven three-hundredths of an inch thick, and one which will only just go in at the mouth would be seventy-five such parts, or a ¼in. in thickness, which we know to be correct. The V is ten times as long as it is wide.

In order to use it, the telescope must first be focussed upon some distant object in order to get a sharp image, and then directed towards the open sky. When the eye is removed a short distance from the eyepiece, a bright little circle of light will be seen in the glass nearest the eye. Now, this little circle has to be measured, by being passed up the slit as far as it will go, if I may use the expression, without being cut into by the edges. This is done by placing the dynamometer upon the eye-glass, and moving it until the edges of the V just take in the circle of light. A hand magnifier will be very useful to do this with, as it requires a little nicety. We will suppose the little disc of light measures fifteen three-hundredths of an inch in diameter, then the clear diameter of the object-glass in inches must be divided by this quantity, and the quotient gives the power required. If the object-glass be three inches in aperture, then three divided by fifteen three-hundredths would be sixty. This would be the power of the eyepiece upon an object-glass of that focal length. Upon a longer focus, of course, it would magnify more in proportion.

I hope our younger readers will be able to make one from these instructions, as I have no doubt it will afford them pleasure to use it, and to know exactly what is the power of each eyepiece which they possess. **Thos. K. Mellor.**

IMPROVED BICYCLE-HEAD.

[20570.]—I inclose sketch of a new and improved head for a bicycle which I have designed, and should much like to hear the opinion of your practical readers concerning it. My object has been to design a head which shall take off the vibration from the arms and hands as well as the body, and at the same time keep the machine perfectly rigid.



I propose to accomplish this by placing the head upon a spiral coil, spring, or springs; or a combination of coil and rubber springs, or upon rubber only. In order to carry out this effectually, I have found it preferable to revert to the old-fashioned open head, which is again coming into public favour, placing a bridge across immediately above the wheel, and extending the forks (the upper part of which is solid) upwards in a parallel line. The portion of forks above the bridge I make 1in. in diameter for 2in. from bridge; the remainder I reduce to ⅝in. The head proper will consist of two tubes, connected by two bridges, and between which the centres will be placed, and the tubes fitting correctly that portion of the forks 2in. in length immediately above lower bridge, and the reduced portion of forks running through upper bridge, which it shall fit. Between reduced portion of forks and tubes there will be an annular space, into which I place the spiral or other spring—these springs taking a bearing upon the shoulders of forks, and carrying the weight of loose head by the upper bridge.

The head will, therefore, be free to fall and rise without having any other motion. A nut or key is provided at the top of forks, in order that spring may be adjusted to the weight of rider and tension taken off springs when out of use. The upper portion to be surmounted by a neat cap, and a brace or plate should be placed down the front of head from bridge to bridge to prevent any liability to twist, and generally stiffen the head and add to its appearance. It will be necessary to leave an additional space of from ¾in. to 1in. between wheel and backbone to allow of play of head.

I feel confident that this head would be much easier riding than any existing machine, as it takes the vibration and jars direct from the front-wheel, and that if used in combination with indiarubber suspension or compression springs, there could be little further to be desired. **E. Martin.**

POPULAR SCIENCE LECTURES IN LONDON.

[20571.]—Do the working men of London care as much for science, when popularly treated, as those of the Northern manufacturing towns, when they crowd to the penny lectures of the Gilchrist lecturers? The experiment is about to be tried at the Victoria Hall, Waterloo-road, in connection with the Friday Evening Temperance Demonstration. The price of admission varies from a penny to sixpence in different parts of the house. The lectures already planned are "Telegrams, and How they Come," by Mr. W. Lant Carpenter, on the 29th inst.; "The Dog as the Friend of Man," by Mr. Arthur Nicols, F.G.S., on Oct. 6th, and "A Telescopic Visit to the Moon," by Mr. Mattieu Williams, on Oct. 13th. If successful, it is hoped that they will be followed by more.

One of the Committee.

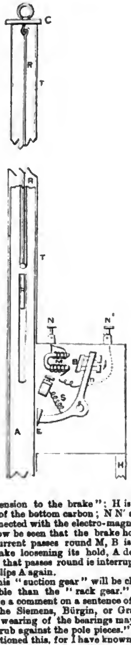
ELECTRIC LAMPS—DYNAMO-MACHINES.

[20572.]—I venture to suggest the following as an improvement that may be made in the construction of the lamp described on page 32.

T is a tube (see sketch), having a cap C carrying the stiff wire R with the plunger (or piston) P. In T fits rather tightly a rod A, drilled out so as to let P fit tightly in it.

It will be seen that A is held up by the suction at P; attached to rod A is that part of the lamp shown at Fig. 2, page 33; this part should be of sufficient weight to make it fall gradually.

The brake consists of an electro-magnet M; B the soft iron armature attached to the bent lever D E, working on the centre F; the spiral spring S "applies tension to the brake"; H is the rod of the holder of the bottom carbon; N N′ are the terminals connected with the electro-magnet M.



It will now be seen that the brake holds A; but when a current passes round M, B is attracted, and the brake loosening its hold, A descends, till the current that passes round is interrupted, when the brake clips A again.

I think this "suction gear" will be cheaper and more reliable than the "rack gear." I should like to make a comment on a sentence of "E.'s"—i.e., "In the Siemens, Bürgin, or Gramme machines, the wearing of the bearings may cause the bobbins to rub against the pole pieces." I am glad "E." mentioned this, for I have known two "Siemens" utterly "smashed up" through the bearings wearing, the armature being ground to pieces and through. I consider it a "complete failure."

Dynamo.

THE ELECTRO-MAGNETIC UNIT OF POWER.

[20573.]—Dr. Siemens, in his address to the British Association, proposes to add to the other electro-magnetic units, a new unit, the "Watt," to express the conception of power, and the quantity of power is estimated at 10^7 C.G.S.

The horse-power, or 746 Watts, would, therefore, be 746×10^7 centimetre gramme seconds.

Now, French engineers estimate the horse-power at 75 kilogrammetres per second: or a horse-power would be 750×10^4 centimetre gramme seconds.

Is there not a mistake in the estimate of the Watt as being expressed in centimetre gramme seconds, instead of centimetre milligramme seconds? **Milverton.**

SECONDARY BATTERIES.

[20574.]—As "C. F. E." (20550, p. 67), asks for my opinion as to the relative merits of the simple Planté and the manifold derivatives from it, I may say that I see no reason to change the opinion I have often expressed, that if these lead secondary batteries ever come into any extended use (as to which I have great doubts), the Planté, and those nearest to it in nature, will prove superior to those modifications as to which most noise has been made. I have tried a great many different constructions myself, having invented for myself most of the different forms recently patented; some of them I should no doubt have patented myself, with a view to possible developments; but I have so little belief in the real utility of secondary batteries, that I tried to work them out before patenting, and others have of course hit upon the same ideas, and appropriated them more quickly.

I entirely agree with Mr. Lancaster (47652, page 70). I do not think, in practical working, more than 50 per cent. of the energy will be got out of them; and an "accumulator" which just doubles the cost of the article put into it, besides the effect of its own value and wear and tear, does not commend itself to me as a valuable agent.

The great distinction between Planté's form and the various alleged improvements is that in the simple lead plate, converted into peroxide and spongy lead, all the particles are in molecular contact, while in the others, the oxides or other substances are merely held together mechanically.

For experimental purposes, I have used the lead prepared for walls, but I think it is a mistake to use the metal too thin, except in such a form as the Meritens. **Sigma.**

"A GLIMPSE THROUGH THE CORRIDORS OF TIME."

[20575.]—Though exceedingly obliged to "Paugul" for his notice in letter 20157, p. 328, Vol. XXXV., of my query in "E. M.", June 9, 1882, I still feel a little mystified as to the reply.

The "diminishing" alluded to in the ninth line of the question is simply the pith of my argument, if worth calling it so. According to every known or ordinary mechanical law, as friction diminishes velocity will gain. If, as the moon is more remote the tide is diminishing, the friction will do so, too. If, then, the friction of the tide impedes the diurnal rotation—with most tide and so most friction—the diurnal period will be slowest, or day longest; and inversely, with minimum tide and friction, the day will be *shortest;* the opposite are the theorists' views or announcements: Though the tide impedes rotation, the day, say they, is becoming longer as the moon retires and the tide *diminishes.* It is not, to my mind, an exceedingly likely hypothesis the whole theory. Either the moon's retiring, so forming a screw spiral in her convolute orbit, or the projection of "earth-moon" whatever from the globe—the first original Laplacean, Herschelian, or even Cartesian hypothesis striking me as more possible as decidedly conforming more to processes of nature:—The matter forming earth and moon extending once to the orbit of the moon in nebulous condition, revolving in one month, say; in cooling contracting to a central globe—the now solid and inhabited earth rotating more quickly while becoming less in size, a ring being left: it, in cooling, collects or gravitates into a globe—the moon—maintaining one uniform position, distance, or velocity. **Interest.**

VIOLIN SOUNDPOST.

[20576.]—Without pretending to understand the greater part of "Fiddler's" letter (20489, p. 16), headed "string vibrations," his challenge to "N. E. G." to make a violin without a soundpost against one of his, appears to imply that that is a consummation devoutly to be wished. But the position of the soundpost has a great effect in regulating the tone and distributing the power evenly over the strings.

Without going to the trouble of shifting the soundpost, which is a tedious process, the effect of change of position may be tried by simply shifting the bridge, say, first exactly over the soundpost, then a little to right and left. Then further off, and right and left of that position, and so on.

I would not advise anyone to tamper with a valuable instrument; but an ordinary one, if carefully handled, will take no harm, and this experiment will give some knowledge of the effect of the change of position, in case it should be wished to try the more elaborate process of shifting the soundpost about. Of course, each time this is done the pressure of the strings must be removed.

Captain Cuttle.

SIEMENS' SOFT-STEEL OR INGOT-IRON.

[20577.]—With the view of assisting the fellow-readers who may be engaged like myself in manufacturing the above metal, I beg to offer following remarks on an expeditious chemical means of detecting presence of oxide of iron, and absence of carbon, in a Siemens or Siemens-Martin bath of metal, and its uses. It has been proved that metal in Siemens' furnace begins to boil when carbon has been reduced to about 1 per cent. (analyses made by myself yielding 1·2, 1·16, 1·10, 1·25, &c.), and silicon to about ·02 per cent. (my analyses gave ·025, ·017, ·020, &c.). During the boil carbon is eliminated as carbonic oxide, whilst last traces of silicon are removed by oxidising nature of flame as ferrous silicate. Rapidity of boil depends largely on consistency of slag—the most basic slag being the most fluid, and, as a consequence, the more rapid is the boil: whilst with a more silicious slag, having a tendency to be more viscid or sluggish, there may be no appreciable metal-boil beyond a simmer here and there. Carbon is then eliminated extremely slowly, due to decreased temperature of metal under a "thick" slag and impeded access of oxygen to flame. Between the two extremes of very fluid and very viscid there are many grades of slags, and as rate of "boil" varies with each, it is difficult, if not sometimes impossible, to tell by appearance of the "boil" when practically whole of carbon has been eliminated. Time of duration of boil, for same reason, it will be seen, is not to be relied on. A sample of metal taken at intervals and broken cold gives a better indication; but this is often fallacious, much depending on presence of silicon and occluded carbonic oxide, both tending to cause brittleness with a given carbon, and both varying in quantity with kind of slag. I have repeatedly confirmed this by experiment.

The following test, however, I have found to be always reliable, based on the fact that as long as an appreciable amount of carbon remains (·14 per cent. and upwards), a solution of ·1grm. in 5cc., nitric acid shows a distinct brown tint, whilst when carbon is practically eliminated, the brown colour is replaced by yellowish green, which becomes more distinctly green as last traces of carbon disappear. Samples of metal are taken from furnace at intervals. When a sample stands several blows on anvil without flying to pieces, it is drilled, and ·1grm. of drillings weighed out, 5cc. nitric acid (strength, 1 fuming acid to 1 water) added in dry test-tube, then heated gradually to boiling, over sand-bath, until brown fumes first appearing are followed by white (generally 2—3 minutes). Cool tube by insertion in beaker of water, and pour solution into a narrow test-tube for comparison. Solution may now be diluted with water or compared in original acid solution. If it is still brown in tint take another sample in 20 minutes and treat similarly. When the solution begins to assume yellowish-green tint (carbon under ·135 per cent.), take next sample in 10—15 minutes. Green colour will now be more decided (carbon ·10). Next samples may be taken every 10 or 12 minutes until green colour is satisfactory, and last traces of carbon are removed as required. Without any further tests, mechanical or otherwise, ferro-manganese can be added and metal tapped. The resulting ingot metal, having taken up some carbon from ferro-manganese used, gives a brown-coloured solution, if above ·14 per cent. carbon, but yellowish-green below ·135, the tint varying somewhat according to time ferro-manganese has been allowed to remain in furnace.

The method I adopt in making soft steel or ingot-iron having a very regular carbon is to make a standard solution as above from a metal having the yellowish-green colour distinct. Dilute to certain point considered best for comparison. This is used as a guide, showing limit of green colour, to which samples must be taken before adding ferro-manganese. Should the last test sample give a rather greener tint than my standard solution, 4 or 5 pounds extra ferro-manganese are added. By this means uniform results in carbon and manganese can be secured in the ingot metal.

As samples become a more decided green in tint, they are found to be tougher when cold, and in fracture more fibrous, like wrought iron; all are however, redshort. The green tint is due to diffused ferrous oxide (FeO) which begins to be absorbed when carbon is practically eliminated. If a little scale ($FeO + Fe_3O_4$ layers) in powder be boiled in the nitric acid test solution of a metal having ·15 carbon, and ordinarily giving a brown solution—a yellowish green tinted solution results. I have found also that when metal has been well rabbled, and sample gives a decided yellowish green tint, the silicon is eliminated as completely as possible (·002, trace, ·006, ·004, ·003); therefore, when this tint appears, both is refined as far as practicable, and, beyond this, metal tends to deteriorate owing to absorption of FeO; latter has to be removed by an additional quantity of manganese.

First use of the test, then, is to show when all carbon is eliminated, and exact condition of bath before tapping. An ingot metal containing any given carbon can then be made by proper addition of manganese alloy containing known quantity of this element.

Another practical use of the test is that by practice (from comparison with standard solutions of different green tints) we may roughly estimate in every sample the relative amount of FeO absorbed in bath, and from this judge quantity of manganese to be added to reduce it and make metal free from redshortness. For ordinary brown solutions, ·8 per cent. metallic manganese is sufficient, even if it remains in the furnace 15 to 17 minutes before tapping. When just yellowish-green ·85 per cent.; but if solution has no yellowish tint, but is distinctly green, ·9 per cent. to 1¼ per cent. must be added, according to depth of green tint, in order to make metal work equally well hot. The writer is endeavouring to arrange a standard series of greenish-coloured solutions, showing approximately for given weight of iron the quantity of FeO absorbed.

A third use of the green solution, and one which I have found very valuable in certain cases, is to distinguish quickly between ordinary wrought iron (i.e. puddled iron) and the milder kinds of steel or ingot iron. One may test to the file and work mechanically as soft as the other; but, whilst mild steels, or that ingot-iron produced by a fusion process, gives under above test a brown solution, or, at most, inclining to yellowish-green; wrought iron, or that iron not made by a fusion process (as Swedish bar-iron, Staffordshire bars, &c.) gives a decided green tint (usually light in strength, but unmistakably green), and one very readily distinguished. It somewhat resembles the second sample after first yellowish-green solution taken from Siemens' bath of metal before adding ferro-manganese. In the ingot of any mild steel or ingot-iron in market I have never obtained this tinted solution.

Most wrought irons can be readily distinguished from mild steels by simply dissolving ·1 grm. in the cold acid. They usually show a tolerably clear decided green colour in the cold, whilst mild steels have a brownish flocculent precipitate in the solution, and never give such a decided green colour.

Ern. W. Harvey, A.R.S.M.

September 20.

CROWN GLASS ACHROMATISM.

[20578.]—Is "W. G. P." (p. 66) *certain* that "Prismatique" "rushed into print" in ignorance of the historical facts on the subject? I trow not. I believe that the statement that focal length, irrespective of form, is the only factor in achromatism, is not borne out in practice. I have it from good authority that one at least of our leading makers obtains almost perfect achromatism by the *form* he uses. Again, I feel sure, from my own experience, that practically some combinations that I have read of were impossible to test for achromaticity. So much for the books. While touching upon this subject, I will, as soon as I can get a practical idea from "W. G. P.'s" articles, construct a set of lenses, and publish results. What is wanted is foci, size, kind of glass, position, and separation. I will say that the construction of a set of lenses to do what is wanted would be preferable to a thousand pages devoted to elaborate argument in favour of the form proposed, however much the mathematical substructure may appear to support it. A few experiments will soon prove the practicability (or otherwise) of the scheme.

Prismatique.

[20579.]—I am not a little surprised that your able writer, "W. G. P.," should consider the short note (20546) an adequate reply to "Prismatique." I would not like to use a discourteous expression; but I will say, most emphatically, that a clever practical artist, such as "Prismatique" evidently is, has probably forgotten more about what is, and what is not, likely to be an achromatic combination than theorists like "W. G. P." or myself can know, or can be expected to know. I consider his opinion is worth more than columns of theory. If "W. G. P." had had the advantage of an occasional correspondence with him, he would know that "Prismatique" would be the last to assert that achromatism did not depend on the form of the lens, even beyond its mere spherical outline.

All that "W. G. P." has hitherto written has failed to alter, in the slightest degree, my conviction that perfect achromatism, in such an arrangement, is not attainable. I may be wrong; but am content to wait until experiment confirms or disproves my views. I cannot persuade myself to believe that a shallow crown lens can exert as much dispersive action as a deep convex one.

The last article of "W. G. P." on the achromatism of eyepieces is a very interesting one, and is, I am glad to observe, a forerunner of others of similar character.

In conclusion, I may remark that "Prismatique" is well able to hold his own, and will doubtless have something to say in reply to "W. G. P." I should not have deemed it necessary to notice this subject, had it not been that "Prismatique's" practical opinion was given in compliance with my request.

Sept. 25. **Orderic Vital.**

"HARD LABOUR" MADE USEFUL.

[20580.]—Such is the title of an article in the *Daily News* for Sept. 23. It speaks of the suggestion as coming from America, and gives a few figures which may be interesting when presented in a slightly different form.

We are told that "the treadmill at Worcester gaol has a circumference of 15ft., and a prisoner at work upon it is under the necessity of exerting his muscles to an extent equivalent to the raising of his body rather more than 30ft. per minute. An unlucky wight who finds himself upon the treadwheel at Manchester, will find it just upon 20ft. all round the wheel, and the ascent per minute will be very nearly 40ft. The time during which prisoners are kept at work varies considerably. One prison will take 185 minutes of ascending to be a day's work, with a total ascent of 7,200ft. Another will take six hours out of a prisoner, in the course of which he will have been forced to do what is equivalent to climbing up over 12,852ft.

If we take the mean of these last numbers, we have 10,000ft., as the distance a man on the treadmill may be supposed to lift his own weight daily. Take his weight at 150lb., and we have 1,500,000 foot-pounds as his day's work, which is about equal to one horse-power exerted for 45 minutes. The force of 32 men, therefore, if stored up, would give one horse-power continuously for 24 hours, or, taking off 50 per cent. for loss, every 32 men in the prison would take the place of a one-horse (indicated) steam-engine, for any such purpose as electric lighting, flour-grinding, &c., where power was required for 12 hours daily. The actual work done by one man in a minute varies from 150lb. lifted 30ft. to the same lifted 40ft. This gives 4,500 to 6,000 foot-pounds, or, roughly speaking, one-sixth to one-eighth of a horse-power (33,000 foot-pounds per minute), with allowance for friction.

The writer of the article, or his American inspiration, appears to be in difficulty how to make the work useful, and yet make each contribute his due quota. The Commissioners of Prisons are quoted as believing that "no ingenuity of mechanism would obviate the shirking of a fair share of labour by the idlers, if any considerable number were combined." By the storing-up principle, each man could have his number of foot-pounds per diem assigned to him by the governor or the medico, just as easily as his daily rations or physic, and the power stored up could be brought into use after "working hours," with, of course, the inevitable losses dependent on the "efficiency" of the machinery employed.

Ploni Almoni.

LEGAL REPLIES.

[20581.]—Title Deeds—Copyhold (47998).—The querist is undoubtedly entitled to the deeds, and he should make a demand for them upon the person in whose possession they now are, and which demand might as well be in writing, and a copy kept. If the holder refuses to give them up, an action should be brought against him in the county-court for wrongfully detaining the deeds, with damages for their detention. This may be in the form of an ordinary summons, which will be issued on payment of the usual fees; but the deeds detained should be accurately described in the particulars of claim.

Medicine.—License (48027).—I do not know of any license being necessary to enable a person to sell an ointment under his own name as the maker, nor need it be registered at Apothecaries' Hall. But, of course, it will not be a patent medicine, and anyone else can make and sell the same preparation.

Company.—Liability (48028).—Unless the company is really "Limited," and is so described in its title, the result would be that, although as regards each other and the company, the liabilities of members would be limited to the amount of their shares; yet, as concerns creditors, they would be responsible to contribute more than this, in the same way as are partners, to pay debts, whatever may be arranged upon between themselves.

Copyhold.—Lease (48035).—By copyhold is meant that the land is held by copy of the court-roll of the manor. This was originally a servile tenure, but it has gradually become much the same as a freehold, and by recent statutes either the landlord or the tenant can obtain the enfranchisement of the land upon terms, and thus make it really a freehold. A lease is merely the letting of land for a term of years, and the lessee is, in law, but the tenant of the owner of the land. The result is, of course, that when that term expires the possession of the land or house returns to the freeholder, who has all along been the legal owner of the property, although for a time he parted with the possession.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

EXAMINATION OF MALT—SOAPS—MAGNETIC SANDS—ANALYSIS OF POTASSIUM CHROMATES.

[20582.]—With regard to the examination of malt, for the determination of the contained sugar and dextrine, Mr. E. S. Beaven's letter (No. 20511, page 39) raises an interesting point. In the example he gives, however, I find that there is nothing inconsistent in the use of the factor 0·08, and the consequent assumption of the presence of maltose rather than glucose. Mr. Beaven found that a wort containing 22·9 grammes of solid matter per 100cc., when diluted with water to ten times its original volume (= ·0229 grammes extract in 1cc.) had a reducing power such that 5·75cc. decolorised 10cc. of Fehling's solution, while after boiling for two hours with dilute acid only 2·40cc. of the dilute wort was required. Now, 5·75cc. contained 5·75 × ·0229 = ·132675 gramme of solid matter. The sugar in this was 0·050 gramme if consisting of glucose, or 0·080 if maltose. Hence the dry extract contains (as stated by Mr. Beaven) 38 per cent. of glucose, or 61 per cent. of maltose. Now, by two hours' boiling with acid, the maltose originally present would be more or less completely converted into glucose, whereas Mr. Beaven assumes it to remain unchanged. By taking the precautions recommended by J. Belcher, complete conversion may be pretty well insured, but in the case in point we can only *hope* that the change was complete, and it is probable that four fifths, if not nine tenths, of the maltose would be converted. Assuming, as we are compelled to do, that the whole is transformed, the 38 per cent. of reducing power would be raised in the proportion of 8 to 5, or, in other words, the wort extract, after treating with acid, would contain 61 per cent of glucose derived from the maltose. But, the total reducing power after conversion corresponds to a content of 93 per cent. of glucose. Hence, 32 per cent. is due to glucose produced from the dextrine; and, as 10 parts of glucose are formed from 9 of dextrine, the original extract contained 28·8 per cent. of dextrine.

The following are the relative proportions of the leading constituents of the wort-extract on the respective assumptions that the sugar is maltose and glucose:—

	Old view: the sugar is glucose.	Modern view: the sugar is maltose.
	Per cent.	Per cent.
Sugar	38·0	61·0
Dextrine............	49·5	28·8
Albuminoids, ash, &c.	12·5	10·2
	100·0	100·0

For technical purposes, the statement in the second view is substantially correct: but we are far from knowing all about the carbo-hydrates produced by the transformations of starch, and it must not be considered that maltose and "dextrine" are strictly the only bodies formed. At the same time, it seems to be pretty conclusively shown that grape-sugar or glucose does not exist in worts, and, almost certainly, that maltose is the only sugar therein contained.

"Soaps" (query 48042, page 75) are apt to contain numerous impurities, the detection and estimation of which is a somewhat long and complicated matter. The best mode of operating is to commence by dissolving a weighed quantity (say 10 grammes) of the soap in hot rectified spirit, filtering boiling hot, and washing the residue with hot spirit. The insoluble residue is dried at 100° C., weighed, and boiled with water. Any matter left insoluble may consist of sand, clay, steatite, heavy spar, gypsum, alumina, bone-ash, carbonate of calcium, colouring matters, &c. Of these, all but the first four will dissolve in hydrochloric acid. The aqueous liquid filtered from these insoluble matters may contain gelatin, starch, alkaline carbonates, sulphates, borates, and silicates. The alcoholic solution of the soap should be treated with a current of carbonic acid gas to saturation, and is then filtered if necessary. Any precipitate consists of K_2CO_3, or Na_2CO_3, produced from the free alkali of the soap, and the quantity can be ascertained by titrating the precipitate with decinormal acid. The filtrate should be diluted with water, and evaporated to expel the alcohol. It is transferred to a suitable vessel, and standard acid added in moderate excess, agitating thoroughly all the time, and noting the quantity of acid used. The fatty acids separate as an oily layer, which will also contain any mineral oil, resin, carbolic or cresylic acid, thymol, &c., which may have been contained in the original soap. The aqueous liquid separated from the fatty acids is titrated with standard alkali, and the amount used is deducted from the measure of acid previously used. The remainder is the measure of standard acid equivalent to the alkali combined with the fatty and resin acids of the soap. Each 1cc. of normal acid thus utilised is equivalent to 0·017 gramme K_2O, or to 0·031 gramme Na_2O in the soap operated upon. "W. H. B." will find fuller details of the method of analysing soap in "Commerial Organic Analysis," Volume II., pages 240 to 266.

I am obliged to "An Old Colonial" (p. 71) for calling my attention to the recent patent of Mr. G. Scott for utilising titaniferous "magnetic sands" in the manufacture of spiegeleisen and ferro-manganese. The patentee appears to prefer these sands to granulated metallic iron because he thereby saves the cost of producing the latter. But if that is all, why not use powdered hæmatite, which would be much richer in iron than the titaniferous sand? I note that the magnetic sand is to be mixed with oxide of manganese and carbon, and the mixture heated in plumbago crucibles to a "temperature sufficient to effect the fusion of the mixture." Just so: but how is that going to be attained? If the patentee reduces the titanium along with the iron and manganese he will obtain an alloy very different from spiegeleisen or ferro-manganese, and if he doesn't get it reduced, how is he going to fuse the refractory titanic oxide? He does not appear to mix any flux with his materials, though he places some on the top. What, then, is going to become of the TiO_2, SiO_2, Al_2O_3, MgO, CaO present in the ores used? By great good luck he may obtain a slag fusible at a high temperature, but to insure this he must arrange to have but a very moderate proportion of titanium, and to effect this it will be necessary to add a very considerable quantity of lime, clay, &c. This makes the operation into one analogous to the production of iron in the blast-furnace, only it is effected in the far more expensive way of melting in crucibles. Spiegeleisen and ferro-manganese are made regularly and easily in the blast-furnaces, each furnace turning out hundreds of tons weekly. How can the patentee hope to compete with this process by any operation in crucibles, even supposing that the titanium occasions no difficulty. On the other hand, if he attempts to smelt his bricks in a blast-furnace he will give the furnace incurable indigestion in a very short time, and probably little short of taking it down will suffice to restore it to a useful condition. What is the use of attempting to overcome the difficulties connected with the smelting of titanic iron sand, when there are other and purer ores of iron to be had at as low or a lower price? If titanium conferred any valuable property on the metal produced it would be a different thing; but under the actual conditions the utilisation of the sand is a day-dream which has been experienced by numerous metallurgists, and always left them heavier at heart and lighter in pocket.

The query headed "Tests" (No. 47714), relating to the estimation of potash in the chromate and bichromate, has been fully replied to by other correspondents, but it is possible the querist would find the following comparatively simple method answer his purpose. Mix the finely-powdered chromate intimately with two or three times its weight of oxalic acid. Cover the crucible closely, and ignite at a moderate red heat. There will remain a mixture of Cr_2O_3 and K_2CO_3. On boiling with water the latter will be dissolved, and the K_2O therein contained may be determined by titrating the solution with standard acid. One source of error is the tendency of the Cr_2O_3 to reoxidise towards the end of the ignition. This may be avoided by passing a current of hydrogen or coal-gas during the operation. The other source of error is the liability of the Cr_2O_3 to retain alkali. This may be in a great measure corrected by treating the product of the ignition with a moderate excess of standard acid, and titrating back to the neutral point with alkali. Of course, the process only gives the total alkali existing as chromate. Any sulphates are ignored, and if it be desired to ascertain whether the alkali is wholly potash, the liquid after titration must be treated with platinic chloride in the usual way.

Sheffield, Sept. 23rd. **Alfred H. Allen.**

THE RECENT RAILWAY ACCIDENTS AND CONTINUOUS BRAKES.

[20583.]—Your interesting article, "A Practical Test of the Rival Brakes," p. 511 of last volume, dealt fully with the circumstances attending the accidents which occurred at Ely and Werrington Junction, and conclusively proved the advantage of automatic continuous brakes, and the worthlessness of those which are non-automatic. Since that time two other accidents have taken place, the results of which are important.

On the 25th of August, an express train from Moscow to St. Petersburg, on the Nicolai railway, when running at full speed, met with a serious accident about five miles from Kleen station. The engine and the three front vehicles, without any warning, left the rails, ran down the embankment, and turned completely over. Very fortunately, the train was fitted throughout with the Westinghouse automatic brake, which instantly applied itself, and brought two of the carriages safely to rest upon the embankment, although off the rails, while the rear portion of the train was actually stopped upon the line in 45 yards, without any telescoping of the vehicles. The company's servants and seven passengers were injured, but it is the decided opinion of the officials that the prompt automatic action of the continuous brake alone prevented the consequences from being of the most fatal character.

A terrible accident took place on Sunday evening, the third of September, near the village of Hugstetten, a station on the Baden State railways, between Colmar and Freiburg.

A return excursion train from Freiburg to

Colmar and Munster, consisting of engine and 26 carriages, containing a very large number of passengers (it is stated between 1,200 and 1,500), was running down an incline, at a high rate of speed, near Hugstetten, when the engine left the rails and ran down the embankment; 20 of the carriages were "telescoped," and more or less smashed and damaged, the *débris* being piled up in enormous heaps. The wreck was so great that at present the exact cause of the accident has not been discovered, but there is good reason to believe that the engine was of a type quite unsuited to running at such high speed, especially over permanent-way stated to have been not in the best of condition. Be this as it may, we have before us the *result* that no fewer than 72 passengers were killed, or have since died from the injuries received, and that more than a hundred others were very seriously injured. We have also the fact that the train was sent out with insufficient and inadequate hand-brakes, these, of course, the brakesman had no time to apply.

Had this train, like those at Ely and upon the Nicolai Railway, been fitted with the Westinghouse brake, there is no doubt that it would have been brought safely to rest without any "piling up" or "telescoping" of carriages, and that the lives of seventy-two persons would thus have been saved.

The Board of Trade report upon the collision which occurred on the 28th of July, near Balado Station, of the North British Railway, has just been issued.

It will be remembered that in this case the 3.20 p.m. passenger train from Milnathort to Glasgow was proceeding on its journey, after having stopped at Balado, when it was run into by a following train, which consisted only of an engine, tender, and guard's van. The collision is due to the driver of this goods neglecting to keep a proper look-out; but it will be seen that if the block system had been in operation an interval of space would have been maintained between the trains, and the accident could not have occurred. The signal arrangements are, indeed, very defective at Balado, as there are no *home* or *starting* signals, the only protection being a *distant* signal in each direction.

The passenger train had the Westinghouse brake, and General Hutchinson reports:—

"The automatic brake with which the passenger train was fitted appears to have done good service. The train was severed into two portions, between the second and third vehicles, by the force of the collision, and the guard in the rear van having been knocked down, it is most probable that the rear part would have run into the front part and produced a second collision, had not the automatic action, brought into play by the severance of the couplings, promptly stopped the rear portion."

The North British Railway Company deserves great credit for the way in which it has adopted and fitted continuous brakes; but it is to be hoped that it will turn its attention to the providing of the block system over its whole system.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Sept. 23.

RAILWAY SIGNALS.

[20584.]—In answer to Mr. Stocke, 20520, the "step" he proposes taking is in perfect consonance with my wishes, and I shall be most happy to abide by the decision of Mr. Stretton. **A. Manock.**

CHEMISTRY FOR ENGINEERS.

[20585.]—Many thanks to Mr. Robinson for noticing my letter. I have not got a laboratory I am afraid; but as I have managed without one in the qualitative analysis of metallic solutions, I thought I might do so in the more complicated processes to which I aspire.

I have test-tubes, mortar, spirit-lamp, retort, and stand blowpipe, and the contents of a Statham's guinea chemical chest, and the following reagents: nitric, sulphuric, hydrochloric, and hydrosulphuric acids; ammonia, ammonic-chloride, carbonate, sulphide, and oxalate, caustic potash, iodide of potassium, sulphate of zinc. What more would I require? The gunmetal would be the only article requiring exact analysis. A qualitative and very roughly approximate quantitative analysis would suffice for white-lead, oils, &c. I have a microscope. **Glatton.**

OIL ON TROUBLED WATERS.

[20586.]—When in the country some days since, there was a quantity of water remained, after a heavy rain, on the side of the road, extending perhaps to the length of 100ft., and several feet broad. The wind being high, a very large ripple travelled from one end to the other of it.

It occurred to me directly that if oil is said to still the waves, the same effect must be produced on a small scale on the little pond before me. I, therefore, dropped three or four drops of olive oil on the end from which the wind was blowing, the oil did not spread on the surface, but retained its globular form. I then dropped the same quantity of petroleum. This spreading, instantly produced a perfectly smooth surface, which was blown along gradually from one end to the other of the water, without alteration of its smoothness. The fresh ripples, as they were formed behind, disappearing as soon as they came up to this smooth surface. Can any of "ours" suggest an explanation of this action?

I have always supposed a wave once formed, extended itself until the amount of power which created it, expanded until the wave became to us invisible, and so determined was this action that two waves could not interfere with each other's course. This is illustrated when two stones are thrown at the same moment into water, the circles produced beautifully interweaving, passing through each other without change of form.

In the above case why does the ripple cease?

J. S. B.

A COMPARISON BETWEEN TAYLOR'S AND NORTHCOTT'S LATHES, AND A SUGGESTION FOR COMBINING THEIR RESPECTIVE ADVANTAGES.

[20587.]—Now that we are reading an interesting series of articles on "The Production of Looped Figures by Gearing," and that at least two of your correspondents besides myself are interested in the subject, I hope I may be successful in my desire to raise a discussion upon this system, which I think, with "J. L.," has been too much overlooked.

First, however, I should like to ask our good friend, "J. L.," to tell us whether he means *true loops*, or only waves more or less deep. I know that all waves become loops when continued to the centre; but on page 583, at the bottom of the middle column, we read, "we can also now get P." I refer to P, and find eight true loops, the line crossing itself each time. Now, I do not see how these could be produced by the apparatus he is describing, for it appears to me that to trace such curves with this apparatus it would be necessary for the mandrel to stop and turn backwards eight times in the revolution. I find no such loops as those at P in the examples given in "The Lathe and its Uses," as showing what can be done in Taylor's lathe.

The chief advantages of Taylor's system are, as explained by "J. L." the celerity with which the patterns are produced, and the great multiplicity of figures and forms obtainable by a comparatively simple and easily-constructed apparatus. Its disadvantage is that only work not requiring the support of the back centre can be manipulated.

The special advantage of Northcott's system over Taylor's is, that while producing all the same figures as the former, it will cut them of any length the lathe will take in and will turn—not only work of irregular transverse section, but of irregular logitudinal section also. Its disadvantage is (I speak under correction) that the friction of the saddle-slide, being naturally much greater than that of a rocking headstock, obliges it to be used at a much slower speed, so that when working upon wood with more than one oscillation per revolution, the work must be done with cutters and drills, instead of the fixed tool.

I should suppose that an oval in wood might be turned in Taylor's lathe by the rocking head and a fixed tool, but that in Northcott's it could not be produced in any material that requires a quicker speed than iron, without the help of cutters.

I desire now to submit for the opinion of my fellow readers a plan which I think combines most of the advantages of both systems. I propose to remove the slide-rest from the saddle-slide of Northcott's lathe, and to fix in its place by means of points, the socket of an ornamental turning slide-rest, which socket should be made to rock on the points by means of an adjustable connecting-rod between the top of the socket and a crank-pin or cam. The waves would now be produced by the rocking slide-rest, which would be even lighter to move than a headstock, and the pattern could be produced at any part of the lathe-bed. I think we should thus secure the chief advantages of both systems, and I should expect to be able to turn an oval column in wood by fixed tools the whole length of the lathe.

September 23. **F. A. M.**

COLOUR.

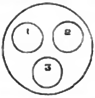
[20588.]—As a contribution towards the discussion of this subject, allow me to describe two pieces of apparatus by means of which many instructive experiments can be made in the analysis and combination of colours. I constructed them when studying the subject many years ago, and I am not aware that the same arrangements have been used by anyone else.

The first is a combination of the spectroscope with the polariscope. The spectroscope is of the usual construction, with the addition of an arrangement whereby the slit can be replaced by a wide aperture at least as deep as the length of the slit. The polariscope is placed behind the spectroscope, between the prism and the eye. The polariser is a thin prism of Iceland spar placed with its refracting edge at right angles to the spectroscope slit. This forms two images of the spectrum, which slightly overlap, the bands of colour being continuous through both. When the wide aperture is substituted for the slit, of course two overlapping images of it are seen, which are colourless except where the two opposite edges are fringed with prismatic colours; these fringes, however, do not interfere with the purpose of the instrument. The analyser and eyepiece is a rotatable Nicol prism, which at each quarter revolution extinguishes one or other of the images. There is also, between the polariser and the analyser, a provision for inserting one or more thin plates of a doubly refracting crystal, so that they also may be rotated (separately from the analyser) on the axis of vision. In using the instrument, the slit end should be directed towards the clear sky, a bright cloud, or a sheet of white paper illuminated by sunlight; in fact, any source of light that will give the wide aperture an even and brightly lighted *white* field of view. The following are some of the experiments which may be performed with this apparatus.

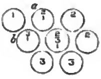
1. Double Analysis of White Light.—When the analyser is in one of the positions in which it allows only one image of the wide aperture to be seen, insert a very thin plate of a doubly refracting crystal—say, mica or gypsum; the other image will then become visible, and both images will be coloured. On rotating the thin plate, certain positions will be found in which the colour is strongest. The two images are of different colours, most strongly contrasted. They are also complementary. The mixture of the two is white (as seen where they overlap): each is white minus the other. If the slit be now substituted for the wide aperture, we see three spectra; the two outer ones composed of various bands of colour separated by dark spaces, being those of the two colours, and the central one being that of white light; and this last is formed by the overlapping of the other two. To show distinctly that these two outer spectra are complementary, let the slit be shortened until the central spectrum disappears, leaving the other two just touching at their inner edges. It will then be distinctly seen that the dark spaces of each are exactly opposite to, or continuous with, the coloured bands of the other, so that when the two are superposed (which we effect by again lengthening the slit) they exactly fill up each other's dark spaces, and form the complete spectrum of white light. The particular pair of complementary colours exhibited depends, amongst other things, upon the thickness of the thin plates used. Suppose in our experiment the plate has the thickness which gives blue and buff colours to the two images of the aperture respectively; on analysing these by means of the slit, it will be seen that the complete spectrum is divided pretty nearly in half about the middle of the green; one half of it, from that point up to and including the red, going to produce the buff, while the other half goes to form the blue. A slightly thicker plate gives a beautiful green and deep pink couple, and the spectroscope shows these also to be compound colours, especially the pink, which contains both the red and the violet of the spectrum. By using successively a number of plates gradually increasing in thickness, a great variety of red-green effects are obtained, the tints of which, as the thickness of the plates increases, become paler or more diluted with white, until a thickness is reached which produces two complementary images the colours of which cannot be distinguished from one another—both, in fact, appearing equally white. Neither, however, contains the complete spectrum of white light, for when analysed, their spectra are seen to consist of a great number of very narrow alternate bright and black bands, the bright bands of the one exactly corresponding with the black bands of the other. Thus although neither of the images contains above half of the spectrum, yet each has about the half of every colour, so that the proportion of the different colours required to form white light is maintained in both.

2. Double Analysis of Coloured Light.—This is effected precisely in the same way as that of white light—a sheet of coloured glass or gelatine being used to impart the colour which we wish to analyse.

The other apparatus is for combining two or three beams of different coloured light. It consists of a conical tube nine or ten inches long. The large end, which is about three inches diameter, is closed by a diaphragm having three circular holes, each about an inch wide, arranged thus. The small end is furnished with a rotatable eyepiece consisting of two Iceland spar prisms and one of glass, cemented together in such a position that they give four images of each of the three holes. The separating power of the eyepiece and its distance from the diaphragm are so adjusted that when the eyepiece is rotated the images appear to slide over one another, and, in certain positions of the eyepiece, to coincide in twos and threes. Thus in the an-

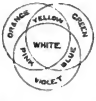


nexed figure, supposing the holes to be numbered 1, 2, 3, respectively, 2 and 1 coincide (nearly) at *a*,



3 and 1 at *b*, and 2, 3, and 1 in the centre. The holes are provided with removable shutters of coloured gelatine, and, of course, where two or three different coloured images overlap, a compound colour is formed. The purity and vividness of the colours are much enhanced if outside the three holes is placed a card, covered in proper places with three different-coloured pieces of paper, fixed so that each of these pieces of paper may be viewed through a gelatine shutter of its own colour; the coloured papers being, of course, illuminated with a good light. The instrument, however, performs very well when only a well-lighted white sheet of paper, or the clear sky, is looked at through its gelatine shutters.

A very instructive experiment is made by inserting in the three holes shutters coloured deep orange, green, and violet, respectively, and making their images overlap partially, as indicated in the annexed figure. The result is that we see a white



centre inclosed by three spaces, coloured yellow, pink, and blue respectively. These three colours are plainly binary compounds of the original three —(orange + green = yellow; green + violet = blue; violet + orange = pink). The central white may be considered as compounded in either of the four following ways:—

1. Orange + green + violet.
2. Pink + green.
3. Blue + orange.
4. Yellow + violet.

I find that, provided a proper proportion is maintained in the intensities or brightness of the three colours, these may be varied considerably in tint without appreciably changing the whiteness of the centre. The orange may be replaced by deep red, the violet by deep blue, and the green may be yellower or bluer; any or all of these changes may be made without apparently affecting the tint of the triple compound white. A difference in the relative brightness or amount of light transmitted by the three shutters, however, effects a notable change of tint in the space where their images overlap. The use of polarised light to illuminate the shutters affords a ready means of showing this. Let the light of the sky be reflected up from a polarising mirror through the coloured shutters; then if we rotate the instrument (as a whole—not the eyepiece merely), we find four positions of it in which all the colours are equally bright, and the centre is white. Rotating the instrument in one direction from one of these positions, one of the images, say the violet in our diagram, gradually fades or darkens, until after a quarter revolution it disappears. Meanwhile the other two images have been brightening, and they reach their brightest when the violet vanishes, and of course the central space, before white, now abandoned by violet, shines bright yellow. Another quarter-revolution in the same direction restores the violet, and slightly dims the other colours, and they are all again equally bright, and the centre white. The third quarter-revolution gradually extinguishes the orange and green, and brings the violet up to its brightest, over its whole surface. The fourth quarter-revolution again equalises the colours; so here we have a means of bringing about any relative degree of brightness of one colour as regards the other two. The effect is produced by the doubly-refracting structure of the eyepiece, and will be familiar to those who have studied the subject of polarised light.

Walter Hardie.

Joppa, near Edinburgh, Sept. 18.

STRAIGHTENING CROOKED CASTINGS.

[20589.]—"Moulder," in his reply to me (20512), proceeds as if I had said: "Ill-proportioned thickness is *the only* cause of castings cooling unequally." But this is transposing two words of mine, and I cannot allow him such liberties. T. D. W. gave two reasons for castings *warping*. I say there is only one—*i.e.*, T. D. W.'s second, "One part cooling before another"—(does "Moulder" deny this? and that his first reason was "*only the* [not *the only*] cause of the second?" as "Moulder" would seek to represent me as saying?)—for there may be many causes besides ill-proportioned thickness for the *one reason* why castings warp—viz., cooling unequally. So as I have shown that "Moulder's" basis is false, the arguments built thereon, and conclusions arrived at, must fall. One of the many causes for the *one reason* exists in "Moulder's" instance of runs, &c., being bent; but he leaves it unexplained —and so will I. In the mean time, I fear, however, that he concludes equal thickness and good proportions to be synonymous. Now, it is a fact that a run or gutter can be made of proportions that will cast straight from a straight pattern; and this proves that "bad proportions" (?) can overcome the *reason* of castings bending.

The case of the unequal column "Moulder" also leaves unexplained. He says, "the fact of it being bent proves that bending takes place when all parts are hot [what does he mean by hot?—there is hot *and* hot] and liable to bend." To this I agree without changing my position in the least, although, I grant, that from my use of the word "rigid," I may have led "Moulder" to appear against me without opposing my arguments; and, therefore, I will take the privilege to explain in what sense my expressions are to be understood. By "rigid" I mean the condition of a casting opposed to plastic (not inflexible, however); by "plastic," the condition which can be impressed on plaster. And with these explanations I leave my arguments again to be criticised, and will now take up "Moulder's" arguments. He will not deny that when castings which cool unequally don't bend, they break; that shows that some part was "rigid" and not "liable to bend," as he says. He may object that this is broken, not bent casting; but, if "Moulder" has reached mature age and is not a novice, he knows that many castings that are broken were only *bent* until they got a slight tap with something, and snapped, relieving the strain caused by the *rigid* part, and became then straight, proving that "bending" *did not* "take place when all parts were hot and *liable to bend*." And here, I repeat, that the reason of bending was that one part got rigid while the other was plastic, and *its* contraction came later. If "Moulder" does not accept this theory, how does he account for castings bending that are not artificially cooled, seeing he has admitted that lineal contraction is equal in amount?

The introduction of the cube I regard as a little out of place. Our subject being linear action, it would have been as logical, and more pertinent, if he had said 36in. will shrink more than 12in., therefore, lineal contraction is not equal in amount. The "coefficient" is only the sum of lineal contraction in the three directions—length, breadth, and thickness. Therefore, "Moulder" attempts to make a distinction where there is no difference. I will not follow him in that line, but will here briefly repeat that T. D. W. spoke of keeping all parts of a casting . . . so that their contraction will be equal. I said, *as to time*, for the amount in thick and thin parts is equal always; not as he said, "a thin body contracts more than a thick."

Our "Moulder" says that every moulder knows it to be undeniable that cooling the middle on the top side of a casting causes the ends to come up. As "ours" has not consulted "every moulder," he cannot speak for them, and I shall be surprised if any considerable number will allow him to be their representative in this case. But our difference here is as to fact, and cannot be settled but by evidence. I have tested the matter (which was witnessed by many moulders) and given my evidence. But now to his theory. "The contraction caused by the cooling of the top side will compress." I say, the contraction can only be hurried to its limit, and cannot compress the top side—it has no power to compress itself, and as little can it "overcome the cohesion of the underside," for in order that the *direction* of action be reversed, a fulcrum, or series of fulcra, would be required, which does not exist in this case. So I deny that the ends come up, and argue that the top side by cooling ("if done early") will reach its limit of contraction, only a little earlier compressing the under side, which is then plastic and will yield as plaster, but when it contracts (only a little later) it acts as a bowstring, and draws the ends down.

Patternmaker.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47004.]—**Bread.**—I am totally at variance with "Incisor" (p. 69) in his opinions respecting hard bread crusts affecting the teeth, and promoting decay. With me, as an old sea-dog, eating soft bread is still the exception. I invariably eat ship biscuits, or the stalest of bread-crusts. If I eat toast it must be cut thin, and done slowly, so as to be crisp. I began life at sea in the days of hard "pantiles," and with the exception of one two years' cruise, I have never known toothache. On the occasion referred to, I did suffer considerably from decay of molars, and on consulting a dentist to have them stopped, he traced the cause to very different reasons. I have never had any trouble since. My teeth are still the admiration of my lady friends, and the envy of the gentlemen. I am also an inveterate smoker; in fact I do not remember seeing a sailor who was able to work and eat ship diet, who had bad teeth. My father, who was also at sea, in H.E.I.C.S., always eat biscuits after he gave up sea, and had a perfect set of teeth (of his own) when he died, at 73 years of age.—Cuidadoso.

[47239.]—**Vegetarianism.**—Thanks to Mr. Ollard, "Meliora," and "H.O'B." The latter gentleman will observe that whether these days are enlightened or not, I take only about two-thirds of a pint per day of the light London bitter. I do it because I like it, and it likes me; and I do not believe that so small a quantity goes very far towards making me fat. I have never tried hot milk, but will do so for a few days. Cold milk is too bilious for me. Sole, fried, is a delightful dish, but not very "staying." I am afraid a sole, and say a dish of fresh (not tinned) French beans, at 6 p.m., after an 8 a.m. breakfast, would find me rather faint next morning. I trust "H. O'B." is not the only reader who has tried my "vegetarian roast goose" (see pages 17 and 69); it really deserves to be well known.—C. L. Hart.

[47239.]—**Vegetarianism.**—I must flatly contradict the statement of the "sea-captain" who informed "H. O'B." as to the uselessness of canned provisions as a preventive of scurvy. I have never known a case of scurvy in any vessel with which I have been connected since canned provisions came into use, and this not altogether owing to the use of limejuice. The first passage I made without a case of scurvy occurring was a six months' one; the crew were supplied with canned meats three times a week, and no limejuice, but the ship was well stocked with abundance of provisions of good quality, and the men were not stinted in their rations. They were also supplied with many little extras to make their diet palatable; but which, even now, money-grubbing owners will not supply. The result was that the men were happy and contented, but above all, the sanitary arrangements of the ship were well attended to; the builder had contrived to give Jack rather more roomy quarters than usual, and in consequence he took extra pride in keeping his berth clean. In fact, the floor was regularly holystoned until it assumed a dazzling whiteness, and being well ventilated, was kept dry as possible. Indeed, the vessel, even in these days of merchant yachts, would have been considered a model of cleanliness and good order. I have never known a case of scurvy since, and my experience has not been a small one. It will be thus seen that the giving of canned provisions as an antidote to a disease is altogether liable to fail, if one of the principal causes of the disease be allowed to exist, viz., uncleanliness, cramped up, and damp quarters. —Ciudadoso.

[47486.]—**Euclid's Axioms.**—The axiom "C. W. B." suggests may be deduced from my result, but I do not see that I assume the axiom to obtain my result, nor any other axiom save (2). However, if I am wrong, which is the correct way? —C. H. Romanes.

[47545.]—**Battery.**—To "J.M." or Others.—In answer to "J. M.'s" reply as regards the expensive instruments, I have galvanometer and resistance coils. What I want to know is how to proceed to measure the intensity (current strength) and resistance of a voltaic battery.—Emandale.

[47550.]—**Dynamo.**—To Mr. Lancaster.—I am anxiously looking forward to your answer, and would be glad to hear it as early as possible. Have done nothing further since writing.—T. F. H.

[47606.]—**Brake Power upon Goods Trains.**—The following table gives the dates when experiments have been specially made upon the Midland Railway to test the power of the ordinary tender and guard's van hand-brakes to control goods and mineral trains of different weights upon various gradients.

GOODS TRAINS. HAND BRAKES.

Date.	Where tried.	Gradient 1 in
Oct. 25, 1868	Derby and Manchester line..	90
Feb. 5, 1870	Bromsgrove—Lickey Incline*	37
Feb. 20, 1875	Brynamman Branch (Swansea)........................	45
July 11, 1875	Derby and Manchester line..	90
Aug. 15, 1875	Between Irchester and Sharnbrook....................	120

* In the experiments upon the Lickey Incline, the bank engine, No. 223, was fitted with Chatelier's counter-pressure apparatus.

In addition to the above trials, many experiments have been made with trains in ordinary working. There is no doubt that goods trains are very deficient in brake-power. Every goods engine should have a powerful brake upon all six wheels, which would give a driver great control over his train.—Clement E. Stretton.

[47616.]—**Tube Well.**—The only information I can give is copied from "Every Man his own Mechanic." Charges, inclusive of pumps, pipes, and labour:—10ft., £6 10s.; 15ft., £7 10s.; 20ft., £9; 25ft., £10 10s.; 30ft., £12 10s. Trial borings, £1 1s. each trial. Further information may be obtained of Messrs. Le Grand and Sutcliff, 100, Bunhill-row, E.C.—G. J. H.

[47656.]—**Woollen and Worsted.**—"T. P.," in last week's Mechanic, will allow me to correct his idea of the above. Where does he draw the line between "long" and "short" wool? As to woollen being "short wool milled and fulled," I am at present making worsted yarn from wool 10in. long, which when woven will be well milled. A few months ago I explained to another querist that the difference between the two is in the *construction* of the thread. A woollen thread is "stretched" (not drawn out) on a mule—by this stretching a thread is formed, having the longest fibres inside forming a core, and the shortest on the outside, at right angles to them. A worsted thread, on the contrary, is drawn out on a frame in such a manner that all the fibres are parallel, and well mixed as regards length, no portion of the thickness having more long or short wool than another. On inquiry, I daresay "T. J." will be told that one-half of a sheet of wool can be made into "woollen" yarn, and the other half into worsted.—Kunst macht Gunst.

[47690.]—**Enamelling Photographs.**—It is not quite clear what is meant by enamelling in this query; but it is certain that the process has been described in back volumes. The simplest plan, perhaps, is to rub the picture over with encaustic paste and burnish it. The encaustic paste is made by dissolving white wax by placing the vessel containing it in boiling water, and adding about three-quarters of its bulk of turpentine. Add some scent (cloves, say) to cover the odour of the turps, and see that you get the best. I should call this "waxing." Another method is to coat the photos with a film of gelatine and collodion.—Tripod.

[47692.]—**Garden Produce.**—Purely a matter for personal arrangement and agreement. There is clearly no right in the garden after the notice expires.—Lex.

[47697.]—**Roundabouts.**—What is it you wish to know? Surely, you don't want a description of the whole process of making a roundabout? Alder, lime, willow, or poplar will do for the horses, the last being very light; but if the thing is to be knocked about much, you had better use beech or oak.—T. P.

[47702.] — **Shoemaking.** — Guttapercha dissolved in bisulphide of carbon. Leather surfaces must be clean cut.—Crispinus.

[47707.]—**Cylinder and Boiler for Half-Horse Engine.**—A half horse engine may have a cylinder of various dimensions, and the boiler might be of any desired type. "Amateur Engineer" should state his requirements—what work it is intended to do—then he might get an answer. Perhaps his best plan would be to call at some of the works and see for himself. Apparently he does not understand that a cylinder 6in. stroke and 3in. diameter, running at 60 revs. per minute, with 50lb. steam in cylinder, would give about half a horse-power; but the same run at 100 revs., with 100lb. steam, would give about two horse-power.—Essar.

[47709.]—**Compressed Lime Crucibles.**—These are, I believe, made in moulds at an enormous pressure—more like 200 tons than 20.—E. G.

[47718.]—**Stains in Woollen Goods.**—Have you tried washing well with soap-and-water? If not, do! Also Fuller's earth laid over wet and allowed to dry. Fetch colour up again with a little weak ammonia-water.—J. B.

[47722.]—**To "Sigma."**—This question having been left for some time, permit me to point out to the querist that the difference is so small that it could be found only by elaborate measurements. Of course, the cell with the larger plate would give much more quantity.—D. Bunsen.

[47723.]—**Restoring Engraving on Silver Plate.**—This can be done only, I think, by melting out the filling, and it would need great care. It depends very much on what the filling consists of.—Ennox.

[47724.]—**Silvering Mirrors.**—Applied underneath the plate, the latter being laid on a table heated by steam.—J. B. E.

[47725.]—**Water-Glass.**—Silicate of soda, I suppose. See the indices. It is not real glass.—T. J. K.

[47730.]—**Labels for Plants.**—The description of these labels has not been published—presumably so as not to disclose trade secrets. Nothing will ever beat lead labels for hanging on branches, &c., the names being stamped with punches.—Essar.

[47740.]—**Boiler Query.**—If you mean that the pipe carrying the mixture of gas and air to the burner is ¼in. in diameter, no wonder it is a failure. Get one of Fletcher's small solid-flame burners, and you will have plenty of steam. Get his list and see which suits you best, or which best lends itself to the conditions—that is, can be readiest adapted.—Essar.

[47743.] — **Discharge from Egg-shaped Sewers.**—I am sorry I cannot enlighten "Etna" with regard to the difference between the formulas. The one I give may be found in Molesworth and other *aides mémoires*, and represents the discharge in cubic feet. I thought at first the difference between the coefficients was owing to the unit measurement adopted, but now it seems this is not so. As "Etna" points out, "diameter of large end should be of lower end."—C. H. Romanes.

[47749.]—**Polarised Relay.**—A description of a polarised relay, whether a single or a compound one, would be but of little use to you unaccompanied by a woodcut. If you intend making one, I shall be pleased to send a drawing to be engraved, but if you don't intend making one, it would be hardly worth while to cut a wood block. You will find a good description of both single and compound relays in the "Telephone and Electric Light," &c., by Prescott, and also several good woodcuts. In answer to your other query, you should harden the steel at a cherry red, then temper to a very light straw.—W. J. Lancaster.

[47770.]—**Preventing Rust.**—Whilst the gas is burning water is being manufactured. If W. P. M. will place a cup with sulphuric acid in the case the evil will be abated. The moisture will then pass by his polished articles and will make for the acid. 2. Adopt this course with any chemical balances.—E. M.

[47771.]—**Dead Black for Brass.**—My best thanks to "J. F. E." and Girdlestone Wright for their replies to the above queries, but they do not meet my wants. "J. F. E.'s" nitric acid process does not give a uniform black colour, and it does not do for soft-soldered articles. Girdlestone Wright's straw process I do not find satisfactory. Will he tell me what Ag Cy K Cy is, and how it is applied to the work? Can any fellow-reader refer me to a back number of ours giving a process with nitrate of silver and sulphate of copper? I have spent hours searching for it without success, although I am confident it is there. I shall be thankful for any further hints on the subject.—One in a Fix.

[47772.]—**Hanley's Discharger.**—Let me know the size of your coil, and whether you wish to fit the discharger on to the base of coil, or on an independent board, and I will tell you how to proceed.—W. J. Lancaster.

[47775.]—**Staining Sycamore.**—Place some alkanet root in linseed oil and rub over the veneer with it. It should only be just tinged pinkish; the very slightest morsel of drop-black would give it the necessary quiet tone.—E. M.

[47780.]—**F.C.S.**—A friend to propose you, and a yearly subscription paid in advance, will entitle you to wear F.C.S., no matter whether you know anything of chemistry or not.—E. M.

[47789.]—**Tent.**—Paint with boiled oil: that will make the tent waterproof, but it will be a little stiff.—E. M.

[47799.]—**Small Battery.**—You could not obtain such a temperature in another vessel as you wish with a small cell. You can easily calculate the amount of zinc necessary to be oxidised in the cell to heat a given quantity of water through a given number of degrees, and you will, from the result, at once find that what you wish to do cannot be done with the means you intend to use.—W. J. Lancaster.

[47808.]—**Telephone.**—To Mr. Lancaster.—You have evidently gone wrong altogether in the construction of your telephones. You ought to get a sound through them when put on to a microphone. Now, of course, you have two bar-magnets, each one capable of picking up at least 1oz. of iron, and you have put the bobbins on the ends of the magnets, and have taken care that none of the wire is exposed through the fraying of the silk covering, and have brought the wires out to binding-screws without touching each other. Supposing all this to be right, then you have carefully adjusted the magnets until they are about one-thirtieth of an inch away from the ferrotype plates, and still the result is bad. "Well, it's all your own fault," someone will say, if they don't speak as they should do; but I have known in many cases that every care has been taken and bad results only obtained, and, as a last resource, a new plate has been put in place of old one—perhaps a thinner or a thicker one, and, somehow or other, the telephones have instantly spoken well, and as they ought to do when spoken to civilly. There are laws governing all this, but they are difficult to learn, and it is only experience which really teaches. See that all connections are clean, circuits clear, plates not buckled, magnets adjusted, then try telephone, and if still intractable, let me know, and I will help you to solve the mystery.—W. J. Lancaster.

[47811.]—**Electric Pendulum.**—I shall be pleased to give you all the information you ask for if you will tell me what kind of clock, size, &c., you wish to fit the pendulum to. Do you want to make the movement, or have you one to which you wish to apply an electric pendulum?—W. J. Lancaster.

[47814.]—**Photographic.**—(1) Wash the prints in the water and not over the water, and never mind if you wash them four or five times. You will preserve your toning-bath all the longer, and will get better and purer prints. The toning is a very old one and a good one; but is more easily remembered as one grain of gold, half a drachm of acetate of soda, and five ounces of water. You should keep a stock-bottle of chloride of gold, say 7½ grain tube broken into a one ounce bottle of distilled water; then use one drachm of gold solution to the half drachm of acetate, and five ounces of water; mix up one day before using. It is better to keep small quantities of toning solution and stock gold, &c., than to make all up at once. (2) Spots are due to a great many causes, and one often the source of trouble is finger-stains. Never touch or even breathe on the surface of a prepared plate; the spots may be in the plate at first, or be due to dust, or impurities in the water. Look through a plate before exposure, and if spots are there, you will see them, and may even feel them.—W. J. Lancaster.

[47827.]—**Grist-Mills.**—I have been waiting for someone to answer this query, and I see it has at last been answered by "Hinckley" in this week's issue; but, contrary to my expectations, "Amateur Farmer" has been advised to go in for a pair of stones. Now I, from practical experience, should most certainly advise to the contrary, and say by all means get one of Messrs. Barford and Perkins' corn-grinding mills, as being very much faster and requiring far less power to do the same quantity of work, although for quality of work it cannot be expected that a high-speed mill can compete with stones, but for farmers' work they are all that can be desired. "Amateur Farmer" need not suppose that because I say they cannot come up to stones in the quality of their work that the corn must needs come through them in a half-split sort of state—far from it, for I have often ground wheat dead enough to make first-class brown bread of. Again, the first outlay is much less, and also the repairs (when any are needed) are a mere trifle, and make the mill as good as new; whereas in stones the repairs, or "dressing" as it is called, are very heavy and come very often, requiring skilled labour. I should advise "Amateur Farmer" to get a No. 4 mill for his 4 h.p. engine.—W. Lissington.

[47839.]—**View Lens.**—You do not tell us the kind of lenses you have the privilege of selecting one from; one may be a plano, another a meniscus, and a third a triple lens; but, on the supposition that all the lenses are of the same build, then the 1¼in. lens will work best of the three. A lens 6in. focus and 1¼in. diameter will cover a ¼ plate well with a stop ½in. diameter, F/12. You might, if the lens is a good one, have a stop an eighth larger; but the corners would suffer a little. Then, for microscopically sharp work, a stop ¼in., or F/24, would work well.—W. J. Lancaster.

[47850.]—**Sensitised Paper.**—Sensitised paper, if made of good albumen, will keep for months in a dry place; but will soon spoil if exposed to a damp air. The best way to keep it is to put it into a long can, made on purpose, and put an india-rubber band over the part where cap overlaps the body of the tube. In this way you can keep it good for months.—W. J. Lancaster.

[47851.]—**Sewing Machine.**—Probably the stitch screw is either too far in or too far out: try both ways, and then if not remedied take off cloth plate *carefully* and see that screw comes into proper place on *button*-shaped piece, and also that frame is in catch of stitch-bar.—J. I.

[47853.]—**Erector for Microscope.**—The erector belonging to a telescope would not be of much use to you, and would be, as you say, "not very satisfactory." The erector to use with it may be made out of tubing 1in. in diameter and 2⅜in. long. At the lower end mount a plano-convex lens ¾in. diameter and 2in. focus, convex surface towards eyepiece, and at the top end another plano, 2½in. focus, with convex surface in same direction; then put a stop ¼in. aperture just within the focus of lower lens of erector.—W. J. Lancaster.

[47857.]—**Defective Sewing Machine.**—Most likely the dogs are worn and will have to be removed, or get a *dogless feed* fitted by Simmonds, 24, Garden-row, London-road, which works beautifully without any trouble. Two machines under my care give great satisfaction now.—J. I.

[47860.]—**Mounting Diagonal for Reflector.**—The Browning method of straining chronometer-spring in three pieces from the flat mount through the body has not, I think, been superseded. An account of the method will be found in Browning's "Plea for the Reflector," to be obtained at that gentleman's establishments.—Prismatique.

[47869.]—**Induction Coils.**—You can use No. 20 silk-covered wire for primary coil, three layers wound closely, then insulate with paraffin paper, and wind as much 32 silk-covered wire on as secondary as the space will allow, carrying the two ends of secondary to two binding posts; this will make a nice small coil. The cells in which sulphate of mercury is used are made of plates of zinc and carbon, placed about ¼in. apart, with the moistened sulphate between them.—W. J. Lancaster.

[47876.]—**Magnetic Sands.**—It was my intention to have given some particulars to this question, but cannot find the necessary papers, in consequence of a stormy flitting, arising out of the upper part of the cottage having been blown about our heads in the great storm of October 14th, last year. We had to run for our lives, and all the furniture that had not been "annihilated," together with some hundreds of volumes of books, boxes of papers, &c., were thrown into the vans as fast as men could throw them. Some books were "happened" on by unwelcome help in clearing away the wreckage, and I have never been able—indeed, do not feel any desire—to get into "ship shape" since. I have the misfortune of being compelled to earn a livelihood, and that is a great obstacle to keeping things in "apple-pie order." But about the magnetic sand. I think that it was either in '59 or '60 that the late Mr. Moseley, the then celebrated manufacturing cutler, of King-street, Covent-garden, sent for me to look at what he called a "real cutting novelty." When I entered his shop, I saw at once the wit of the thing—I mean of the cutting—in a fine display of blades and knives of all shapes and sizes, having stamped upon them the word Taranaki. Mr. Moseley, himself, took a small dirk and drove its point through several copper coins upon the counter, and with pen blades pared the edges off penny-pieces as though the copper was but hard wood. He next showed me the black magnetic sand, the magnetism of which was amusingly demonstrated, some "pigs," ingots, bars, and forged blades of the metal, ending by introducing me to a Captain Moorson, I think, who had brought the sand over in barrels from the shores of Taranaki, New Zealand. I wrote an account of what I had learnt and seen, which appeared in the *Times*. A company was then attempted to be formed, but it fell through, somehow, and no more sand came over. Mr. Moseley made it all into fine cutlery, and a large number of surgical instruments, which were highly spoken of. I have some of the old knives at home now, whilst many of my friends supplied themselves liberally after seeing the quality of the edges.—Stuart Murray.

[47880.]—**Liquid for Binnacle.**—To Mr. Lancaster.—Glycerine would be the best liquid to float compass card on, but you should protect the back of compass card first. If it has been chipped, I should rather see the compass, as it is difficult to understand from your query exactly what is wrong.—W. J. Lancaster.

[47896.]—**Photographic.**—About the best dead black you can use is made of best vegetable black and best French polish, mixed up to the required consistency; mix just as much as you want to use, and clean the vessel out containing it, when done with. You cannot prepare successfully the black paper put between the plates, but you can use any opaque paper—e.g., brown rope. Enlargements.—You require an enlarging lantern with condensers sufficiently large to take the whole of the plate, say pair of 5in. lenses, an achromatic front giving crisp definition from centre to edge, and a brilliant light in as small a volume as possible. Then, of course, you want some of the bromo-argentic paper, and the developing and fixing solutions; and by following the instructions sent with paper, you will be able to produce good enlargements up to any size at will.—W. J. Lancaster.

[47900.]—**Weather-Glass.**—The so-called "storm-glass" is useless, and not worth its making. Years ago, I made a lot of them in a hundred different ways, but found them all equally useless. You can get any amount of visible precipitate by altering the quantities of spirits and water. You do not say which way yours is stupid, so that I am at a loss to know whether you have too much or too little precipitate.—W. J. Lancaster.

[47902.]—**Preventing Silver from Tarnishing.**—Hyposulphite of soda will not at all prevent silver from tarnishing—it will dissolve off any tarnish; but if you want to prevent the silver from tarnishing, then coat the silvered articles with a thin collodion: this will keep the silver bright (if not in use or handled) for a long time. You can purchase plain collodion from any photographic dealer, and then thin it with methylated ether.—W. J. Lancaster.

[47916.]—**M. R. Engines.**—I can inform "Meteor" that engines 61, 62, 63, 64, 65, 66, and 67, all rebuilt 1882, have cylinders 18 by 24. "Meteor" makes some mistakes as to the 890 class: there are at least 70 of them. The 40, 120, 130 classes are all of this build; although they have Mr. Johnson's dome and valve, that does not alter the class.—A. Driver.

[47916.]—**M. R. Engines.**—The engines which I mentioned have steam brakes only. I am well aware that the vacuum is not applied to the engine-wheels, neither are they fitted with the Sanders ejector, not injector; the Smith's has been removed from 786—789. There are six 800-class which have longer cylinders than the others, 18—26 I think the numbers are 803, 804, 815, 819, and 829—I don't know the other. 61, 62, 63*, 64*, 65, 66*, 1078*, and 1293, rebuilt 1882, have had larger cylinders put in, also had a larger tender. (I have placed an asterisk to four of them: they are fitted with Westinghouse air-brake.) 165 and 166 are another class of engine. There are 40 engines known as the 40-class: they are very much like the 890-class, only they are a little higher in frames, and there are other things besides. They number 2, 5, 7, 12, 19, 21, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 67, 68, 69, 72, 90, 91, 92, 95, 120, 121, 122, 124, 125, 126, 127, 128, 130, 131, 134, 135, 136, and 148; I have forgotten 123. I may also mention that the M. R. are building ten new passenger bogie-engines, cylinders 18 by 26in., wheels 68½in.; they will number from 1562—1571; they are also having 50 six-coupled goods engines built by Messrs. Beyer, Peacock and Co., Manchester. They are same as 1441, dimensions given in replies 47916 last week.—Camomile.

[47921.]—**Brake Trials on the Midland.**—In the above reply it is mentioned that brakes have been tested between London and Bedford, Leeds and Bradford, in ordinary working. This is a point upon which I desire further information as to the date of trial and length of time each one was tested for.—A. Driver, A.S.R.S.

[47923.]—**Polishing Speculum.**—To "Prismatique."—The wavy surface is caused by not rotating the mirror on its axis properly. The mirror must not move twice on the same line. A portion of a revolution must be described at each "pull-back stroke." The number of strokes per each revolution may vary from 120 to start with to 50 for finishing. This is not arbitrary, but will give an idea. The pitch-polishing will remove all rings and waves.—Prismatique.

[47925.]—**Electric Engine.**—To make a small motor, as you wish, you should get a steel magnet forged like Fig. 1, 2¼ by 2 by 1½, with the pole ends forged so as to allow of the hole being bored ⅝in. clear. When this is done it may be permanently magnetised by any of the well-known methods, a hole drilled in the foot to screw it to the wooden stand, and two on each side of the pole-pieces to carry two strips of brass to act as bearings for the armature. The latter should be of the shape shown in Fig. 2, deeply grooved, and should be made of soft iron, well annealed, and its dimensions should be ⅝in. diameter, 1½in. long. It may then be wound in the groove with B.W.G. 30 silk covered, soaked in paraffin, leaving two ends for attachment to commutator as shown in the plan, Fig. 3, one brass bearing piece being bent to allow of commutator working inside. When armature is wound, two brass discs should be screwed by two screws to each end, each of these being centrally drilled and tapped to allow of axles being screwed in. The latter should be 3-16in. when finished, but should be of ¼in. wire, and turned after fitting to armature. The commutator may be made by pushing a small ring of ebonite tightly upon the axle, and upon that a piece of brass tubing, diagonally split, to each side of which the two ends of armature wire are soldered. Two binding screws upon the stand, having each a thin strip of copper soldered and split, reaching up to the commutator, completes the working part of the engine. A small wooden pulley may be put upon the axle to transmit the power to models, &c. A small bichromate will work this well.—Fred. Walker.

FIG. 2.

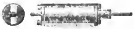


FIG. 1.

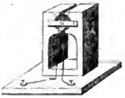
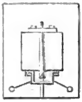


FIG. 3.



[47935.]—**Ventilation of Room.**—Probably the bad ventilation of your room is due largely, and perhaps entirely, to the fact that the fire of the room can get air more readily through the ventilator than elsewhere. In fact, in a room of the ordinary construction, a ventilator such as you describe could hardly be expected to work. You are practically situated in the *bend* of an inverted siphon, the longer limb of which is represented by the chimney of your fireplace, and the shorter by the space above your ventilator. You have a strong source of heat at the bottom of the long limb and a weaker at the bottom of the short limb. Naturally a current is set up *down* the short limb, through the ventilator, and up the long limb or chimney. Assuming that your difficulty is due to this, I would recommend you to do two things: First to have a pipe fixed in the wall below the grate at the back of your fireplace, which would convey air direct from the cellar, or the outside of the house, in sufficient quantity to feed the fire; and, second, to see that the perforations in your ceiling, and the gratings in the outer wall are sufficiently large to carry away the foul air.—L. Archbutt.

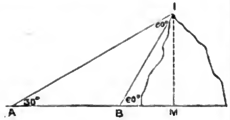
[47937.]—**Photography.**—I have frequently endeavoured to take portraits in a room at night by means of magnesium ribbon, but with no success. I have, however, just perfected a light, whereby photography may be carried on at night, and in a sitting. My lamp will be exhibited at the forthcoming exhibition in London; but if "Sempervivo" will favour me with his address, I will supply him with all necessary information.—John Y. M'Lellan, Craig-street, Glasgow.

[47947.]—**Land Reclamation.**—The term "warping," as applied to the reclamation of land, means the flooding of such land with the waters of some river or torrent highly charged with earthy matters in suspension. The water in this way being spread over a large area, loses the velocity that it had in the torrent, and the sediment is precipitated on the land, the level of which, in the course of time, is raised. In the Tuscan Maremma, large tracts of swampy land have been reclaimed in this way, and in the neighbourhood of Grosseto, the flood-waters of the Ombrone, highly charged with rich, earthy substances, brought down from the mountains during its rapid course, are led on to the low lands by proper channels, and the water, which at the inlets is of a dirty yellow colour, flows over the land and is drawn off at the outlet perfectly clear.—Etna.

[47947.]—**Land Reclamation.**—I have seen a little of the system of land reclamation by "warping," but it is somewhat different from that described by "G. J. H." The silt or "warp" is brought up with the tidal-water, and subsides from it when the water has reached its height and begins to recede. A "fresh" brings very little sediment indeed, compared with the tide-water. The best season for warping is a dry summer, when, if there be strong tides, the amount of deposit will be considerable. I have seen the stone steps of a ferry covered to the depth of three or four inches with deposit from a single tide; but of course it must not be supposed that a large area would receive even half that depth. The total thickness of warp which can be obtained on any area depends on the difference between the land level and the height of the tide-water. Sometimes four or five feet can be got on small areas. When a district has been embanked round for warping, a large drain is made, embanked on both sides from the sluice to nearly the farther extremity of the area. On the tide-water being admitted, it rushes down to the extreme parts and gradually spreads until the force of the tide is expended. The subsidence of the river then admits it to slowly return, leaving behind a deposit of warp. The unequal periods of rising and falling are especially suitable for allowing the water to clear. In the river to which I am alluding, the rise of the tide occupies about, or rather over, two hours, while the returning time is consequently nearly ten hours, thus giving the warp ample time to subside. Large areas of bog, peat, or "turf," have been transformed into excellent corn-land, where the situation and surrounding conditions have admitted of the system being applied. In some instances warp has been carted from the river side on to poor land; but it is generally considered less beneficial than when gradually deposited from water.—O. V.

[47952.]—**Agricultural Chemistry.**—"J.D.B." will find "The Fields of Great Britain," a text-book of agriculture, adapted to the syllabus of the Science and Art Department for Elementary and Advanced Students, by Hugh Clements (Board of Trade), with an introduction by H. Kains-Jackson, price 2s. 6d., a capital book for the purpose required. Published by Crosby Lockwood and Co., 7, Stationers' Hall-court, London, E.C.—F. EVERITT.

[47957.]—**Measuring Height of Mountain.**—Unless "Glen" measures height by means of variation of atmospheric pressure by the barometer, it is essential that he be able to measure some angles—say, by marking lines on a board and running his eye along them. Suppose he can measure the angles 60° and 30°. Let A be the point in plane of base, at which angle PAM = 30°, and let B be point in straight line AM (by walking straight towards M), at which angle PBM = 60°. Measure AB, let it = a—say; ∴ PB = AB = a, PM = PB sin 60° = $\frac{\sqrt{3}}{2}a$, ∴ height = $\frac{\sqrt{3}}{2}a$. Of course, any angle would do; these are the easiest. AB must be level.—B. A., Cantab.



[47959.]—**Gauges of Continental Railways.**—The ordinary gauge of the Italian Railway, as regulated by a Government commission in 1871, is 1·445m., or 4ft. $8\frac{89}{100}$in., or slightly larger than the English, which would be 1·43m., or 4ft. 8¼in. The distance from centre to centre of rails, 1·50m., or nearly 4ft. 11⅛in.—ETNA.

[47959.]—**Gauges of Continental Railways.**—I do not know exact measurement of gauges of Continental railways, but they must be all the same, with the exception of Spain, for I have seen Russian, German, and Italian carriages often in the north of France, some of them as far as Calais; and I know there is no changing of carriages between Paris and Vienna. At Calais, every Friday night there is a sleeping-carriage that runs through to Brindisi with the Indian mail, via Mont Cenis tunnel.—VEGA.

[47963.]—**Legal.**—Under the circumstances stated in this query, A. devises a life estate to his wife Jane, with remainder in fee to his son B. B. does not "give away what neither he nor his wife ever possessed." Under A.'s will B. has a future and contingent interest (viz., a fee simple expectant on the determination of Jane's life estate), and he is expressly empowered to dispose thereof by will by the Act 7 Will. IV., and 1 Vic., c. 26, s. 3. He devises that interest to Mary his wife, who dies (presumably intestate) in Jane's lifetime, and so the interest passes to Mary's heir or heirs, whoever he or they may be, and it will vest as an estate in fee simple *in possession* immediately on the death of Jane. In the mean time, it may be disposed of from time to time by conveyance *inter vivos*, or by will, but is always ready to vest on Jane's death, as above stated. "The property" (by which I suppose "Anglo Dane" means the contingent interest devised to B.) does not "go back to Jane as A.'s widow and heir." The "elder son," and not Jane, is A.'s heir; but the heir's right is destroyed by A.'s will.—LEX.

[47973.]—**Barium Compounds.**—Perhaps it is best, where the native carbonate (Witherite) is cheaply obtainable, to make barium chloride the starting point for the preparation of all these compounds. The nitrate is produced from it by double decomposition with sodium nitrate (Chili saltpetre), forming sodium chloride and barium nitrate. From the latter salt, barium oxide (caustic baryta) is easily producible by mere heating to redness, and this may be done in an iron pan. The nitric acid becomes decomposed, and is disengaged in the form of oxygen mingled with red nitrous fumes, and these may be collected and utilised in a variety of ways:—(1) They may be reconstituted into nitric acid; (2) they may be used in the place of nitric acid in the manufacture of sulphuric acid; (3) they may be mixed with hydrogen, and being then passed through a heated tube or retort filled with pumice (which has been dipped in a solution of any salt of iron, dried, and subsequently calcined) may be entirely converted into a corresponding proportion of ammonia NH_3. Thus caustic baryta can be made from the nitrate, starting previously from the chloride and the nitric acid completely recovered as such, or utilised in an advantageous manner. The barium hydrate may be formed by acting on the caustic baryta with water. The caustic baryta slakes like caustic lime, and if the hydrate thus formed be dissolved in boiling water to saturation, and allowed to cool, crystals of the barium hydrate, with eight equivalents of water, become deposited, and may be drained and collected. Further, these crystals fuse easily if heated in a cast-iron pan in their water of crystallisation, and this may be evaporated till a monohydrate is left, and by merely heating this still further in the same pan it will enter into fusion, and may be ladled out, and cast into pigs like so much lead. In this form barium hydrate keeps well, and is easily packed for transport. Barium hydrate is further obtainable from the barium chloride, by boiling with an equivalent proportion of sodium hydroxide, when on cooling barium hydrate crystallises out. At the present low price of sodium hydroxide (caustic soda) this method of producing barium hydrate is feasible. In the manufacture of barium sulphide from the ground sulphate which B. D. Williams recommends, it is a mistake to state that any kind of reducing-furnace will suit. Such is not the case, and anyone who tries it will find that the bricks are rapidly destroyed. In course of experimenting in this direction with a celebrated French chemist, we were led, upon his suggestion, to try bricks made from pure magnesia, obtained from magnesite. We constructed with these the bed of a reverberatory furnace, and this bed lasted for more months than our ordinary firebrick bed had lasted for days. Finally, we prepared our barium hydrate by decomposing the barium sulphide with zinc oxide. The following is the best mode of proceeding:—Barium sulphate was mixed with one-third to one-half its weight of coal-dust, and decomposed in our reverberatory furnace, heating it with a very fuliginous flame. The black mass was lixiviated with boiling water, and the hot solution of barium sulphide drawn off clear by decantation. On cooling, such a solution separates into crystals of barium hydrate mixed with barium sulphide and a barium polysulphide, which latter remains in solution. The solution is drawn off then after cooling, and we just simply threw it away at that time. The crystals were dissolved again in boiling water, and to separate the small quantity of sulphur still present the following method was pursued:—On adding to a sample of this liquor an excess of zinc oxide, the sulphur is separated entirely as an insoluble zinc sulphide, $BaS + ZnO = BaO + ZnS$; but besides this, the barium hydrate remaining in solution takes up more of the zinc oxide, forming a compound with it corresponding to what one might look upon as a kind of barium zincate. It is obvious that were the zinc oxide added in just the right proportion, this latter compound need never be formed; but it is difficult to hit the exact point in this manner; so in practice it is better to divide the solution into two parts, and then to add the excess of oxide to a first portion, and the clear solution of zinc thus obtained to the other part or second portion of the liquor. As, practically speaking, the liquors are always obtained (or may always be obtained) in precisely the same conditions of saturation, and with like proportions of sulphur it is easy to establish, once for all, the bulk of liquor to be taken which, when treated with the excess of zinc oxide, will serve to desulphurise the other part without leaving any undecomposed sulphide in solution on the one hand, or any free zinc on the other. The only points to be attended to are to so manage the liquors as to maintain them boiling hot, or at least as nearly a constant temperature as possible during the whole operation, and this is not difficult when dealing with large bulks of liquor which retain their heat. Lastly, we also made some of our barium hydrate from the carbonate direct, heating it first with coal in our reverberatory furnace with its bed of magnesia, and then extracting barium hydrate by lixiviation. Without magnesia this is quite out of the question. The high temperature required, and the extreme basicity of the baryta, causing rapid fluxing of all ordinary bricks. I believe this further information may be of value to querist *re* "barium compounds" in last but one of "ours." I shall be happy to afford any further information on this subject, about which I believe I have more experience than most persons, and am only surprised that barium compounds are not already, as they deserve to be, an important branch of British manufacture.—LUX.

[47975.]—**Testing Lightning Conductors.**—The only way to test your conductor is to resort to the common and well-known method usually termed "steeple-jacking," and having accomplished the somewhat perilous task of attaching a wire from the top of the conductor to the earth, to make the ordinary calculations on the galvanometer. As the majority of conductors which have been erected for a long time have not, upon being tested, proved to be in proper working order, but on the contrary an absolute source of danger, it is very likely that you may meet with the same result. Should you find this to be so, I would advise you to adopt "Vyle's Patent Easily-tested Lightning Conductor," which is guaranteed to be made of 96 per cent. pure copper, and can moreover be tested at any moment without the inconvenience and danger of the method above referred to.—JOHN BULL.

[47979.]—**Locomotives.**—I see "Meteor" could not give you the size of cylinders for 1128 and 1394: they are 18 × 24in.; the former was built by Neilson and Co., Glasgow, the latter at Derby by M. R. Co. There are three engines, 1397, 1398, and 1399; I have been informed that they were the property of the Somerset and Dorset Railway, and the M. R. Co. took them from them when it was made into a joint committeee; they are small tender engines, I think they have wheels 5ft. 4in., and cylinders 15 × 20in. I may also state that they have steel boilers; the engines which our friend "Meteor" means are from 101—109, they have had their numbers altered from 1390-tys. to the former; cylinders, 18—26; wheels, 7ft.—CAMOMILE.

[47997.]—**Black and Tan Terrier.**—A white opacity of the whole of the front of the eyeball often occurs in dogs from some irritation, such as thorns—this, of course, should be looked for, and the whiteness will disappear by itself. If it does not do so soon, something in the shape of a small blister just in front of the root of the ear on the same side, kept open for a week or more, will often effect a cure. A little blistering fluid carefully rubbed in with a small hard brush will be the best thing, but the opacity in this case may perhaps be internal; for this nothing can be done.—F.R.C.S.

[48009.]—**Integral Calculus.**—Since $\frac{x}{\sqrt{1-\cos. x}} = \frac{1}{\sqrt{2}} \cdot \frac{x}{\sin. \frac{x}{2}}$. Let $\frac{1}{\sin. \frac{x}{2}}$ be developed by Maclaurin's theorem; and we have

$$\frac{1}{\sin. \frac{x}{2}} = \frac{2}{x} + \frac{1}{6} \cdot \frac{x}{2} + \frac{7}{360} \cdot \left(\frac{x}{2}\right)^3 + \frac{31}{15120} \cdot \left(\frac{x}{2}\right)^5 + \frac{381}{1814400}\left(\frac{x}{2}\right)^7 + \&c.$$

Hence, $$\frac{x\,dx}{\sqrt{1-\cos. x}} = \frac{d\,x}{\sqrt{2}} \cdot \frac{x}{\sin. \frac{x}{2}}$$

$$= \frac{d\,x}{\sqrt{2}}\left\{2 + \frac{x^2}{12} + \frac{7x^4}{2880} + \frac{31x^6}{483840} + \&c.\right\}$$

Integrating

$$\int\frac{x\,dx}{\sqrt{1-\cos. x}} = \frac{1}{\sqrt{2}}\left\{2x + \frac{x^3}{36} + \frac{7x^5}{14400} + \frac{31x^7}{3386880} + \&c.\right\}$$

—MILVERTON.

[48010.]—**Oil on the Waves.**—It would certainly take a very long time before the ocean was completely covered with a film of oil, and I doubt whether this would ever happen, as the oil would partly decompose and be partly eaten. As, however, a machine has been invented for the purpose of pouring the oil upon the "troubled waters," it is not at all unlikely that one may be invented to collect it.—JOHN BULL.

[48023.]—**Fixing Cylinders and Eccentric in the Lathe.**—First bolt eccentric on face-plate of lathe and bore out with a side tool for shaft, then place it on a mandrel turned true to fit, and face up each side of eccentric and turn boss; from the two centres in mandrel set off the throw with a pair of dividers. Place mandrel on a surface-plate, and draw two lines parallel with a scribing gauge. Where the line crosses mark with a centre punch carefully at each end, place eccentric sheaf on mandrel and run throw up. To bore cylinder, the lathe should be a self-acting one, and the cylinder placed on saddle and bored out with a boring bar and a proper-shaped cutter. I believe large cylinders are bored out with a machine designed for that purpose. Only say what you wish to fit, and I will help you.—Working Blacksmith.

[48025.]—**Preparing Insects for the Microscope.**—Kill the insects in spirits of wine, then soak for some hours in pure spirits of turpentine, and finally mount in Canada balsam.—F.R.C.S.

[48025.]—**Preparing Insects for the Microscope.**—In a paper by Staniford Green, read before the Quekett Club, March 22nd, 1878, it is recommended to kill the insects by turpentine, and allow them to remain in it for a few days, when they will be transparent and fit for mounting in balsam, without pressure. Dipterous insects of moderate size should be boiled in the turpentine for a moment, and left in cold turpentine till they are tolerably transparent, with a clear outline. Specimens were shown at the meeting, and the beautiful condition of trachea, eyes, and muscular tissue was noticed.—T. W. W.

[48033.]—**Agriculture.**—I can strongly recommend "Agile" to procure the book I use, and with which my present teacher obtained first-class honours last year, viz., "The Elements of Scientific Agriculture," price 2s. 6d., by John J. Pilley, medallist, and holder of first honours certificate in agriculture. At the end of each chapter are questions from the various stages of examination papers. The publishers are Messrs. Geo. Gill and Sons, Paternoster-row.—E. A., Longstaff.

[48034.]—**Ammonia.**—(*a*) The specific heat of ammonia (water = 1) is ·508. (*b*) The pressure of the heated gas increases by 1-273rd of its amount for every degree centigrade above freezing-point. Now 100° F. = 38° C.; 150° F = 66° C.; 200° F. = 93° C. Hence, the ratios of the pressures at 0°, 38°, 66°, 93°, are 1, $1\frac{38}{273}$, $1\frac{66}{273}$, $1\frac{93}{273}$. Taking the atmospheric pressure at 15lb. per square inch, we get the total internal pressures at the three temperatures 17·1lb., 18·6lb., and 20·1lb. The excess of internal over external pressure is, hence, at 100° F., 2·1lb.; at 150° F., 3·6lb.; at 200° F., 5·1lb.—M. A.

[48034.]—**Ammonia.**—The specific heat of ammonia gas referred to an equal weight of water as unity is, according to Regnault's researches, 0·5084. Gases expand $\frac{1}{491}$ of their volume for every degree Fahr. by which their temperature is raised. Therefore, one cubic foot at 32° Fahr. would become $1 + \frac{100 - 32}{491}$ or $\frac{559}{491}$ cubic feet at 100° Fahr., $1 + \frac{150 - 32}{491}$ or $\frac{609}{491}$ cubic feet at 150° Fahr., and $1 + \frac{200 - 32}{491}$ or $\frac{659}{491}$ cubic feet at 200° Fahr. But, as in the case under consideration, the gas is not allowed to expand, the pressure will be increased in the same ratio, according to Boyle's law, for the gas may be considered to be compressed from the volume it would occupy at the above temperature, until it occupied one cubic foot. The ordinary atmospheric pressure being 14·7lb. on the square inch, the pressures at 100° Fahr., 150° Fahr., and 200° Fahr., would therefore be respectively $\frac{14·7 \times 559}{491}$, $\frac{14·7 \times 609}{491}$, and $\frac{14·7 \times 659}{491}$lb. These expressions give the values 16·7, 18·2, and 19·7, or to state the excess of the pressure over that of the atmosphere, as is usually the case in practice, the pressures would be 2lb., 3·5lb., and 5lb. per square inch respectively.—H. O. M.

[48048.] — **Bichromate Batteries.** — The strength of the bichromate solution was:—Saturated solution of bichromate of potash. Sulphuric acid, one-sixth part. The proportions were by measure. I used a pint jar for the elements I mentioned on page 39.—Sema.

[48051.]—**Dulcimer.**—Beech is one of the best kinds of wood for this purpose. Make a strong frame composed of five pieces as follows: Two pieces 12in. long, 2in. wide, and 1½in. in thickness; one piece 2ft. long, 1½in. in width, and the same in thickness; another piece 18in. long, 1½in. wide, and same in thickness; another piece 1½in. wide, 1½in. thick, and 12in. in length. This piece will be secured in centre of frame to give extra strength. These five pieces should be firmly dovetailed together to form a strong frame. The wood should be perfectly dry, and free from any knots or splits. It should also be well seasoned. Next prepare two pieces of beech ¼in. thick, and large enough to form the top and bottom portion of the frame, and flush with the outer edges of it. These pieces should be dressed perfectly smooth on both sides. In one of these pieces, which is to form the upper portion of the soundboard, drill four holes about 2in. diameter in the centre, but not too close together. Fix this piece on the frame with good hot glue and one or two good screws. Afterwards secure the piece to form the base of the soundboard in a like manner. This piece will not require any holes to be drilled through it; it should fit so as to come exactly flush with the outer edges of frame. When this is done, fix two bridges of hard wood (the harder the better) 12in. long, ½in. wide, and the same in thickness, 1in. from the edges of soundboard, and on the upper portion of it where the holes are drilled. The holes are required for the same purpose as the F holes in a violin. If the bottom piece is omitted, then no holes will be required in the upper portion of the soundboard. The querist may choose whichever method he prefers. A little glue will suffice to hold the bridges on. The next thing to do is to secure the pins, which should be situated at the straight end of soundboard, and about ½in. from the bridge. At the other end secure the pianoforte pegs, two for each note, in a similar manner as in a bichord pianoforte. The pins at the first end should be rather thick, as the wire has to pass round it. One piece of wire will answer the purpose of two strings to one note, which is termed bichord. If three wires are required for each note, it will be better to have a separate string for each pin and peg. The querist can apply as many notes as space will permit, and tune it according to his taste, and at any pitch he desires. Brass wire is, I think, preferable to steel for a dulcimer, but either can be used. Dulcimers are made in various ways. If the querist will strictly observe the instructions I have sent, he will be quite satisfied with the result after he has finished. I shall be happy to supply any further information on the subject that may be required.—G. Fryer.

[48054.]—**Turkish Bath.**—This correspondent who believes in both allopathy and homœopathy, and takes china (is it blue?) would find his cure, I should imagine, in ceasing to trouble himself about all these things.—F.R.C.S.

[48058.]—**Wild Beast Trap.**—Any trap on the live-mouse-trap principle which will take the animals alive, so that they may be mercifully shot. The natives in most countries understand the building of these traps, which are baited inside with meat; spring steel traps are too cruel to be used for any animal, keeping them in torture for hours.—F.R.C.S.

[48060.]—**Melting Temperatures.** — Bodies which expand on liquefaction, as is usually the case, would certainly have their melting-points somewhat lowered if the pressure on them is diminished; but I am of opinion that the lowering of pressure consequent on a rise of 6,000ft. would not be sufficient to produce any perceptible alteration in the temperature of liquefaction.—H. O. M.

[48060.]—**Melting Temperatures.**—A substance which melts at 212° cannot be melted at 200°, even under a lower atmospheric pressure; but the boiling point of water can be raised by adding a considerable quantity of common salt to it. If the question of carriage is no object, chloride of calcium is better for the purpose than ordinary salt, which is only referred to as being easily procured in almost any part of the world. — Thomas Fletcher, Museum-street, Warrington.

[48060.]—**Melting Temperatures.**—The result depends upon the nature of the substance. The melting temperature depends upon pressure as well as heat, and upon the vapour tension of the substance. Water boils at a lower temperature under lower pressure, because the act of boiling is change of state to vapour, which forms earlier. But this does not affect the mere fact of melting where vapour is not formed. In the case put, the substance which melted at boiling temperature, 212°, would not be capable of being melted at all when the boiling temperature was lowered to 200°.—Sigma.

[48062.]—**Watch Repairing.**—"J. B." does not say in what way he has failed to time an English lever, but can time Genevas very well. I should have thought he could have managed the lever as well if he knows how to count the vibrations right. I have never found any difficulty in springing ordinary watches. Jewel-holes can be bought ready set and drilled for English watches, gauged to size; Genevas are set in the plates. There are tools sold to open the setting, and they have been described in "ours" some time back. I use a mandrel to turn out jewel seats, but I believe watch-jewelling is a separate branch. Any further information with pleasure. — Working Blacksmith.

[48063.]—**Medical Coil.**—"A Novice" has not done what he says, and followed my instructions. The directions given, p. 359 of my book, and shown in the diagram, are to connect the battery only to the two ends of the primary circuit of 18 wires. These magnetise the core, and the extra current from them passes into the body through any length of secondary wire included. The connections from which to receive the shock are from the commencement of the primary, and from the commutator studs, to which the other end of the primary, and successive lengths of secondary are attached. The result, he observed, is what ought to happen: if the secondary is included in the battery circuit, the magnetism of the core is so much reduced as to diminish, instead of increasing, the shock.—Sigma.

[48067.]—**Silver Watch-Case Repairs.**—First remove the springs and also the bow. This is generally fastened with a steel screw. I think the brown colour which your watch-case had on removal from the acid, must have been caused by an iron or steel screw, or perhaps a piece of iron binding wire, which you had left on the case. Iron in contact with silver in sulphuric acid has this effect. It is, I expect, a result of galvanic action. Your pickle is much too strong Add sufficient acid to the water to render it sharply acid to the taste. Any sort of clean water will do. This pickle will do for either gold or silver. There is another reason why you should remove the bow. The push-pin is generally made of brass, with a small piece of silver soldered on the top. This is sometimes fastened on with pewter or tin solder, and in hard soldering the case you would be sure to spoil it (the push-pin). Carefully examine the case to see that it has not been previously botched with pewter, as the smallest particle of lead, tin, or zinc, will, when the case is red-hot, run through and leave a large (or small) hole. If there should be any such about it and it cannot be removed, don't have anything to do with the case. You can buy what is called "joint wire," this is a piece of thin plate bent into the form of a tube, and then pulled through a draw-plate to the required size; recollect that it is not soldered. You will see the edges running down on one side of the wire, this side will be the inside part (so to speak) of the joint, so that when the solder runs it will join these edges together, as well as join the knuckle to the case. You can get, at the watch-tool shop, a file with a round edge. The edge of the file must be no larger than the joint, and it is used to file out a place for the joint. If two knuckles are broken, you will find it best to file off the third, and put them all on fresh; if you are only putting one or two on, you must be very careful not to file too much away, as this would spoil the joint altogether. We will suppose you have neatly and flatly filed away the old joint, or a part of it, place the two parts of the case together, and cut the joint wire (with a fine saw) the proper length, and scrape that part of the wire where the edges join. You have your borax ready on the slate, smear a little on the joint just in the centre of each knuckle, and put the pieces of wire in their places on the wet borax; now add to each one a small panel of solder (dipped in borax), and allow the whole to dry. I should now solder it just as it is; that is, I should just tack each knuckle with a very small quantity of solder, and if more were required, separate the pieces of the case, and solder again with a little more, but you must be very careful of the solder, as, if any of it runs away, it will spoil the work and the fit of the joint. You need not solder the two pieces at once if you don't like, but let the borax be quite dry before you separate them, as if the knuckle shifts it will get loose or come off; whereas, if you separate them when the borax is wet, you have no means of knowing whether it has shifted or not. A word of caution about joint-pins; perhaps you do not know how they are fixed. In the best watches, the joint-pin is of steel, iron, or brass, and it is made of such a length that it just fits into the centre of the joint; and a piece of silver or gold wire, as the case may be, is then pushed in at each end, and carefully brushed over. These gold or silver ends can be removed with the point of a graver: just stick the point in, and drag or push out the piece of wire. Common watch-cases generally have German silver joint-pins all through. Some cheap watches (called silver) have silver back and front, while the rim or body of the case is German silver. This should all be ascertained, as it is no use putting a silver knuckle or joint on to a German silver case. These cases require to be plated after being hard-soldered. You will find a draw-plate very useful: they are rather expensive, but last a long time. If you have or can get a draw-plate, I will tell you how to make the joint-wire, as you will want it of different sizes, and it can only be reduced with a draw-plate—it must not be filed. It can be purchased at the tool shops.—Os.

[48068.]—**Eyesight.**—"Nigel" can have spectacles with two different shaped lenses, one to suit each eye. If he will select a lens which is right at, say, 10in. distance for each eye, the selected lenses can be put in one pair of spectacles. This is commonly done, and probably "Nigel" has not explained the difference between his eyes when attempting to purchase. Odd spectacles are never kept in stock, but the lenses can be changed in a few minutes; the additional cost will be little or nothing.—Thomas Fletcher, Museum-street, Warrington.

[48069.]—**L.N.W. Engines.**—No. 2047 is a six-coupled saddle-tank short funnel, stationed at Camden.—Alaric.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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47445. Electrical, 460.
47451. Varnish for Clay Pipes, 460.
47455. Boiler Tube Piecing, 460.
47457. Injector, 460.
47458. Reeds for Jacquard Loom, 460.
47466. Lion, 360.
47472. Indian Workmen, 461.
47480. L. and N.W.R. Compound Locomotive Experiment, 461.
47483. Mining Queries, 461.
47484. Bennett's Battery, 461.
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47684. Tin-plate working, p. 556.
47685. Photography, 556.
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47691. Siemens' Dynamo, 556.
47700. Collimation, 557.
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47713. Aniline Dyes, 557.
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47727. Boot and Shoemaking, 557.
47729. Drying Hose, 557.
47741. Winding Engine, 557.

QUERIES.

[48070.]—**Prospects in Western Australia.**—Having part interest in a concern which proves unable to support two leading hands, and the trade not being a generality, and at the present period very slack, I should be glad as an intending emigrant, of information (trustworthy) or of references to books that may be purchased containing the enlightenment desired of the district named above. I can, of course, withdraw the interest named, about £200. What are the chief products of the country? Is it suitable to a European constitution, the value of land and its fertility, and if cattle disease has ever obtained a footing there? Can anyone explain the following?—Government grants of £20 value given to all who pay their passage there. The above has been seen in Post-office window. To what part of country does it refer?—A MECHANIC.

[48071.]—**Coil Winder.**—Will any of "ours" be kind enough to give me directions for making the above, accompanied by a rough sketch, if possible?—A BEGINNER.

[48072.]—**Induction Coil—Edison Lamp.**—I have made an induction coil, core ¾in., two layers of No. 16 cotton-covered for primary, and about thirty layers of No. 36 silk-covered for secondary, condenser, and separate contact-breaker. I get a good shock from it, but hardly any or no spark. Will Mr. Lancaster, or other kind electrician, inform me what length of spark ought I to obtain, and if I added 2oz. of No. 36 silk-covered to it, would it give a better effect? I have got a ten-candle Edison lamp, and seven quart Bunsens, but do not get near ten candles' power from it. The person at the shop I purchased it at said it would work with seven batteries (Bunsen), and I fear it requires greater power. Will you kindly give your opinion on the subject, and oblige?—W. H. E.

[48073.]—**Water-engine.**—I want to make a small water-engine of about ½-h.p. If any reader can supply me with drawings or instructions, I shall be much obliged. The engine to be worked by pressure obtained from water-main.—JACK.

[48074.]—**Cosmical Rising of Lyra.**—In "Ovid, Fasti I.," 315, there is a passage which refers (so Keightley says in his note) to the cosmic rising of Lyra, on the 5th Jan. Now, if I rectify my globe for latitude 42° (that of Rome, say), and bring Vega, say, to the Eastern edge of the horizon, and observe the day answering to the degree of the Ecliptic cut by the eastern edge of the horizon, I should obtain, I fancy, the day on which Vega rises cosmically. But this corresponding day seems to be early November, and not early Jan. 7, and no allowance for precession will, so far as I understand the matter, make Lyra rise cosmically in Jan. 7. If I work on Algenib in Pegasus from the latitude of London in the same manner, I find its cosmical rising to be Feby. 10th, which is correct, I am told. I hope someone who knows will have the courtesy to answer this inquiry.—W. D. B.

[48075.]—**Astronomy—Herschel's "Outlines."**—What books should be read first? On pp. 4 and 5 of the eleventh edition of Sir John Herschel's "Outlines of Astronomy," the following passage occurs:—"The preliminary knowledge which it is desirable that the student should possess in order for the more advantageous perusal of the following pages, consists in the familiar practice of decimal and sexagesimal arithmetic; some moderate acquaintance with geometry and trigonometry, both plane and spherical; the elementary principles of mechanics, and enough of optics to understand the construction and use of the telescope, and some other of the simpler instruments." I would be much obliged if some one would kindly give me the names of the best books limited, or nearly limited, to the subjects or such parts of the subjects of which such preliminary knowledge is desirable. If, there are treatises which satisfactorily afford the necessary information without giving the numerous exercises found in school manuals, such treatises would probably be the most convenient.—O. L.

[48076.]—**Emigration.**—I am thinking of going out to South Africa. Will any kind friend give me a little advice? I have always followed clerking (railway and P.O.). How are railway officials paid out there? Would there be any difficulty in getting into the locomotive department? I may say I have a knowledge of agriculture—would I be able to make anything out of that? I am informed Dutch is chiefly spoken. Can I be recommended a book on that subject suitable for that part? Are there any openings in the Army for a steady young person? Any relative information as regards climate, dress, manners, &c., will be gladly received.—J. A. F.

[48077.]—**Legal.**—To MR. WETHERFIELD.—I am a schoolmaster. Part of my salary is a house which I have let. Tenant was served at Lady-day with notice to quit at Michaelmas. He refuses to go out. There are several other houses empty in the village. There is no written agreement, as the man had the house at a nominal rent, *merely as accommodation* whilst getting another. How am I to deal with him? Would or could there be any legal quibble over my power to let? Notice to quit was served by an independent person, but not in the presence of a witness. Is a witness required? As I am urgently in need of the house at the present time, your assistance will be thankfully received. I may say there has been no rent, nor is there appearance of any. Can I put in an execution?—W. G. TALONE.

[48078.]—**Muntz Metal Tubes.**—I have been lately fitting pieces of these together by riveting and soldering, but think if they could be put together by brazing it would be an improvement. Would some reader kindly inform me how to do this, and what spelter and flux is necessary? Any information would greatly oblige.—Y. Z.

[48079.]—**Voss Induction Electric Machine.**—Many thanks to Mr. John C. Frank for information as to the No. of the "E. M." where I should find a description of the above machine; but as it does not give the sizes of the different parts, would it be troubling him too much to ask the following questions?—What should be the sizes of two plates? 2. What distance should the revolving plate be from the fixed one? 3. Thickness of plates? 4. Would not vulcanite or ebonite plates do as well as glass, as they are less expensive, and not so likely to break?—W. J.

[48080.]—**Compensation Balance in Watches.**—Will any of "ours" kindly explain the construction and use of the compensation-balance in watches? Any information on the subject will undoubtedly be of interest to many of our readers as well as myself.—G. FARNE, Swansea.

[48081.]—**Small Blower.**—Will some one tell me how to hinge the boards together so that the leather may not be liable to crack, and how and where to join the leather in a small blower I intend making? It will be about 12in. by 14in. with rounded corners.—H. W. W.

[48082.]—**Single Eccentric Link Motion.**—Will some one inform me if the above will answer, the link being pivoted at the centre, and connected to the valve-rod by a movable connecting-rod?—H. W. W.

[48083.]—**Keeping Launch Funnel White.**—Will any of "ours" tell me what to coat the funnel of my launch with to keep it white, or any light colour? Have tried white paint, whitewash, &c., but everything burns off, and the funnel looks rusty. Have tried Brunswick black, but even that burns off after three or four trips. I may mention that there is an inside funnel, and that the one I wish to keep white is the outer casing.—THOMAS PAGE.

[48084.]—**Camera.**—Would Mr. Parkinson or Mr. Robinson kindly give me a few hints as to turning out a nice half plate bellows-body camera to take views and two portraits on half-plate? I intend making one in the winter evenings. I have made a smaller one, but I would like some questions as to brass-binding, &c.—SEMPER FIDELIS.

[48085.]—**Rosin for Violin Bows.**—Will "Fiddler," Mr. Schucht, or some other kind friend versed in the matter, tell me how to prepare rosin for the above use, and how it is shaped into fancy squares? I find it sticks to moulds made of plaster of Paris.—CELLO.

[48086.]—**Red Ink.**—Can any reader give me a recipe for red ink made from logwood?—A. A. DONALD.

[48087.]—**Dynamo-machine.**—I am making a dynamo as follows: Armature 4½in. diam., ¾in. wide, of the Gramme form, having 16 coils of No. 20 B.W.G. cotton covered copper wire; field-magnet 1in. diameter, round, iron bent to shape, legs 6in. long, pole pieces screwed on to magnet with 4½in. circle cut from them. I understand the magnet is a little small, but I cannot get it altered. Will any reader kindly tell me how much, and size of wire to put on magnet, and what I may expect from such a machine? The total weight of wire on armature is 13 oz.?—A. A. DONALD.

[48088.]—**Legal.**—A. rents a farm after the rate of 35s. an acre, and is assessed after the same rate. Upon A. leaving, B. takes the farm at the rate of 30s. per acre, but is assessed on the old rental of 35s. per acre. Can B. be legally assessed on the old rental, or on any sum above the permanent rent?—A FARMER.

[48089.]—**Preserving Wood Fish Tank.**—Can any of our readers help me with the following?—I have a fish tank made of wood (deal), only the front being of glass. What paint, or other substance, would be best to put on to preserve wood without injury to fish?—ONE IN DOUBT.

[48090.]—**Bleach and Dye Refuse.**—Will Mr. Allen, or other reader, inform me if the refuse matter from a small bleach and dye-works run into the main sewer on to a sewage farm a mile distant will be injurious to vegetation? Collecting area for the sewers, 13 sq. miles, population 12,000. Has any local board, or other sanitary authority, the power to prevent such refuse being turned into the sewers? Please name a few places (if any) where such refuse is turned into the main sewers and run on to a sewage farm.—J. C., Local Board.

[48091.]—**L.B. & S.C. Engines.**—Will any correspondent give me names, and for what kind of traffic engines Nos. 23—28 are used for?—DUBLIN.

[48092.]—**The Properties of the Number Nine.**—Will some reader kindly inform me why the result of subtracting the sum of the digits of any number should give a multiple of nine, thus: 653442, the sum of the digits is 24, which, on subtraction, gives 653418? This is a multiple of nine.—TIRO TIRONUM.

[48093.]—**Compact form of Bunsen Battery.**—I have made a battery as described in letter 19698, p. 193, May 5, 1882. Would your correspondent, "H. S. B.," kindly give description of lamp, and cost of same? and oblige—A BROTHER-READER.

[48094.]—**Legal.**—A man has opened a fried-fish shop next to mine—a confectioner's. The stench from the fish and fat in which it is fried greatly injures my business. Can I do anything to stop the nuisance? If so, how shall I have to proceed?—SUGAR.

[48095.]—**Equation of Equal Altitudes.**—To "F.R.A.S."—Will "F.R.A.S." kindly oblige "Roi ne Puis, Souza je Suis" by noticing the "Equation for Equal Altitudes" which appeared in Vol. XXXII., No. 830, p. 569, where the "true time of apparent noon" is stated to be equal to middle time $+ x + y$ (x and y being seconds of time), said x and y being obtained as follows:—

$$\log x = \text{log. } A + \text{log. } 3 + \text{log. tan. latitude}$$
$$\text{log. } y = \text{log. } B + \text{log. } 3 + \text{log. cotang. polar dist.}$$

and

$$A = \frac{1}{30} \cdot \frac{\text{Interval}}{48\text{ hours}} \text{ cosec } (\tfrac{1}{2}\text{ interval})$$
$$B = \frac{1}{30} \cdot \frac{\text{Interval}}{48\text{ hours}} \text{ cotan. } (\tfrac{1}{2}\text{ interval})$$

I suppose "interval" is the time between the two sets of observations, and hence is in "time," and not in arc. Will "F.R.A.S." say how we can speak of "cosec. (or cotan.) ½ interval"? Is this "time" reduced to "arc," and how? I dare say it is simple enough when known; but as I generally use another formula for "double altitudes," I should like to know how this one is worked.—ROI NE PUIS, SOUZA JE SUIS.

[48096.]—**Photographic.**—Will some correspondent kindly oblige by answering the following questions?—The lenses of my camera (three in number, 1½in. in dia.) are made up in the following manner: First, a concavo-convex, then the stop with ⅛in. aperture, then at the back a concavo-convex, and double convex with the shallowest side on side, the latter two being separated by a thin brass ring. I wish to photograph a landscape; but the photographs always turn out with the trees 30ft. distant, blurred and indistinct, and if I alter the camera to show the trees distinct 30ft. away, then the trees only a few feet distant, will be out of focus. Can I alter the combination of the lenses in any way so as to be able to show objects in the foreground and background clearly on the photo, as in proper landscape cameras? What is this lens best adapted for? Would using a smaller stop be any advantage?—C. R.

[48097.]—**Egyptian Railways.**—Who are the builders of the locomotives on lines near Alexandria, in Egypt? Are there any single express engines on these lines? What is the general appearance of these engines?—C. R. K.

[48098.]—**S.E.R. Bogie Expresses.**—Can some reader oblige by giving a few of the principal dimensions of the new coupled bogie express engines on the South Eastern Railway, and, if possible, a sketch, which, I think, would be a good addition to the drawings of British engines which have appeared before in the "E. M."? Although I have looked some vols. back, I do not see any sketches of the S.E.R. engines.—C. R. K.

[48099.]—**Model Locomotive Boilers.**—Can any of your readers inform me what is the best form of boiler for a model locomotive ½in. scale; length of boiler including fireboxes, 9in.; diam., 2½in.? What would be the necessary heating-surface, and how heated; if by spirit-lamp, how many wicks? The model in question represents the 8ft. G.N.R. engine, and am quite unable to raise the necessary pressure with a two-wick lamp, and three ½in. tubes, and inside firebox 2½in. by 1½in. Any other hints will be gratefully appreciated.—R. H. G.

[48100.]—**Legal.**—A person dies and leaves by will certain freehold property to his son A. for his life, and at his (A.'s) death to be divided amongst his children, share and share alike. The will also contains a precisely similar provision for his daughter B. Now there is no difficulty about this part of the will; but when the will comes to deal with the son's (C.) share, the word children is dropped, and the word issue used instead, and it stands thus: To his son C. certain freehold property is left to him for life, and is then at his death to be divided amongst his issue share and share alike. Now issue is a very different thing from children, and the question arises whether C.'s interest under the will is to be divided amongst his children only, or to be equally divided amongst children and grandchildren of C.; that is to say, amongst his issue, which means, I suppose, C.'s lineal descendants. The question is, what construction must be placed on the word issue? The grandchildren say they are issue, and claim equal shares with the children, and the children say they cannot, and the will never meant to include grandchildren. The grandchildren say they take the will as it is worded, and it includes them as well as the children.—A CONSTANT READER.

[48101.]—**Westinghouse Brake.**—To MR. C. E. STRETTON.—Will you kindly give a description (with drawing, if possible) of Stroudley's (?) driver's brake-valve used on Brighton line, and say if it is supposed to have any advantage over the ordinary Westinghouse valve? It seems to me that on the G.E.R., for example, where they use Westinghouse's own valve, the brake works in a much smoother manner.—McK.

[48102.]—**Dynamo.**—I wish to make a small hand-power dynamo-machine equal to 10 or more Bunsen cells. Please state size of Siemens I armature, which, I suppose, would be the best for small machines: size of wire wound with, also size and form of field-magnets and wire to wind same? Please describe arrangement of shunt dynamo.—C. J. EVE.

[48103.]—**Straightening Wire.**—To "JACK OF

All Trades" and "Fellow-Workman."—Will you kindly tell me the most sure way of straightening pieces of wire 3ft. long, for an aviary? They must be perfectly straight, or they don't look nice.—One in Distress.

[48104.]—**Legal.**—To Mr. Fred. Wetherfield.—An annuity settled on "a lady" on her marriage, and paid to her husband and their joint signature, wishes to know how the new law affects her? Her husband cannot will it away or leave it to pay his debts. Could she get complete control of it, to put it by for her children?—A Lady.

[48105.]—**M.R. Engines.**—Will "Camomile" state how many engines the Midland Railway possess numbered above 2000? From what company were they obtained? Of what class and build are they? I should also be glad of a few particulars of No. 201—208, and 1322—1328.—Metror.

[48106.]—**Waterproof Worsted Cloth.**—I have seen a worsted cloth used for ladies' waterproof which is waterproof on one side. Can any of your correspondents inform me what is the best solution to use for this purpose, and the easiest way to put it on the cloth level?—H. R.

[48107.]—**Tin and Zinc Work.**—Will any reader kindly inform me in what way and by what kind of tool the lap joints of tin and zinc work are made? Also, by what tool the tin or zinc metal is bent around wire for strengthening the rims of tin vessels?—Gomashta.

[48108.]—**Spongy Iron Filters.**—Could anybody give me particulars as to "spongy iron filters"? I am told that large quantities of water can be rapidly passed through them, and that they are used on a large scale at the Antwerp waterworks? I should be glad to know if this is the case, and, if possible, to have full particulars as to their merits. What is "spongy iron"?—Etna.

[48109.]—**Zinc.**—Will any reader kindly say what is the most approved process, and the best solder for soldering zinc?—Ignoramus.

[48110.]—**Siphons.**—I should be glad if some reader of the "E. M." would give particulars as to the use of siphon for emptying reservoirs. Siphons on a large scale are, I believe, in use for draining the Fen district. I should like to know if they are used to any extent for taking the water from reservoirs or lakes for the water supply of towns, and where they are in use? Any details as to the valves used and appliances for starting the siphon, either by air-pumps or otherwise, would oblige. Also a few particulars respecting those in use in Lincolnshire would be acceptable. Are there any objections or difficulties as to their use?—Etna.

[48111.]—**Abney's Shutter.**—How is Captain Abney's instantaneous shutter made—that which drops into a little bag fixed under the lens? Is it simply a round hole in a plate of brass falling between the lenses of a doublet or passing in front of a view lens? Will somebody who uses this simple arrangement explain its construction, and oblige?—Shutter.

[48112.]—**Photography.**—I often want to tone a print on albumenised paper whose permanence is of no great consequence. Is there not some simple way of obtaining a black or brown colour without the use of chloride of gold?—Gold.

[48113.]—**Knees of Trousers.**—There is an appliance for taking the wrinkles out of the knees, &c., of trousers and restoring them to their original shape and fit. Will some kind friend tell me how to make this instrument, and oblige?—Peckham Knees.

[48114.]—**Magic-lantern.**—I want some black opaque quick-drying varnish to paint on my slides between the views. How can I make such?—Lantern.

[48115.]—**Photo. Lens.**—Has a photographic view lens of wide aperture any advantage over one of lesser aperture, both being of equal focus?—Lens.

[48116.]—**Cigarette Making.**—Can any reader tell me how cigarettes are made by the trade—whether by hand or by machines, and if by hand, what is the process by which they can make them so uniform in size?—Smoker.

[48117.]—**Electro-plating Solution.**—Will any one kindly inform me if there is any other way besides evaporating to get rid of grease in solution? I have about 30 gallons of good silver solution which has, unfortunately, got impregnated with paint or grease of some sort, off sides of vessel in which it was inadvertently placed. I have tried filtering, but it is still unfit for use, and I don't like to throw it away, being such a large quantity of silver in it.—R. M.

[48118.]—**Electro-plating.**—How can I electroplate a lead or pewter cream-jug? I have tried nitrate of mercury first, but this seems to rot the metal, and I can't get any current to act through it, it being such a bad conductor. It will deposit in places, but not all over. Is there any other way of preparing for the bath? And in gilding the inside, how can I deepen the colour of the gilding? Ought a copper anode to be used, or gold one?—R. M.

[48119.]—**Land Tax.**—To Mr. Wetherfield.—Last year I was a tenant under a three years' agreement, in which there was a clause by which I paid all rates and taxes except property-tax. My landlady, however, refused to allow the land-tax. After the agreement ran out I took the premises for six months. Will you kindly say if I am not entitled to deduct land-tax, which I have since paid?—W. B., Enfield.

[48120.]—**Legal.**—To Mr. Fred. Wetherfield.—I am possessed of some title-deeds, which were given me as security for money lent some years since, and for some time past I have failed to get any interest thereon. What action must I take to compel payment, or the execution of a legal mortgage?—J. W. Morris.

[48121.]—**Legal.**—At what age does the minority of women cease?—Kunst macht Gunst.

[48122.]—**Drying Room.**—I have a lot of gaspipes, and want to get a drying-room attached to laundry. Please let me know would the steam take away the smell off them after a time, or what would clear them before being put up?—J. Kearsey.

[48123.]—**Reed Organ.**—Will some correspondent oblige by answering the following? I am building reed organ with 3½ rows of reeds, and am going to suck the wind instead of forcing it. What reeds must I use—will the ordinary harmonium reeds do? What will be the best selection of stops? Please give size and detail of reed-pan. Will one channel do for the 3 or 4 reeds answering the same note, and consequently one pallet-hole; or must I block the channel off for each reed, and have a separate pallet-hole and one large pallet to cover the 3 or 4 holes. I may add that the reed-pan will be above the keys, and the pallets will be worked with stickers.—E. J. L.

[48124.]—**G.N.R. Engines.**—Wanted principal dimensions of the following G.N.R. engines:—No. 8, 26, 31, 208, 212, 562; also 161, 385, 625, 251, 281. Could any descriptions be found in back numbers of "E. M."? If so, quote vols.—H. M.

[48125.]—**Electric Bell.**—I have bought the following parts of an electric bell:—Magnets with bobbins wound with silk-covered wires, armature, and hammer pillar and contact-screw, and two binding screws. Have put them together, but cannot get them to work. Where should I take the end of bobbins wires to? I have taken one of the wires to binding screw, the other wire I have put under head of screw in frame, and I have taken a short piece of wire from the other binding screw to pillar at contact screw. Have I done right? If not, I hope some of our readers will put me right and oblige—A Poor Reader.

[48126.]—**Electro-Deposition.**—I have made a rectangular trough of wood 18in. by 9in. and 9in. deep, and am lining it with guttapercha for electro-deposits. Would such a bath be too large to be worked by two half-pint Groves' cells, or, if necessary, 3; or had I better divide my trough into two parts, one for electro-type and the other for silvering? And could I use stair-rods composed of an iron rod, covered with a thin case of brass, to conduct the current, and how could I fix them one above the other? Would wood, varnished with sealing wax varnish, do? Any information would oblige.—Bystander.

[48127.]—**Legal.**—To Mr. Fred. Wetherfield.—Richard C. dies without issue, and leaves certain landed property to his half-brother Henry for life only. At the death of Henry the property is to go to George, the youngest half-brother to R. C. Henry dies childless. George takes possession of the property, is married, but childless, and makes a will, leaving all he is possessed of to his wife. Does the wife take the landed property? If she does not, who does? In the will of Richard C., no mention is made of heirs or of assigns.—E. W. F.

[48128.]—**Income-Tax.**—Will Mr. Wetherfield be good enough to answer the following:—Supposing a person in business obtains a loan at interest. In paying this interest should be deduct Income-tax? If so, will the Income-tax authorities take the amount of profit to be taxed as shown on the balance sheet, or will they add the interest on loan, as if the former, they lose the Income tax except on amount deducted for Income-tax?—Ruxcons.

[48129.]—**Steam Boilers.**—Could any of your numerous readers tell me why in boilers at two pits feeding from the same water, the plates and rivet-heads of the one are all corroded just like a honey-comb, while the others are untouched? Any suggestions for prevention will be thankfully received.—Steam User.

[48130.]—**Steam Boiler Manhole Doors.**—Could any of your numerous readers tell me what is the best and most profitable material for making joints for above-ment oned doors? At present I use plaited white rope, but this requires to be renewed each time the boiler is off, and I would like something to stand more than once.—Steam User.

[48131.]—**Colouring of Engines.**—What are the colours of boilers and wheels, tenders and framing, and how picked out, of the following engines, bogies:—Midland, North Eastern, North British, Caledonian, Great Western, L.N.W.R., Great Eastern, M.S.L., L. Glasgow and South Western, L.B.C.R., S.W.R.—E. P.

[48132.]—**Bacteria in Beer.**—To Mr. W. A. Thoms.—Will Mr. Thoms kindly indicate the significance of bacteria in beer as "dispensed" by the publican? Constant and close observation has convinced me that malt liquor, and particularly stout, in which these "disease ferments" are conspicuous by their absence, is the exception and not the rule. That they are devitalised is probable, as there is little to be observed beyond the Brownian movement; though, according to Cohn, "certain kinds of spherical bacteria" (and they are not wanting) "appear never to move." My impression is, that the rod-like organisms, to which I more particularly allude, are the factors of the third or putrid stage of fermentation—their appearance being commensurate with the suspension of the brewer's operations.—Observer.

[48133.]—**Locomotives.**—Wanted principal dimensions of the following locomotives: Midland.—883, 1212, 1456. G.E.—95. G.W.—Alma and No. 2211. L.N.W.—1000, 2003, 2342. L.B. & S.C.—Ventnor, Penge, Victoria, Genoa, Freshwater, Wimbledon, Cherbourg, Brighton, and the goods engines on this line. Thanks to "Meteor" for his answer to my query last week. Could he give me the size of the cylinders of Princess Alexandra, as I have not volumes he mentions?—Alaric.

[48134.]—**Watersnail.**—To "Scotch Working Mechanic" or Others.—(1) What is the smallest angle at which this machine can raise water? (2) What relation does the amount of water raised in a given time bear to the velocity and measurements, and from what data can the amount raised be calculated?—Scotia.

[48135.]—**Indicators for Electric Bell.**—Will any of our electrical friends give me drawings and a few hints to enable me to construct indicators for electric bell? I have fourteen rooms, all fitted with the old crank bells, and one by one they all are getting dreadfully out of order; so instead of paying constant bills for repairs, I intend to connect each room to an electric bell, adding indicators as each crank bell goes out of order.—Onward.

[48136.]—**Eczema.**—I have been suffering for some time past from a peculiar discolouration of the skin (pinkey-brownness) on my chest, sides, stomach, and shoulders without any irritation or feeling whatsoever, which I take to be "chloasma." This, I believe, I have now cured by means of an arsenic remedy recommended by Sir Erasmus Wilson at the end of his book on "Skin Diseases." But, curiously enough, just at the time that this was disappearing, an aggravating itching, accompanied by a sort of red blistering of the skin appeared on my upper lip and sides of nose. I shaved my lip and used a zinc ointment: it disappeared. The hair grew again, and ever since the aggravation (which I take to be eczema) has reappeared and disappeared (on the application of the ointment) at intervals of about ten days, and shows no signs of discontinuing. Will some medical reader of the "E. M." kindly advise me on the subject?—Derma.

[48137.]—**Barker's Centrifugal Mill.**—To "Scotch Working Mechanic" or Other Competent Reader.—(1) From what data can the horse-power of this mill be calculated? (2) What would be the principal measurements of a mill of 1-h.p.?—French.

[48138.]—**Child's Ankle.**—Would Dr. Edmunds, or some able medical reader, kindly reply to the following?—I have a boy two and a half years old with a weak ankle (right foot), left by a stroke he had when four months old, and which took the entire use of his leg from the knee, but can now use it. Leg and foot are smaller and leaner than the other one. Knee, with foot, have a tendency to turn outwards in standing or walking, but more so when walking. Ankle a tendency to fall inwards, so as to cause him to walk on edge of boot-sole. We have got him a pair of strong laced boots. Would be glad of hints as to remedying this?—A Third One.

[48139.]—**Locomotives.**—I should be glad of the principal dimensions of the different types of locomotives used for goods and passenger traffic on the L.C.D. and M.S.L. railways.—Alaric.

[48140.]—**Coil.**—To Mr. F. Walker.—I am making a coil such as you described. I have put on six layers of No. 18. Now should the primary and secondary wire be soldered together?—W. Wright.

[48141.]—**Case-Hardening.**—Would any of our readers favour me with information respecting the proper method for case-hardening iron bars 4ft. long and of an irregular form? Is there no other method than plunging them into cold water after being heated, &c., as this is sure to warp them?—Loco.

[48142.]—**Liquid Gold.**—I have used liquid gold, but it turned dark on exposure to the air, and washed off on being cleaned. Can you recommend a liquid gold which is not affected by the air, or injured by washing?—Esquimaux.

[48143.]—**Patterns.**—To Mr. Wetherfield.—Would it be an offence to trace a wall-paper pattern, even if registered, and adapt it to another fabric (say a curtain)? If so, would taking portion of the pattern and working it into another design avoid the difficulty? The colouring in either case would not be copied.—Manufacturer.

[48144.]—**Legendary Astronomy.**—Could any of "ours" kindly give me a hint as to the works proper to consult in order to obtain a knowledge of the legendary lore connected with the stars? Also, where I could get full information concerning the names given in different countries to the various stars and constellations?—Spica.

USEFUL AND SCIENTIFIC NOTES.

The Jablochkoff Electric Light Company has taken large premises on the Albert Embankment, to be used as a manufactory for its carbon candles, and warehouse, and as a lighting centre. It is also about erecting a building on the Victoria Embankment for the purpose of more effectually carrying out the contract with the Metropolitan Board of Works. It is stated that numerous applications have been received for the supply of the Jablochkoff light, to meet the demand for which several power centres for the necessary machinery are about to be established.

How to Destroy Wasps.—A correspondent of the *Times* says:—I have for the last 10 or 12 years destroyed these troublesome feeders on fruit with methylated chloroform, and this involves the necessity of waiting till night when all are at rest. But pulverised "commercial cyanide of potassium," one or two tablespoonfuls, may be put into the entrance of the nest at any time of the day, and if quietly done does not in the least disturb the ingress of the insects. They readily enter, never to return, so that in 24 hours every individual is destroyed. The entomologist may then dig them up, or they may remain; they can do no more mischief. I was curious to know the contents of a large nest, measuring nine inches across, having eight tiers of cells. I counted 3,400 wasps, and five of the tiers were full of pupæ, which I did not count. Such simple and inexpensive means I consider a public benefit to be made known as much as possible.

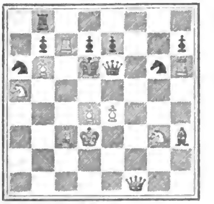
To Distinguish Cotton-seed Oil from Olive-oil.—Prof. Zecchini takes pure colourless nitric acid of the density 1·40, and mixes it with half the quantity of oil in a tin tube closed with gum. After shaking it for several seconds, the tube is allowed to rest in a vertical position for five or six minutes. If the oil was from olives, the liquid is at first pale or colourless, changing to an ashy grey, with a slight yellowish hue. Cotton-seed oil is at first of a golden yellow, then copper-coloured, becoming almost black. The reaction is delicate enough to detect an adulteration of 5 per cent. of cotton-seed oil.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXXV.—By A. E. Studd.

Black.

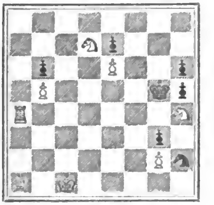


White.

White to play and mate in two moves.

PROBLEM DCCLXXXVI.—By J. Pierce.

Black.



White.

White to play and mate in three moves.

Solution to 781.

White.	*Black.*
1. P to Q B 3	1. K takes Kt (*a*)
2. Q to Q 2 (ch)	2. K to K 5
3. Kt takes P mate	
	(*a*) 1. Kt to Q R 5 (best)
2. B takes Kt	2. Anything
3. Q takes P mate	

Solution to 782.

White.	*Black.*
1. R to B 5	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

H. F. L. M.—Thanks for problems.

Correct Solutions to 782 by Schmucke; to 779, 780, 781, and 782 by Celsus.

Mr. Blackburne's next blindfold contest will be against six or eight members of the City of London Chess Club, all of whom are to be of, at least, third-class strength.

As there is, practically, no second-class in this club, the single player will be contending against opponents who want but little to be first-rates; so the result of the contest will be of unusual interest. The fact probably is, that Mr. Blackburne can play very nearly as well blindfold as when seeing the board, his powers being stimulated by the strain upon them and the excitement of the struggle.

The North London Chess Club.—The annual supper of the above will take place on Oct. 2, at the Old Four Swans, Bishopsgate-street.

Captain Mackenzie has left our shores for his adopted country, where he will probably receive the genuine American ovation due to a champion who has planted the flag of stars and stripes so nearly on the highest point of the citadel of Chess.

Holloway's Ointment, aided by his Pills, presents the only rational mode of curing pimples, boils, carbuncles, abscesses, and disfiguring diseases. Tainted blood, the fountain of these evils, is thoroughly purified by these Pills, and the evidences on the surface are effectually eradicated by the unguent, without pain or danger.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 27, and unacknowledged elsewhere:—

A. F. Furby.—Foster Bros.—J. Kemsley.—W. J. Smallen.—T. McNulty.—Exeter Bicycle Co.—Fiddler.—M. I. C. E.—Church.—Hill.—G. B. T.—Novice.—J. C. A.—R. M. Steele.—W. Robinson, jun.—B.—R.—Politzer.—Amateur.—Ernest.—D. Crossley.—J. C. Belcher.—H. A. Wassell.—Altojoe.—Glatton.—Plumber.—H. Stooke.—A. S. I.—J. L.—A Fellow of the Royal Astronomical Society.—B. A. Raves.

Semper Fidelis. (The preparation never contains lime-juice, except as a small "addition," and sometimes is merely a solution of soap, to which limewater has been added. Take of slaked lime 1oz., loaf-sugar 2oz., distilled (or boiled) water 1 pint; grind the lime and sugar to a paste with a little water, and add to the bulk; shake the bottle, let stand, and decant the clear. To 10 drachms of the lime-water add 15oz. of water, 12oz. of olive oil, and 6 drachms of essence of lemon. Shake. You can mix limewater (plain) and glycerine if you like, and so have a reason for one part of the name.)—Learner. (Not suited for the purpose. The comparison is impossible.)—G. J. D. (You will find all about it in No. 819, p. 291.)—W. Simpson. (You should obtain one of the useful handbooks issued by some of the agents who advertise in our columns. At any rate, it would be wise to get an agent to transact such business.)—Saria. (Yes, that is about the cost, as it is entered at the Rolls Court. There is no necessity for that unless you expect to inherit property.)—Newcastle. (It depends on the process adopted. Messrs. Bell, of your city, prepared a trisodic aluminate from Bauxite, and precipitate the alumina as hydrate by carbonic or hydrochloric acid. The precipitate is moulded into balls with charcoal and common salt, which are heated in retorts, through which dried chlorine is passed. Sodic aluminic chloride distils over; ten parts of this, with 5 of cryolite and 2 of sodium, are placed in a reverberatory furnace, when the chlorine combines with the sodium, and the metallic aluminium collects at the bottom. We believe this process is not worked now, but it will give you an idea, and for the others you must consult the textbooks.)—A Constant Reader. (Is not the information on p. 615, No. 884, sufficiently definite, or have you been a "constant reader" only since last March?)—Sammy. (If of mahogany, better French-polish it. For full particulars, see No. 814, 816, pp. 175, 227. Several stains in back volumes; but you will find it cheapest and decidedly best to get a bottle of Stephens's mahogany stain. You could use the French polish as varnish, or clear copal.)—W. Wright. (A recipe was given on p. 601, Sept. 1, reply 47757. We gave the usual formula on p. 606, in answer to another querist.)—Young Mechanic. (Hernia is remedied by a truss to keep the parts in position. You should consult a surgeon.)—A Learner. (You can buy a "tutor" for one shilling. Tune one string to a fork or a piano, and the others true fifths to that.)—Fitter. (Classes of the kind are held at many places in London, mostly at schools. You can get a list on application to the Secretary, Science and Art Department, South Kensington. There is a free library at 143, Upper Kennington-lane, and another in Great Smith-street, Westminster. Those are the nearest to the spot mentioned.)—J. W. Hiscox. (Several recipes in p. 97, No. 810.)—F. G. S. (See pp. 202, 247, last volume, and the index published last week.)—W. A. T. (Similar query to the first recently asked. 2. The method adopted by the professionals is to lick the picture with the tongue, and then apply the water-colours.)—One in a Fix. (Daniell's cell is, perhaps, the best constant battery; but your Bunsen should be quite constant enough, and has more E.M.F. Overhaul it, for it ought not to fail in three hours, or even in three times three. You do not say what the machine is.)—Midland Reader. (You should look through the indices. Solution of rubber in bisulphide of carbon is used for fixing the stamps; but they readily adhere if the metal is perfectly clean, and is heated and dusted over with sulphur. The glycerine named will do.)—Outdoor Man. (What is it you wish to have? What has the telescope to do with "3 microscope"?)—E. Hughes. (They are tuned by filing them; filing the free end sharpens, near the heel flattens.)—Electrical Inquirer. (Thompson's "Elementary Lessons," Macmillan. For full description of the special apparatus named you must see special works, or look through back volumes.)—Cocoa. (We do not know of any such book.)—Home Baker. (You want machinery for making aerated bread. See p. 29, No. 782.)—Jeweller's Assistant. (The Daniell.)—J. S. R. (Defective circulation, the cause of which can only be discovered by a medical man.)—M. F. (Get a lump of quicklime, break it, and take from about the centre a small piece. Crush that to powder and mix with white of egg to a paste. Use as a cement, or drill a hole in each part so as to take a wooden peg, which cement in with plaster of Paris. 2. If you cannot find sufficient in back volumes, wait for Mr. Sprague's new book. The construction of the principal batteries was minutely described in Vols. XXVIII. and XXIX.)—Anxious. (Apparently a simple case of myopia or short-sight. Let an optician fit him with suitable spectacles.)—H. L. Dunkin. (The wires must be connected to the springs. The *s* and *p* on each side should be in metallic contact; but it is impossible to speak definitely from the particulars. What arrangement is provided for rotating the bobbins, or have you tried to get a current without turning them?)—H. S. G. (No, the American Association for the Advancement of Science held its meeting on August 23 at Montreal.)—W. Watson. (If the precipitate is dissolved in the water, don't wash it; but out of what was it precipitated? Could you not say what the precipitate is?)—E. M. Mearns. (The proposed patent would be void.)—Scissors and J. J. E. (Your queries are really advertisements for situations, and we regret we have neither the space for their insertion, nor the power to help you.)—Rustic. (Lenses differ in price, like other things, and for similar reasons. The advertiser you mention will give you fair value for your five shillings, but will, we are sure, tell you frankly he does not mean to sell you the same thing for which the other opticians would charge five pounds. 2. The apparatus is perfectly safe, and will give good results. Mr. Fletcher himself would doubtless advise if consulted privately.)—W. M. Gardner. (It struck us that "Nun. Dor.'s" criticisms were rather pertinent, and we saw nothing insulting in his letter. Your present communication is a fresh departure, and we really have no further space to spare.)—Etta. (He may use a dozen if he likes, and if he has become generally known by one or any of them, the document so signed will be valid. 2. No.)

Deafness in Schools.—In a recent paper to the Bureau of Education at Washington, Dr. Sexton inquires into the causes of deafness among school children and its bearing on education. It is unusual, he states, to meet with a child that has not had some ear disease. He divides the causes into (1) local causes and (2) affections of the ear from nervous sympathy. Under the second heading are included cold in the head and dental irritation; the latter a very common source of injury to the ears. Among the many school children brought to the New York Eye and Ear Infirmary for ear affections it is rare to find one case in which the state of the teeth is not to be considered as a factor. Further, the entrance of water into the ears (as in bathing), diphtheria, mumps, close cutting of the hair, are among the causes of ear disorders. Dr. Sexton thinks pupils should be examined at the beginning of each session to ascertain what number are too deaf to receive instruction in the ordinary way, and what number having slight defects would get on better if seated properly in the schoolroom. The best test is the voice of the person with which the children are familiar in learning; various test-sentences should be repeated at about 12ft. distance, the listening pupil having the eyes closed, and one ear stopped by an assistant. From an examination of 570 pupils it appeared that, though the teachers were only aware of one case of deafness, and the pupils themselves of 19, the author detected 76 cases, or about 13 per cent., of greatly diminished hearing in one or both ears. Of the entire number 487 were questioned as to previous ear-ache, and 173 recollected having had this symptom. Simple directions are given regarding the treatment of pupils with impaired hearing; those hearing with difficulty should be placed near the teacher, those who hear well only with one ear placed with that ear towards the teacher, &c. Pupils who cannot understand the teacher at 5ft. should be separated and receive special instruction. Dr. Sexton alludes to the importance of good hearing for teachers, and thinks that persons seeking pedagogic education at the public expense should be subjected at the outset to an aural examination. He also remarks on the discouraging situation of a deaf child, and advises that when no apparent cause for a child's dulness of action is known to exist, a thorough investigation of the acoustic organs should be made before necessarily regarding the child as a dunce or feeble-minded.

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The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 6, 1882.

HOME CHIPS.

A CORRESPONDENT has suggested a chapter or two upon home carpentry, as applied to the construction of fencing, sheds for bicycles, and such like every-day necessaries; and, perhaps, such an article may prove of service to many readers of the English Mechanic. The correspondent in question lays down, however, certain postulates—viz., few tools, very clumsy fingers, and that the directions are not to be suitable to apprentices. These are hard conditions, and we must cap them with others. The fingers must cease their clumsiness, the tools must be suitable, and in good order, and the period of apprenticeship must be served—but may be shortened, it is hoped, by the present article. What is required, however, in this case, is plain carpentry, to the exclusion of that finer and neater work which is known as joinery; and, although in both the principles of construction are the same, carpentry is in some degree the easier of the two. No satisfactory work, however, can be done in either unless the workman is competent to undertake the primary operation of squaring up his timber, quartering, or boards. For this, some sort of work-bench will be necessary, with either a vice or an equivalent, the vice being cheap and very superior to any of the substitutes. Moreover, such a work-bench is easy to make, and may be made at first of sawn stuff, unplaned. It should be, at least, 6ft. long, and 2ft. wide, and a greater length is much better if the shop will take it. I have at the present time a great deal of carpenter's work going on at my own premises, to say nothing of masonry, which is far more detestable, and I have just measured a carpenter's bench set up in an empty coach-house—a bench I intend to keep, if possible, as I want another myself. It measures 8ft. in length by 2ft. in width, the top being of 1¼in. board. The front board is 15in. wide, and the legs are of 3in. quartering, and the whole is 2ft. 8in. high. This is a carpenter's bench, not an amateur's, and it is of decidedly rough build, but strong and serviceable, having already lasted a lifetime. I will give sketches and descriptions of its parts, and explain the method of its construction. First of all, the legs and framing of the ends are made (see Fig. 1). For this you must saw off the required lengths of quartering, which *need* not be planed, but *must* be truly square, as upon the squareness of this stuff all the truth of the work will depend. Now here is a necessary apprentice's lesson. However rough the work and small the supply of tools, squaring the stuff *must* be somehow accomplished, or every part will be crooked, and the structure weak. Hence, a square must of necessity be one of those few tools spoken of. It may be of wood and home made, but it must be quite accurate. It is held as at *a* of Fig. 1 B, to mark out mortises or lines by which to guide the saw in cutting wood off square, and as at *b* to try the squareness of a beam or board. Suppose the wood out of square, or in winding, a mortise marked by the square will not be true to the surfaces of the piece, and when the parts are put together they will be all on the twist, and cannot be forced into place. This, I believe, is the commonest of all faults in home carpentry. Moreover, you may try, as at B*b*, with the square all along a bit of wood, and at each point it may be square, yet the whole may be in "winding," as it is called: and this has often deceived the home carpenter, and resulted in bad work. To ascertain this, two parallel strips of wood are placed some distance apart upon the wood, as *a*, *b*, of Fig. C, and the eye so placed as to look along them in the direction of the dotted line. If the top edges agree with each other, the stuff is so far true; but if not, it is winding, and the adze or plane, or both, must be used to rectify them, or the axe and plane if no adze is at hand. Now, all this is not to be deemed tiresome or useless, even in a job of outdoor carpentry, because it is impossible to do strong and ship-shape work if the principles of good carpentry are neglected. But, in rough work, as, for example, in putting up palings which are to be nailed to two horizontal rails mortised into posts, this absolute truth of surface is only required just where the rails are to come; and if these are not in winding with each other, it matters little about the intermediate portion of the post. The same is true of the legs of the carpenter's bench. They must be out of winding where the rails are to come, and it is of no real importance if they are not so elsewhere. But this stipulation refers chiefly to clumsy fingers; it is not at all orthodox carpentry except as stated in rough outdoor work. D E F represent the rails of the bench marked *a*, *b*, in Fig. 1A; D is the top rail, F the bottom one, E is the top rail fitted into its place in the legs, which legs are in section to show the position of the tenons of the rails. The difference between the two rails is that the tenon of the upper one is not cut away at top and bottom, but at top only, for the purpose of allowing more stuff above the mortise in the legs, so that it may be less liable to split out the piece when driving the tenon home. Sometimes, however, in such work as the present, the mortice is sawn out as an open one, like G, and the rail cut like H, with only a short shoulder below. The joint is not so strong, but is much more quickly made than a mortise, and it will very often do quite as well. It would do well enough for the work-bench, as, when its top is on, the open mortise and rail are hidden by it. Let us, nevertheless, learn to make a proper mortise, which will be required for the bottom rail, which may be 6in. from the end of the legs. Measure (if not known already) the width of the rail, which in this case is supposed to be of 3in. stuff. If I had it by me I should use, for the legs, 4in. square pieces, or four by three; but we can use the 3in., which is always easy to get ready sawn. See that it is square at the two ends, and fairly straight and out of winding. Mark in pencil, by the square, the lines *a*, *c*, *b*, *d* of K, and carry on these lines all round the pieces. This marks the end of the tenon or mortise. These will be 3in. from the end if the legs are of 3in. stuff, as the tenon should just come through. Allow, however, a little extra length, to enable the end to be cut off clean when in place, then saw the lines to cut the end as shown. The shaded cheek pieces are sawn quite off at *b c*, leaving the central tenon ⅓rd the thickness of the piece, which is generally a good proportion to give to a tenon. Now hold the tenon in place against the leg, and pencil it round, and afterwards with the square correct the lines, ruling them truly. Or set out *on both sides* of the wood, this mortise by measure with compasses and square, making it 3in. by 1in., which will be the size of the tenon; cut it half from one side and half from the other—not quite up to the lines at first, and then pare it inside with a very sharp chisel till the lines are just visible, but never by any chance cut into the lines of either mortise or tenon, or you will fail to get a good fit. Make in this way both the frames, which form the ends of the bench and include the four legs. It remains but to connect these frames by nailing on the front board A, Fig. 2, and a bottom rail, B, with a similar pair on the opposite side, and a slanting rail, C, on each side, to prevent any endlong oscillation when planing. These rails will complete the bench, and render it very stiff and strong. The longitudinal rails are often merely nailed on; but may, and ought to be, notched into the legs a little way. Many benches have a drawer for nails or small tools, sliding in from the front. It only remains to fix the wood-vice, of which the screw and nut have to be purchased at 2s. 6d. or less. The entire vice consists of four pieces. Fig. 3, A, the chap or chop or front jaw, which is of board, an inch and a half to 2in. thick, the top of which is to be exactly level with the top of the bench. It has a round hole to admit the screw easily. C is the screw, and B its nut, which is attached by screws to the back of the front board of the bench. Observe: this board should be outside the front edge of the bench top; for if the stuff to be held in the vice gets a bearing against this edge, screwing up the vice tends to pull off the

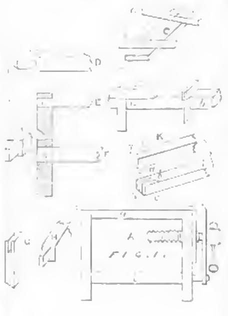


FIG. 1.

FIG. 2.

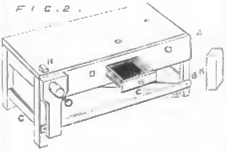
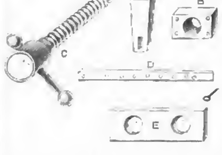


FIG. 3.



front board. A hole is, of course, made in the latter exactly opposite that of the nut. D is a strip of wood, about 2in. wide, and half or three-quarters thick, with a row of holes in it to receive a pin of iron, about the size of a slate-pencil. This is mortised into A, at its lower end, and pinned so as to have a little play in the mortise. This bar slides either through a mortise in the front bottom rail, or through an iron staple: if the rail is not sufficiently wide to allow a mortise to be so cut into it. This forms the connection of the vice to the bench at the bottom, and the cross-pin is placed in either one of the holes to rest against the staple, a hole being selected according to the thickness of the work to be held in the vice-jaws. Sometimes this bar comes so near the inside of the bottom rail C, that by nailing a piece of board inside to render it still thicker, two staples may be inserted into it, and the piece D can thus slide in both of them, which will keep it more steady. An upright vice like this is very generally used; but, if preferred, it may take the shape of a square, or rather, oblong board, like E, and two screws, or a screw and a square guide-bar may be used with it. Carpenters, however, seldom use two screws, as they would deem it waste of time to have to manipulate two when one will serve the purpose almost as well. The planing-stop at H, fitting into a square mortise, is generally a mere block of wood, like K; but there is a better one of iron now made, and obtainable at most tool-shops.

Such is the bench in its simple and ordinary form, and very little can be done without it. A table or plank on tressels or other device may do once in a way, but is very inconvenient, and a proper bench, even if not home-made, is by no means a costly affair—£1 to 30s. will generally purchase a very good one. If it happen not to be perfectly level on the top, a carpenter will often lay upon it a separate board an inch or so thick, planed true, on which to lay any boards or other work needing to be very truly planed. It generally happens, sooner or later, that the top of a bench gets cut and knocked about a good deal, which, of course, destroys its truth sadly, and necessitates this separate planing-board, but it is a pity to chop upon it with the axe or to use it when cutting through work with the mallet and chisel. The saw also very frequently injures a bench when proper care is not used. Two or three holes, as at *e*, *f*, are generally made to receive the tail of a bench holdfast, and some in the front board, which ought not to be less than fourteen or fifteen inches wide. The latter are intended to receive pegs of wood to support planks or boards during the planing of their edges while they are being held at one end in the vice. Do not forget that the top of the bench is not to overlap the front board, as it would do if it were an ordinary table.

J. L.

(To be continued.)

SIZE OF STEAM-PORTS AND PASSAGES.

SUCH of our readers as have made for themselves a toy engine (and we incline to the belief that the number will be found not inconsiderable), and have watched it whirling away at a speed of some 2,000 or 3,000 revolutions per minute, might naturally be led to the conclusion that there was no limit to the velocity with which steam can travel, or to the speed with which it can enter and pass out of the cylinder, and its motion be changed or reversed. Such a notion, however, would be in the highest degree erroneous, as the speed at which steam travels on its way to or from the cylinder of a steam-engine is an important factor in determining the best size of the steam passages, ports, &c. It has been found by experiment that so long as the steam in a pipe is not required to travel at a higher rate of speed than 100ft. per second, or 6,000ft. per minute, the loss from friction, &c., in the pipes and passages is not a serious one, and the pressure at which it can be obtained on the piston is not much reduced from the boiler-pressure. Beyond this speed, however, serious loss of pressure takes place, and hence the importance of having the steam-ports so large that the velocity referred to may not be exceeded.

Those engineers who have had much experience in the overhauling of steam-engines, are aware that in a large number of old engines the ports and passages in the cylinders are very much too small.

In a case which recently came under the notice of the writer, the area of the steam-port was not more than one-thirtieth of the cylinder area, and the loss from wire-drawing, poor vacuum, &c., was in consequence very considerable, although the piston-speed was not a high one.

When the steam-ports and passages of an engine are too crippled, there is, in addition to the loss from wire-drawing, &c., a further loss of power, from the increased resistance to the exit of the steam from the cylinder, causing what is known as "back-pressure."

In condensing engines, even though there may be a plentiful supply of cold water and a good "vacuum" in the condenser, when the exhaust passages are tortuous and contracted, an exceedingly poor effect of the vacuum will be obtained in the cylinder. Perhaps, as good an illustration of this as could be obtained is shown in the diagrams (Figs. 1 and 2) taken from a condensing engine some time ago in the south of England. The engine was furnished with a cut-off valve, by means of which the steam could be cut off at any desired portion of the stroke. In Fig. 1, it will be observed, the steam is admitted during about nine-tenths of the piston's stroke, and, when released, escapes with such difficulty through the contracted exhaust passages, that the back-pressure exceeds that of the atmosphere during three-tenths of the return stroke, and, at the termination of the stroke, when the full effect of the vacuum is usually obtained in the cylinder, there is an absolute back-pressure of something like 6lb.; that is to say, to use the common expression, the "vacuum" is only 9lb. Fig. 2 was taken from the same engine immediately after Fig. 1, when driving a much lighter load, and the steam cut off at about 1-6th the stroke. The quantity of steam to be condensed is here so much less that a "vacuum" of 13¾lb. is now shown in the cylinder; and although the effect of the restricted exhaust passages is still seen at the commencement of the exhaust, a very much greater effect is obtained from the vacuum throughout the stroke than under the conditions shown in Fig. 1. Hence, we see that, besides the loss of pressure in admission when the ports and passages are too small, an even still greater loss is experienced from the back-pressure, resulting from the resistance to the egress of the steam.

FIG. 1.

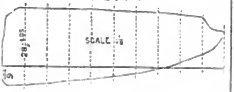
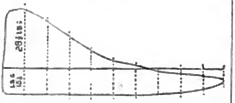


FIG. 2.



Many rules have been given for determining the size of steam-ports, &c.; but none can be considered as other than empirical which does not take into account the fact above-mentioned—viz., that the velocity of the steam in following a piston should not in the passages exceed 100ft. per second, or 6,000ft. per minute. Bearing this in mind, we shall see that the area of the steam-ports should have the same ratio to the area of the cylinder that the piston speed in feet per minute has to 6 000, from which we easily deduce a rule thus:

$$\text{Area of port} = \frac{\text{Area of cylinder} \times \text{piston speed in feet per minute,}}{6{,}000}$$

A rule in very general use amongst engineers, and to be found in most engineering pocket-books, is to make the area of steam-port equal to 1-16th the area of cylinder. Let us see how this corresponds with the rule we have just found. Take for example, say, an engine having a 5ft. stroke running 50 revolutions per minute; that is to say, with a piston speed of 500ft. per minute. By our rule we have

$$\text{Area of port} = \frac{\text{area of cylinder} \times 500}{6{,}000} = \frac{\text{area of cylinder}}{12}$$

so that we see for 500ft. piston speed, the common rule of making the steam-port equal to 1-16 the cylinder area would give too small a passage, the port requiring to be not less than 1-12th the cylinder area, in order not to lose pressure and power from the entering steam having too high a velocity. If the piston speed were only 400ft., the port might be made only 1-15th area of cylinder, because

$$\frac{\text{area of cylinder} \times \text{400ft. per minute}}{6{,}000} = \frac{\text{area of cylinder}}{15}$$

and so, if the piston speed were still further reduced, the common rule would give a larger steam-port than is necessary. In order to avoid the great loss experienced by restriction of the exhaust, as shown in the above diagrams, it is customary to make the exhaust-ports about half as large again as the steam-ports, so that the egress may be as free as possible, and the back-pressure on the piston reduced to a minimum. There being, then, so much advantage in having large passages to and from our cylinders, the consideration naturally arises as to what conditions determine the limits in the opposite direction; or, can we really make the steam-passages, &c., too large? It is well known that too much "clearance" space at the ends of a cylinder means loss of steam at each stroke of the piston, and in the same way an excessive capacity of steam-port or thoroughfare would mean waste, through more steam having to be thrown away in exhausting the passages than is really necessary. A further consideration respecting the disadvantage of having too great width and area of ports is found in the cooling influence of exhaust steam, the temperature of which, at or below atmospheric pressure, is very much lower than that of the fresh steam at its entrance to the cylinder. The passage of the exhaust-steam through the same ports as the high-pressure steam has to pass through, abstracts a considerable amount of heat from every part of the metal with which it comes in contact, and this heat has to be supplied again by the entering steam at each stroke. The question, therefore, of having the steam-ports of an engine a proper size, and neither too small, so as to cause loss from wire-drawing, back-pressure, &c., nor too large, so as to give rise to loss from cooling, &c., it will be seen is one which has a material influence on economical working. The rule we have given is a practical one, and we can recommend it from long personal experience.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE thirty-first annual meeting of the American Association was commenced at Montreal on August 23rd. The president for the year is Dr. J. W. Dawson, of Montreal. With the Americans the rule is that the retiring president delivers the long address, the president elect devoting his attention to the business before him. Professor G. J. Brush, of Yale College, the retiring president, took as the subject of his address the

Progress of American Mineralogy.

referring primarily to the labours of Dr. Archibald Bruce, Colonel George Gibbs, Professor Parker Cleaveland, and Professor Benjamin Silliman, the four pioneers in the work, the latter being succeeded by the distinguished Mineralogist, Professor J. D. Dana, whose works are known throughout the civilised world. The first State Geological Survey was made by North Carolina, in 1824; the example was followed in 1830 by Massachusetts, and then by other States, until now the whole territory of the United States and Canada either has been, or is being, surveyed. It cannot be attempted, however, to follow the admirable sketch of work now being done by living mineralogists, nor to reproduce the highly suggestive remarks on the relation of this science to chemistry and kindred sciences. Evidently a broader foundation is now needed for it than in earlier days, and there must be co-operation between special investigators. There is an interdependence between mineralogy, geology, chemistry, and physics, such as warrants the continued existence of an association that shall make sure that every new fact and law observed shall be used for the common advancement of all sciences.

Fine Rulings.

Prof. W. A. Rodgers offered a communication concerning the problem of "Fine Rulings, with reference to the Limit of Naked Eye Visibility and Microscopic Resolution." The finest lines ever reached are those of Nobert's bands, viz., 113,000 to the inch. No one has been able to go with certainty beyond this limit, although Mr. Fasoldt, of Albany (N.Y.), claims to have ruled one million lines to the inch. Conceding this to have been done, it is not conclusive as to their visibility. In the discussion that followed it was shown that when ruled lines are filled with graphite, and the surface covered with a film of moisture, they become for a moment easily visible, even though their width is but one one-hundred-thousandth part of an inch. Fasoldt's claim has been dealt with by experts over here, and at present it remains a claim (see pp. 341, 378, Vol. XXXIV.)

The Time of Approach of Two Spheres.

An animated discussion arose on a paper read by Prof. De Volson Wood, of Hoboken (New Jersey), entitled "A Correction in Newton's 'Principia' in regard to the Time of the Approach of Two Spheres." Newton says that if two spheres of the same material as the earth, and each one foot in diameter, be placed 12¼ inches from each other between their centres, in void space, they will be a month's time in coming together by their mutual attractions; whereas the experiments of Prof. Wood showed the time required to be less than 5½ minutes. Dr. S. Haughton, of Trinity College, Dublin, at once challenged the quotation, saying that it was incredible that so accurate a writer as Sir Isaac Newton should have fallen into such an error. A spirited discussion followed, which led to the production of the Jesuits' edition of the famous "Principia," with numerous foot-notes. Dr. Haughton claimed that the second volume, from which Prof. Wood had quoted, while a great literary curiosity, was not genuine, because it referred to matters that were unknown in Newton's time. Prof. Wood, in defence, asserted that the error he had corrected was found also in the larger edition of Newton's works, in his "Treatise of the System of the World," and he took it for granted that it was genuine.

The Earth-Moon System, and Geological Time.

Dr. Haughton then read a paper on "Darwin's Theory of the Evolution of the Earth-Moon System, in its bearing on the Duration of Geological Time." Concurring in Mr. G. Darwin's published calculations he differed from his physical conceptions. The eighteenth century astronomers believed in the perpetual motion of the planetary system, but now we know that perpetual motion is as impossible among planetary bodies as it is at the surface of the earth. It used to be held that the planets passed through a liquid to a solid condition, and that the earth now consists of a solid crust resting on a fluid mass. But Sir William Thomson has proved that the present condition of the earth, as a whole, is more rigid than glass or steel. From the most probable hypothesis as to the rings of Saturn being composed of discrete meteoric stones; from the low specific gravity of Jupiter and other outer planets; from recent researches as to meteoric showers and comets; and from investigations into the true nature of asteroids, as well as from other considerations, it is probable that when the earth and moon separated from the solar nebula, they did so as a swarm of solid meteoric stones, each having the temperature of interstellar space, *i.e.*, about 460° F. below the freezing point of water. The earth and moon were pushed apart by tidal friction; and the algebraic calculations by which this may be proved fit equally well the hypothesis of a viscous earth or that of a rigid earth with a liquid ocean. Sir William Hamilton's theory, that one hundred million years ago the earth was as hot as melted steel, differs greatly from Dr. Haughton's theory that its component particles were intensely cold, and that volcanoes were but as pustules on the surface. The paper was discussed by Professors Chase, Young, and others.

Optics.

Prof. W. H. Brewer drew attention in a paper on the "Apparent Size of Magnified Objects," to a series of experiments he had made with many persons as to the relative size of objects as seen by the microscope and the naked eye. A magnified image having a theoretical value of 4·66 inches, appeared to one observer to be six inches, to another twelve inches, and to another (an experienced draughtsman), five feet in length. The practical conclusion was that, while much depended on a healthy condition of the eye, much was attainable by education, it being evident that an eye educated to use the microscope would be less liable to error than one that had never been trained. Mr. W. Le Conte Stevens, who has made the subject of stereoscopy a study, read a paper describing the results attained by the use of the electric spark in binocular vision. When the relation between the visual lines was such as to imply no unusual muscular strain, it was found impossible to interpret the binocular retinal image by the aid of a single spark.

Geology and Anthropology

furnished subjects for a number of papers which were not confined purely to American branches of those sciences. Thus for instance a paper on "Subterranean Map Making," particularly with reference to American Caverns, in the course of which a map of Mammoth Cave, Kentucky, was exhibited, being the completion of the diagram only partially shown at the Cincinnati meeting last year, and also a new map of Luray Cave, Virginia, made from a careful survey by the proprietors last winter, was followed by a paper on the "Caves of Staffa and their Relation to the Ancient Civilisation of Iona," by Mr. F. C. Whitehouse, of New York, who advanced the original idea that Fingal's Cave, and other grottoes in its vicinity, were artificial productions, instead of being caused by erosion.

Professor F. W. Putnam read papers on "The Exploration of Mounds in Ohio and Tennessee," in which flints were found, as well as fragments of pottery and numerous animal remains. The remains of a log cabin had also been discovered belonging to the "Stone Grave Period" in Tennessee. The first indication of the building was a piece of charcoal found in digging. This led to the unearthing of a mass of charcoal so fresh as to be plainly the remains of some burnt building. The clay between the logs was well preserved, and even the marks of fingers could still be seen. The antiquity of the structure was shown by the fragments of pottery found amid the ashes. Professor Putnam also read a paper to show that copper implements and ornaments had been in use from the beginning of the so-called Neolithic Period. None of these were cast, but all were hammered out from pieces of native copper. Mr. R. P. Hoy held that the Mound-builders were the immediate ancestors of our modern Indians. Some of the mounds are of very recent date, as is evinced by the brass kettles, iron tomahawks, beads, and other modern articles found in them.

Prof. Carrill Lewis read an important paper on "The Terminal Moraine across Pennsylvania." The southern limit of the great ice sheet that once wrapped a large part of North America is marked by a terminal moraine. It is claimed that this deposit has been traced from Cape Cod, where it begins, across Rhode Island, Long Island, and New Jersey, into New York State. It has also been traced across Ohio, Indiana, Illinois, Wisconsin, Minnesota, and Dakota, to the Saskatchewan region of the Dominion. Professor Lewis claims to have filled the gap in this long chain by his discoveries in Pennsylvania. He traced the moraine for 400 miles, across the great divide between the Atlantic and the Gulf of Mexico, where it exists at the height of 2,480 feet above the sea. Where it enters the State of Ohio it has descended to the height of 800 feet above the sea-level. The line between the areas of glacial action and those where the ice had not been were so sharply defined that you could stand with one foot on the striated rock and the other on rock that had not been glaciated. All along this line of demarkation were found crystalline boulders and masses of labradorite that must have come down from the Adirondacks and highlands of Ontario. Dr. Dawson and several other geologists of note took part in the discussion of this important paper. The exhibition of fossils, minerals, and "specimens" was as usual very attractive; the excursions were numerous and pleasant, and the social festivities were all that could be desired. The next meeting will be held in Minneapolis, with Prof. C. A. Young, of Princeton, as president.

ACROBATS UNDER WATER.

THERE has recently been exhibited in the Circus of the Champs Elysées, in Paris (we learn from *La Nature*), a curious example of the ability to remain a considerable time under water without asphyxia. This is "Miss Lurline, the Queen of the Water," as she is called. The aquarium in which she performs consists of a large rectangular vessel with glass sides (the larger about 10ft. long by 7ft. high), and filled with water which is slightly tinted green, and is strongly illuminated by means of five or six oxyhydrogen lights.

Miss Lurline dives, swims, lies down, and eats at the bottom of the water, passes between bars of a chair, &c.

At a certain moment, the music ceases, the girl draws a few long breaths, then lets herself sink to the bottom, where she kneels on one knee, crossing her arms on her breast. A man outside stands with watch in one hand and hammer in the other, with which latter he counts the half-minutes by striking. One half-minute,—one minute,—a minute and a half,—two minutes,—two minutes and a half! During the silence, interrupted only by the sound of the hammer, the minutes seem very long; the spectators are painfully intent, and experience a relief when the diver returns to the surface.

To appreciate what is implied in passing two minutes and a half without taking breath, let anyone (says M. Kerlus in the journal named) make a small experiment, holding his breath as long as possible, while watching a seconds' watch. Few persons reach one minute: the majority are obliged to take breath before 45 seconds have elapsed, and it is only exceptionally and with much difficulty, that some attain one minute fifteen seconds.

The fishers of sponges, mother-of-pearl, and of pearl-oysters in the Mediterranean and elsewhere, do not ordinarily remain under water longer than two minutes. It has never been authentically observed, *watch in hand*, that they effected a voluntary immersion of more than three minutes. The mean time is one minute to a minute and a half. Even under these conditions, the work of a diver in deep water is excessively painful. On coming out of the water, they usually remain some time motionless, the face congested, the eyes bloodshot, and often blood given out by the mouth from rupture of blood-vessels in the lungs. Those divers do not live long; they sometimes die of apoplexy after coming out of the water; they also frequently lose sight by reason of congestion of vessels of the eyes.

The public divers in Aquaria run much less risk. They have not to bear any great pressure resulting from thickness of the layer of water above, and, besides, they remain still in the water, whereas the fishing divers have to perform active work during immersion, and so exhaust more quickly the supply of oxygen retained in their lungs.

During the last twelve years, four or five divers (male and female) have exhibited in Paris, under various aquatic names, such as "l'Homme-poisson," "l'Homme-amphitre," "La Femme-Siren," "La Reine des Eaux." Their exercises have been much the same. One of them, however, the fish man, made a very curious experiment. He smoked a cigarette almost entirely, but without emitting the smoke. Then he lay down at the bottom of the water, and let a succession of grey bubbles of smoke rise to the surface. The quantity of smoke thus returned seemed enormous. At intervals the series stopped, to commence again a few seconds later, greatly to the surprise of the spectators. Some of these estimated that the experiment lasted quite five minutes. In reality, it did not exceed one minute.

While a diver is immersed, if one do not look at a watch, one finds it difficult to calculate the time of immersion correctly, and generally exaggerates. Hence, in all probability, the accounts of many wonderful divers. It is said, e.g.—that Ionian and Sicilian divers employed after the naval battle of Navarino, in 1827, remained five to ten minutes under water, and one of them even a quarter of an hour. Exaggeration here is evident.

Whence comes this power, possessed by some persons, of remaining longer than others without breathing? The old physiologists attributed it to the aperture of Botal not being closed in the heart (as in the child before birth). This is easily proved to be an error.

It has also been supposed that divers feed only on vegetables, their food yielding blood less rich in corpuscles, and so requiring less oxygen. Another idea is that divers exhibiting in public take either morphine with the view of retarding the circulation, or digitalis with the view of retarding the heart-beats.

These supposed means (says M. Kerlus) are not practicable, or they would tend to the opposite of the end aimed at. The power of remaining a long time without respiration seems due simply to a great development of pulmonary capacity, to lungs of large volume and perfectly sound. This great capacity may be natural; it may be the result of heredity, as is probably the case with the sons and grandsons of fishing divers; it may be acquired, or at least developed, by exercise. The profession of diver is similar in this respect to those of the runner, the gymnast, and also the singer.

PRACTICAL NOTES ON PLUMBING.—XLV.*

By P. J. Davies, H.M.A.S.P., &c.

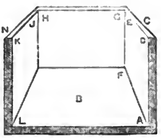
(*Continued from page* 82.)

Cistern Lining.

I SHALL proceed with this step by step, in the following working manner:—

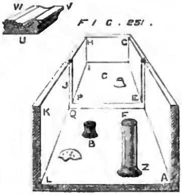
Suppose the cistern to be a small one, as shown at Fig. 250—say, 2ft. 7½in. square and 1ft. 9½in. deep, the thickness of the sides to be 1½in. boards. For the sides of this cistern we shall require a piece of lead twice 1ft. 9½in. and twice 1½in. for the turn-over at K N on the top—in all 3ft. 10in.; the bottom, B, is 2ft. 7½in., and, adding this to 3ft. 10in., will make 6ft. 5½in.; say, 2in. more for squaring up, equals 6ft. 7½in. in length. If the cistern is a square, the lead will be this size the other way; but, if not square, add or deduct the difference of the bottom. Supposing the cistern to be lined with 6lb. sides and 7lb. bottom (the extra thickness in bottom to allow for treading upon, &c.), then the lead must be cut accordingly; that is, if it will suit your lead, cut it as follows, so as to save solder, and to have only one corner to wipe up. Measure round the side and one end, double this will give the length, allow 2in. for lapping, as shown at C J G, Fig. 261. Next take the depth: this is, say, 1ft. 9½in.; then the 1½in. for top, and take notice and allow 1in. for the bottom return lead, as shown at A, Fig. 261, and at C, Fig. 255; but, in looking at this for the side return lead, as also the bottom lead, turn the drawing sideways, and sight along the arrow D.

FIG. 250.



If the cistern is to be a long, shallow one—say, 10ft. long by 12in. deep, and 3ft. wide, then 10ft., and often 20ft., of solder may, without any disadvantage, be saved by putting in the bottom and side or sides in one piece, and wiping in the two ends. To say the least, you here save 20ft. of soldering, equalling in weight to 5lb., and three hours' work, equal to 8s. 4d., or thereabouts. Of course, I do not recommend this style in awkward situations; but it should be borne in mind that by saving solder you also save time (that is when plenty of strength is at hand), and the two combined is in many ways a desideratum of considerable importance in cistern-lining. On the other hand, it must be borne in mind that circumstances alter the work. Suppose you have a cistern too large for your pieces of lead—say, 9ft. 9in. deep, 13ft. long, and 10ft. wide: for such a cistern the depth of the side lead should be cut off the length of the sheet (one side will take nearly two-thirds of a sheet), with a joint in the middle, as at J, Fig. 251. For this joint the wood should be sunk down at least ⅜in., and 1½in. to 2in. wide, so that the joint may be wiped flush. The sinking of this chase is shown at U V W in the above diagram. It not unfrequently happens, notwithstanding the size of the cistern, that the lead cuts very badly, or that you have a piece you would wish to use up, or that you must use up, having no other: in these cases the chase will be found handy.

FIG. 251.

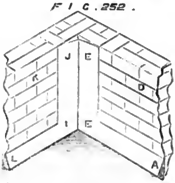


Brick, Stone, Slate, and Iron Cisterns Lined with Lead.

It often happens that cisterns other than wood have to be lined, such as a cracked slate one, or one of brick or cemented work. These materials are too cold to wipe against, and there is no good fixing for the under lead. In such cases, fix fillets of wood, about 4in. wide, 1in. thick, and feathered off to nothing, as shown at A L, Fig. 252. This feather-edged stuff, as it is called, must be properly fixed all round the angles to be soldered, as shown in the above diagram at J I L and E F A, the bottom being all wood; if not, another lot of the feather-edged stuff must be used—that is, laid flat upon the bottom, to fix the bottom return lead of the sides to, &c.

When putting the lead into such a cistern as that shown at 252, let the top part, or edge of the lead, go all over the brickwork, and turn down on the other side; or, if coping-stone is to be used, let the lead go past the first joint of the brickwork, and fix it with large nails into the middle joint: this will prevent the side lead from bagging.

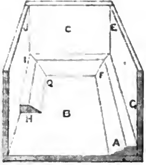
FIG. 252.



Blocking up for New Bottoming.

Suppose it is required to put a new bottom into an old lead cistern that has been soldered all round the bottom; the old solder would be in your way, and should be cut out, usually just above the old solder, with a chipping-knife; then, having removed the old bottom, lay some fillets or blocking all round, as shown at H I Q and F G A, Fig. 253. The size of this blocking must be governed by circumstances. Suppose the flat part that rests upon the bottom to be 6in., the back 1½in., flat part on top 2in., which will leave 4½in. splay; or, should you prefer more top flat for wiping, make it 2¾in.; this will give you only 3¾in. splay. The wider the top is kept the better chance you will have to keep the solder up to the joint.

FIG. 253.



Preparing and Putting the Lead into a Cistern.

Having the lead cut out, you proceed to roll it out upon the nearest floor to the cistern, or if in a roof, lay some scaffold or other boards upon the joist or otherwise, so as to form a stage; in fact, arrange this as best you can, but look out that you do not damage the ceiling. Say everything is ready: the cistern, Fig. 250, is to be lined. First see if the sides are parallel, then take the depth of the side, and the thickness of the board for the turn-over lead at C, and lay this upon the lead at E F, and also at D A, Fig. 254 (let these marks be made with a chalk line, and parallel with the top edge of the lead); next see if the bottom is parallel also, take the exact size of it, and line this upon the lead, taking care to allow ⅜in. for the substance of the lead, so that it may be easily put in, as shown from A to L, and F I; now mark off the top of the other side, as at J K, and strike a chalk line. Next see if the cistern is square: if so, lay a square or templet upon the outside line of the lead, as at E D, and square the lead G H; then measure the end H I, allowing sufficient for the top edge turn-over, and strike the chalk line I F; *but be sure to have it at the same angle as the cistern, which is in this case square.* Next measure the bottom from I to L, allowing for the thickness of the lead, &c., as before mentioned—namely, ⅜in. Now see that this line is square to A F, and strike the line A L; then measure off the distance from the bottom line L to the line M, and strike the line M N, leaving the 1½in. for turning over the top edge, as at T V. I must now refer you to the lines O, P, Q, R, outside the main or dotted lines H, G, M, N, &c. These lines are, with the compasses, struck ¾in. to 1in. away from the main or chief lines, and are for the return lead; that is to say, to turn round and nail to the side of the cistern, as shown at C, Fig. 255; the small pieces, S U Z, Y V, and T, Fig. 254, are for covering over the top of the corners of the cistern, see C E, Fig. 257, which must be sunk down for the solder to be wiped flush. Having marked this lead out, take a good pair of snips (10in or 12in. long is the best size for our work), and cut the lines Y P, V O, T R, Z Q, and 1 X, as also 2 W, S 3, U 4; the latter four lines *are cut within ¼in. of the meeting-point of the lines* at A F I L. Having cut the lines as shown, next procure a piece of quartering—let it be straight, and with good edges—lay it upon the line G N, and pull up the side E D, and, with the hornbeam dresser, set it in; but not too sharp. For cistern-work I often knock it from behind, and up to the quartering, which tends to thicken the lead at the line. Next place the quartering on the line M H, and pull up the other side K J, set this in as before; next provide yourself with a piece of quartering the length of the bottom of the cistern less the thickness of the lead, and lay this upon the line I F, pull up the end H G, and set it in. next lay the quartering upon the line L A, and pull up the end M N, and set it in: now the sides of the lead are all pulled up square. Next bend the return lead K O P Q to clip sides as shown at Q L P F, Fig. 256. The next thing to do is to knock the corners L F, Fig. 256, into a slightly-rounded shape, so that the sharp corners of the lead will not catch or hang in the angles of the cistern when the lead is being put into it. See that the lead round the bottom is square, then, with the dresser, bulge or belly the bottom of the lead inwardly, say 2in. or 3in. up, this will draw the sides inwards, and so make the lead narrower. Now have what holes you require cut in the bottom of the cistern, especially the waste, which must be dished down, as shown at Z, Fig. 261. to allow of the lead-pipe, also the washer, being wiped flush, or a little below the bottom of the cistern; have this hole cut large enough to allow for the opening of the pipe to receive the washer. This is a point very often not allowed for, being generally cut too small, as are also butler's pantry-sinks. Have the top corners sunk down, say, 2in. wide, and ¾in. deep, so that the solder may be wiped flush, as shown at C E, Fig. 257.

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FIG. 254.

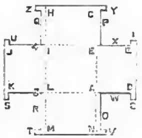


FIG. 255.

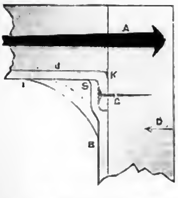


FIG. 256.

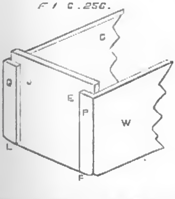
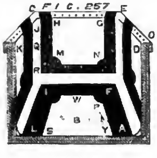


FIG. 257.



Now examine the cistern for nails, glue-teats, &c., also clean it out, then drop the lead carefully into the cistern. Pull the lead J E, Fig. 256, inward, and with the dresser or chase-wedge drive the lead P Q Fig. 256, to fit closely into the angle, and nail it every 6in. or 8in., as shown at C K, Fig. 255. Next knock down the top lead over the top, as shown at K D, Fig. 257, and nail it with 1½in. copper nails every 3in. apart. When copper nails are not allowed, use 1½in. Town clout (iron). Some plumbers turn the lead right over the outside of the top, as shown in the above engraving.

(To be continued.)

MR. MATTHEW ARNOLD ON THE VALUE OF LUCIDITY.

AT the close of an interesting address delivered last Saturday, at the reopening of the Liverpool University College and School of Medicine, Mr. Matthew Arnold said if there was one word which he should like to plant in the memories of his audience, and to leave sticking there after he had gone, it was the word *lucidity*. If he had to fix upon the three great wants at this moment of the three principal nations of Europe, he should say that the great want of the French was morality, that the great want of the Germans was civil courage, and that our own great want was lucidity. Our own want was, of course, what concerned us the most. People were apt to remark the defects which accompanied certain qualities, and to think that the qualities could not be desirable because of the defects which they saw accompanying them. There was no greater and salutary lesson for men to learn than that a quality may be accompanied, naturally perhaps, by grave dangers; that it may actually present itself accompanied by terrible defects, and yet that it might itself be indispensable. Let him illustrate what he meant by an example, the force of which they would all readily feel. Seriousness was a quality of our nation. Perhaps seriousness was always accompanied by certain dangers. But, at any rate, many of our French neighbours would say that they found our seriousness accompanied by so many false ideas, so much prejudice, so much that was disagreeable, that it could not have the value which we attributed to it. And yet we knew that it was invaluable. Let them follow the same mode of reasoning as to the quality of lucidity. The French had a national turn for lucidity as we had a national turn for seriousness. Perhaps a national turn for lucidity carried with it always certain dangers. Be this as it might, it was certain that we saw in the French, along with their lucidity, a want of seriousness, a want of reverence, and other faults, which greatly displeased us. Many of us were inclined in consequence to undervalue their lucidity, or to deny that they had it. We were wrong: it existed as our seriousness existed; it was valuable as our seriousness was valuable. Both the one and the other were valuable, and in the end indispensable. What was lucidity? It was negatively that the French have it, and he would therefore deal with its negative character merely. Negatively, lucidity was the perception of the want of truth and validness in notions long current, the perception that they are no longer possible, that their time is finished, and they can serve us no more. All through the last century a prodigious travail for lucidity was going forward in France. Its principal agent was a man whose name excited generally repulsion in England, Voltaire. Voltaire did a great deal of harm in France. But it was not by his lucidity that he did harm: he did it by his want of seriousness, his want of reverence, his want of sense for much that is deepest in human nature. But by his lucidity he did good. All admired Luther. Conduct was three-fourths of life, and a man who worked for conduct, therefore, worked for more than a man who worked for intelligence. But having premised this, it might be said that the Luther of the eighteenth century and of the cultivated classes was Voltaire. As Luther had an antipathy to what was immoral, so Voltaire had an antipathy to what was absurd, and both of them made war upon the object of their antipathy with such masterly power, with so much conviction, so much energy, so much genius, that they carried their world with them—Luther his Protestant world, and Voltaire his French world—and the cultivated classes throughout the continent of Europe generally. Voltaire had more than negative lucidity; he had the large and true conception that a number and equilibrium of activities were requisite for man. "*Il faut donner à notre âme toutes les formes possibles*" was a maxim which Voltaire really and truly applied in practice, "advancing," as Michelet finely said of him, in every direction with a marvellous vigour and with that conquering ambition which Vico called *mens heroica*. Nevertheless, Voltaire's signal characteristic was his lucidity, his negative lucidity. There was a great and free intellectual movement in England in the 18th century—indeed, it was from England that it passed into France; but the English had not that strong natural bent for lucidity which the French had. Its bent was towards other things in preference. Our leading thinkers had not the genius and passion for lucidity which distinguished Voltaire. In their free inquiry they soon found themselves coming into collision with a number of established facts, beliefs, conventions. Thereupon all sorts of practical considerations began to sway them. The danger signal went up, they often stopped short, turned their eyes another way, or drew down a curtain between themselves and the light. "It seems highly probable," said Voltaire, "that nature has made thinking a function of the brain, as vegetation is a function of trees; that we think by the brain just as we walk by the feet." So our reason, at least, would lead us to conclude, if the theologians did not assure us of the contrary; such, too, was the opinion of Locke, but he did not venture to announce it. The French Revolution came, England grew to abhor France, and was cut off from the Continent, did great things, gained much, but not in lucidity. The Continent was reopened, the century advanced, time and experience brought their lessons, lovers of free and clear thought, such as the late John Stuart Mill, arose among us. But we could not say that they had by any means founded among us the reign of lucidity. Let them consider that movement of which we were hearing so much just now; let them look at the Salvation Army and its operations. They would see numbers, funds, energy, devotedness, excitement, conversions, and a total absence of lucidity. A little lucidity would make the whole movement impossible. That movement took for granted as its basis what was no longer possible or receivable; its adherents proceeded in all they did on the assumption that that basis was perfectly solid, and neither saw that it was not solid, nor ever even thought of asking themselves whether it was solid or not. Taking a very different movement, and one of far higher dignity and import, they had all had before their minds lately the long-devoted, laborious, influential, pure, pathetic life of Dr. Pusey, which had just ended. Many of them had also been reading in the lively volumes of that acute, but not always good-natured rattle, Mr. Mozley, an account of that great movement which took from Dr. Pusey its earlier name. Of its later stage of Ritualism they had had in this country a now celebrated experience. This movement was full of interest. It had produced men to be respected, men to be admired, men to be beloved, men of learning, goodness, genius, and charm. But could they resist the truth that lucidity would have been fatal to it? The movers of all those questions about Apostolical succession, Church patristic authority, primitive usage, postures, vestments—questions so passionately debated, and on which he would not seek to cast ridicule—did not they all begin by taking for granted something no longer possible or receivable, build on this basis as if it were indubitably solid, and fail to see that their basis not being solid, all they built upon it was fantastic? He would not say that negative lucidity was in itself a satisfactory possession, but he said that it was inevitable and indispensable, and that it was the condition of all serious construction for the future. Without it at present a man or a nation was intellectually and spiritually all abroad. If they saw it accompanied in France by much that they shrank from, they should reflect that in England it would have influences joined with it which it had not in France—the natural seriousness of the people, their sense of reverence and respect, their love for the past. Come it must; and here, where it had been so late in coming, it would probably be for the first time seen to come without danger. Capitals were natural centres of mental movement, and it was natural for the classes with most leisure, most freedom, most means of cultivation, and most conversance with the wide world to have lucidity though often they had it not. To generate a spirit of lucidity in provincial towns, and among the middle classes bound to a life of much routine and plunged in business, was more difficult. Schools and universities, with serious and disinterested studies, and connecting those studies the one with the other and continuing them into years of manhood, were in this case the best agency they could use. It might be slow, but it was sure. Such an agency they were now going to employ. Might it fulfil all their expectations! Might their students, in the words quoted just now, advance in every direction with a marvellous vigour, and with that conquering ambition which Vico called *mens heroica!* And among the many good results of this, might one result be the acquisition in their midst of that indispensable spirit—the spirit of lucidity.

THE FOOD AND ENERGY OF MAN.[*]

By Prof. De Chaumont, F.R.S.

ALTHOUGH eating cannot be said to be in any way a new fashion, it has nevertheless been reserved for modern times, and indeed we may say the present generation, to get a fairly clear idea of the way in which food is really utilised for the work of our bodily frame. We must not, however, plume ourselves too much upon our superior knowledge, for inklings of the truth, more or less dim, have been had through all ages, and we are now stepping into the inheritance of times gone by, using the long and painful experience of our predecessors as the stepping-stone to our more accurate knowledge of the present time. In this, as in many other things, we are to some extent in the position of a dwarf on the shoulders of a giant; the dwarf may, indeed, see further than the giant; but he remains a dwarf, and the giant a giant. The question has been much discussed as to what the original food of man was, and some people have made it a subject of excited contention. The most reasonable conclusion is that man is naturally a frugivorous or fruit-eating animal, like his cousins the monkeys, whom he still so much resembles. This forms a further argument in favour of his being originated in warm regions, where fruits of all kinds were plentiful. It is pretty clear that the resort to animal food, whether the result of the pressure of want from failure of vegetable products, or a mere taste and a desire for change and more appetising food, is one that took place many ages ago, probably in the earliest anthropoid if not in the latest pithecoid stage. No doubt some advantage was recognised in the more rapid digestion and the comparative ease with which the hunter or fisher could obtain food, instead of waiting for the ripening of fruits in countries which had more or less prolonged periods of cold and inclement weather. Some anatomical changes have doubtless resulted from the practice, but they are not of a sufficiently marked character to found much argument upon; all that we can say being that the digestive apparatus in man seems well adapted for digesting any food that is capable of yielding nutriment, and that even when an entire change is made in the mode of feeding, the adaptability of the human system shows itself in a more or less rapid accommodation to the altered circumstances. Food, then, is any substance which can be taken into the body and applied to use, either in building up or repairing the tissues and framework of the body itself, or in providing energy and producing animal heat, or any substance which, without performing those functions directly, controls, directs, or assists their performance. With this wide definition it is evident that we include all the ordinary articles recognised commonly as food, and that we reject all substance recognised commonly as poisons. But it will also include such substances as water and air, both of which are essential for nutrition, but are not usually recognised as belonging to the list of food substances in the ordinary sense. When we carry our investigation further, we find that the organic substances may be again divided into two distinct classes, namely, that which contains nitrogen (the casein), and those that do not (the butter and sugar). On ascertaining this, we are immediately struck with the remarkable fact that all the tissues and fluids of the body, muscles (or flesh), bone, blood—all, in short, except the fat—contain nitrogen, and, consequently, for their building up in the young, and for their repair and renewal in the adult, nitrogen is absolutely required. We therefore reasonably infer that the nitrogenous substance is necessary for this purpose. Experiment has borne this out, for men who have been compelled to live without nitrogenous food by dire necessity, and criminals on whom the experiment has been tried, have all perished sooner or later in consequence. When nitrogenous substances are used in the body, they are, of course, broken up and oxidised, or perhaps we ought to say more accurately, they take the place of the tissues of the body which wear away and are carried off by oxidation and other chemical changes. Now, modern science tell us that such changes are accompanied with manifestations of energy in some form or other, most frequently in that of heat, and we must look, therefore, upon nitrogenous food as contributing to the energy of the body in addition to its other functions. What are the substances which we may class as nitrogenous. In the first place, we have the typical example of the purest form in *albumin*, or white of egg; and from this the name is now given to the class of *albuminates*. The animal albuminates are: Albumin from eggs, fibrin from muscles, or flesh, myosin, or syntonin, also from animals, casein (or cheesy matter) from milk, and the nitrogenous substances from blood. In the vegetable kingdom, we have glutin, or vegetable fibrin, which is the nourishing constituent of wheat, barley, oats, &c.; and legumin, or vegetable casein, which is the peculiar substance found in peas and beans. The other organic constituents—viz., the fats and the starches and sugars—contain no nitrogen, and were at one time thought to be concerned in producing animal heat. We now know—thanks to the labours of Joule, Lyon Playfair, Clausius, Tyndall, Helmholtz, &c.—that heat itself is a mode of motion, a form of convertible energy, which can be made to do useful or productive work, and be expressed in terms of actual work done. Modern experiment shows that all our energy is derived from that of food, and, in particular from the non-nitrogenous part of it, that is, the fat, starch, and sugar. The nutrition of man is best maintained when he is provided with a due admixture of all the four classes of aliment which we have mentioned, and not only that, but he is also better off if he has a variety of each class. Thus he may and ought to have albumen, fibrine, gluten, and casein among the albuminates, or at least two of them; butter and lard, or suet, or oil among the fats; starch of wheat, potato, rice, peas, &c., and cane-sugar and milk-sugar among the carbo-hydrates. The salts cannot be replaced, so far as we know. Life may be maintained in fair vigour for some time on albuminates only, but this is done at the expense of the tissues, especially the fat of the body, and the end must soon come; with fat and carbo-hydrates alone vigour may also be maintained for some time, at the expense of the tissues also, but the limit is a near one. In either of these cases we suppose sufficient water and salts to be provided. We must now inquire into the quantities of food necessary: and this necessitates a little consideration of the way in which the work of the body is carried on. We must look upon the human body exactly as a machine; like an engine with which we are all so familiar. A certain amount of work requires to be done, say a certain number of miles of distance to be traversed: we know that to do this a certain number of pounds, or hundredweights, or tons of coal must be put into the fire of the boiler in order to furnish the requisite amount of energy through the medium of steam. This amount of fuel must bear a certain proportion to the work, and also to the velocity with which it is done, so both quantity and time have to be accounted for. No lecture on diet would be complete without a reference to the vexed question of alcohol. I am no teetotal advocate, and I repudiate the rubbish too often spouted from teetotal platforms, talk that is, perhaps, inseparable from the advocacy of a cause that imports a good deal of enthusiasm. I am at one, however, in recognising the evils of excess, and would gladly hail their diminution. But I believe that alcohol properly used may be a comfort and a blessing, just as I know that improperly used it becomes a bane and a curse. But we are now concerned with it as an article of diet in relation to useful work, and it may be well to call attention markedly to the fact that its use in this way is very limited. The experiments of the late Dr. Parkes, made in our laboratory at Netley, were conclusive on the point, that beyond an amount that would be represented by about one-and-a-half to two pints of beer, alcohol no longer provided any convertible energy, and that, therefore, to take it in the belief that it did do so is an error. It may give a momentary stimulus in considerable doses, but this is invariably followed by a corresponding depression, and it is a maxim now generally followed, especially on service, never to give it before or during work. There are, of course, some persons who are better without it altogether, and so all moderation ought to be commended, if not enjoyed. There are other beverages which are more useful than the alcoholic, as restoratives and for support in fatigue. Tea and coffee are particularly good. Another excellent restorative is a weak solution of Liebig's extract of meat, which has a remarkable power of removing fatigue. Perhaps one of the most useful and most easily obtainable is weak oatmeal gruel, either hot or cold. With regard to tobacco, it also has some value in lessening fatigue in those who are able to take it, but it may easily be carried to excess. Of it we may say, as of alcohol, that in moderation it seems harmless, and even useful to some extent, but, in excess, it is rank poison. There is one other point which I must refer to, and which is especially interesting to a great seaport like this. This is the question of scurvy—a question of vital importance to a maritime nation. A paper lately issued by Mr. Thomas Gray, of the Board of Trade, discloses the regrettable fact that since 1873 there has been a serious falling off, the outbreaks of scurvy having again increased until they reached 99 in 1881. This, Mr. Gray seems to think, is due to a neglect of varied food scales; but it may also very probably have arisen from the neglect of the regulation, about lime-juice, either as to issue or quality, or both. But it is also a fact of very great importance that mere monotony of diet has a most serious effect upon health; variety of food is not merely a pandering to gourmandism or greed, but a real sanitary benefit, aiding digestion and assimilation. Our Board of Trade has nothing to do with the food scales of ships, but Mr. Gray hints that the Legislature will have to interfere unless shipowners look to it themselves. The ease with which preserved foods of all kinds can be obtained and carried now removes the last shadow of an excuse for backwardness in this matter, and in particular the provision of a large supply of potatoes, both fresh and dried, ought to be an unceasing care; this is done on board American ships, and to this is doubtless owing in a great part the healthiness of their crews. Scurvy in the present day is a disgrace to shipowners and masters; and if public opinion is insufficient to protect the seamen, the Legislature will undoubtedly step in and do so. And now let me close by pointing out that the study of this commonplace matter of eating and drinking opens out to us the conception of the grand unity of nature; since we see that the body of man differs in no way essentially from other natural combinations, but is subject to the same universal physical laws, in which there is no blindness, no variableness, no mere chance, and disobedience of which is followed as surely by retribution as even the keenest eschatologist might desire.

A PENNY SCIENCE LECTURE AT THE "VIC."

THE experiment was tried at the Victoria Coffee Palace, New-cut, Lambeth, on Friday evening, of giving a popular lecture on science, at prices of admission varying from one penny to sixpence. Mr. W. Lant Carpenter, B.A., B.Sc., who has had a large experience in this department of educational work in connection with the Gilchrist Educational Trust, kindly offered to contribute one lecture, and selected for his address the taking title of "Telegrams, and How they Come." The pit of the great theatre was well filled, chiefly by a class fairly representative of the better type of *habitués* of the old "Victoria Theaytor" before its transformation into a coffee-tavern.—very young men, who freely smoked and did not trouble to remove their hats during the proceedings. Many, indeed, only came in for twenty minutes or half-an-hour, then giving place to others. Free-and-easy as were the manners, a certain standard of order was maintained by the audience, any attempt at vociferous cheering, prolonged exclamations of "Oh!" or other interruption, being promptly silenced by cries of "Shut up!" or similar outspoken remonstrances. The higher-priced seats were almost empty, except the sides of the balcony, where the front rows were nearly full.

The lecturer was heavily handicapped by being relegated nearly to the end of a Temperance Demonstration, to which, it appears, Friday evenings are primarily devoted at the "Vic." A recitation, of the spirited dramatic type, which goes down with such an audience, given by a gentleman rejoicing in long hair and a heavy moustache, was followed by "Cherry Ripe" and "Thady O'Grady," by a lady vocalist; selections by the orchestra, in which the bass viol played a prominent part, a temperance address by a police-court visitor, followed by a long and unprepared speech from the clerical chairman, occupied the first hour and a half, and only left Mr. Carpenter the fag-end of an evening and a wearied audience. The lecture may be summarised as a popular chat upon the elements of of electro-magnetism, illustrated by experiments shown on the screen by the projection lantern of Stohrer and Son, of Leipsic, and by lantern photographs. It was delivered without the aid of a single note, and was followed with close attention, but with great impatience, by the audience, who began to whistle and stamp at the very slightest hitch or delay in an experiment; exacting as the auditors had been, however, they testified at the close their appreciation of the clear exposition of the subject, and of the success of all the experiments, by a long and noisy round of cheering.

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[*] From a lecture delivered at the Sanitary Congress, at Newcastle-on-Tyne, September 28th.

Having introduced his subject by referring to the fact that we were reading details in the London newspapers of the bombardment of Alexandria within three or four hours of its occurrence, and to the immense electric advance telegraphy was upon semaphore signalling, by which it was preceded as a means of communication, the lecturer said electricity could be developed either by mechanical power or by the chemical action of liquids upon two kinds of metal; the former was much too powerful for sending messages, but was utilised for the production of the electric light. The latter mode of production was known as galvanic electricity, and the simplest form was to place a sixpence on the tongue and a piece of zinc beneath it, when a peculiar taste would be experienced whenever the ends of the metals were brought into contact. If for the mouth of the experimenter they substituted a trough filled with acid and connected the pieces of metal, say zinc and copper, by a wire, they would have a cell, and a number of these connected together would be a battery. If they examined the plates and wire when thus brought into contact, they would find that some influence was passing from one to another along the wire, and for want of a more definite term, this was known as an electric current. There were several modes of arranging and filling these groups of cells, some of which were shown. That used for telegraphic purposes consisted of a pot containing zinc and weak acid, in which was another of porous earthenware, containing copper, and in the latter was poured some sulphate of copper, a very large number of the cells being used to increase the current. Telegraphy depended on the very curious and close relation between electricity and magnetism. Long since it was noticed that a certain stone found in Asia had the power of attracting to it iron, and it was further discovered that if a piece of steel were stroked in one direction along this lodestone it also acquired the same power of attracting iron to itself, and that iron in turn attracted the magnet. More than this, it was found that if the magnet were suspended so as to move freely it always came to rest at a point nearly north and south. The magnetic power was seen to reside chiefly in the ends, and if two magnetised pieces of iron were brought near to one another, one end of each attracted and the other end repelled the same end of the other magnet. The next stage of the discovery, and a very important one, was that while a piece of copper did not act as a magnet to attract and repel iron, it temporarily acquired this power while a current of electricity was passing through it, whereas as soon as the current was stopped its magnetic powers ceased. (Incidentally the lecturer remarked, as another illustration of the force or energy in the wire, that if a powerful current was passed through a wire not thick enough to convey the whole of it, the excess of force was converted into heat, and this was utilised for exploding mines of powder by a red-hot wire, and by passing an intense current through pieces of carbon the brilliant electric light was produced.) It was apparent that if a copper wire became a magnet just so long as a current passed through it, it ought to influence a steel needle hung on a pivot near it, and this was the case. Not only so, but experiments showed that if the current were passed in one direction with respect to the needle, the needle was always deflected on one side; whereas, if the direction of the current were reversed, the needle was deflected to the opposite side. Further than this, if the length of copper wire forming the circuit were greatly increased, the current passed along it and deflected the needle without the loss of a fraction of a second, and thus the wire from the length of the stage of the Victoria Theatre, could be increased to a hundred or a thousand miles, and the needle would still be deflected to right or to left, as the direction of the current was reversed. All that was needed was a code of signals indicating letters by several taps to the right or left, and a mode of communication was established along the wire. This was the principle which underlay the single needle instrument largely used on the railway. An important discovery in the history of electricity was that if the wire which conveyed a current were wound round a bar of soft iron, that bar in turn became a magnet while a current was passing through the wire, and the more often the wire was coiled round it, the more powerful as a magnet did the bar become. The operation of magnetising and demagnetising a bar of soft iron could be performed many hundred times in a minute, as was demonstrated by experiment. This property of instantaneous attraction and release was that by which the electric bell was made available; a spring held the keeper above the magnet, but the current passing through attracted the keeper, and so broke contact; at this the spring again came into play, and once more contact was again made. By this means a series of rapid taps were made upon the edge of a bell. The post-office instruments consisted of an electro-magnet, with a keeper attached to a spring. When the current passed, the keeper was attracted; when the current ceased, the spring threw it back to its original position. This back and forward motion produced a sharp "click," and by combinations of short and long intervals between the clicks, letters and words were signalled. These instruments were called sounders, and one of them being placed in the projection-lantern, was exhibited in action on the screen, as were also several other pieces of apparatus, the connections and disconnections being made by raising and depressing a key. The signals could be made more rapidly and read more accurately than those in the single needle instruments first adopted, and still in use on the railways, and where it was necessary to record the signals transmitted, it was effected by a modification of the instrument which punched dots and strokes on a ribbon revolved by clockwork.

DEATH NOT UNIVERSAL.

THE *Times* last week reproduced under the title of "A curious fact in evolution," the extract from the *American Journal of Science* which appeared in these pages eight weeks since. Mr. Jabez Hogg commenting thereon in the *Times* gives another curious fact in evolution which he believes is not nearly so well known as that already referred to. A certain spot in the grounds of the Rev. Lord Sidney Godolphin Osborne, Durweston, has, for many years, by that gentleman's kindness, furnished microscopists with a peculiar kind of earth. On taking a very minute portion of this earth and immersing it in a drop or two of pure water, two species of a most lovely animal, Rotifer vulgaris, will be developed in about ten minutes. No matter how often you repeat the experiment the same two forms invariably appear. The proceeds of development can be watched under the microscope with a quarter inch power; for in this short space of time named, the complex organisms will be seen to swim about and exercise, in a perfect manner, all the functions of their existence. A curious fact in connection with the subject is that if the earth is carefully kept, the same process may be repeated, with like results for 12 months at least, after which these animals seem to be unable to resist further desiccation. But not so a more lowly organised form which also makes its appearance in the solution, for at the end of 10 or 12 years Mr. Jabez Hogg has obtained a good crop of minute protoplasmic creatures, amœba, belonging to the lowest class of animal life, such as those mentioned in the paragraph from the *American Journal of Science*, and whose reproduction is carried on as there described, by segmentation, separation, or self-division; a process which has probably been going on throughout all time, and will, Mr. Hogg ventures to think, go on *ad infinitum*. Only recently on taking a packet of earth from a drawer, dated Durweston, July 13, 1869, and placing a very small quantity in a drop of water on a microscopic slide, in a short time Mr. Hogg says he had an interesting display of these curious protean bodies, amœba, moving about over the field of the microscope. Lord S. G. Osborne, writing by way of reply to Mr. Hogg, says that the material was really the dust of the garden, which collected in cup-like receptacles artificially made. He resigned the living of Durweston some years ago, and is quite sure the material will not be found there now.

CHEMISTRY OF PHOTOGRAPHY.

THE following abstract of a paper read by Dr. Garrison, of Chicago, before the Annual Convention of the Photographers' Association of America, will be found interesting and useful by many who, like himself, are amateurs:— Many of you wish to make oxalate of potash for your ferrous oxalate developer, and you at once ask the question, how much oxalic acid should I use to a given quantity of carbonate of potash? Now, how many of us can figure that out? Suppose that you have two ounces of oxalic acid, how much carbonate of potash shall you purchase or weigh out to neutralise that? The common way would be to add little by little until you have got enough; but you are almost sure to get in too much, and then, if you have no reserve of oxalic acid, you are in a fix. You have made your solution alkaline, and cannot correct it. There is a way to determine these questions chemically. Let me put an example before you. You are going to make dry plates by the new process, and you have a certain quantity of nitrate of silver. Take a case that occurred in my own practice. I was going to make some dry plates the other day, and weighed out my entire stock of silver, and found the amount to be one that would astonish you by its smallness—only 464gr.; that is all I could scrape up. Now, how much bromide of ammonium would that require? This was not a quantity—464gr.—that could be found in any formula, but I was able by a very simple calculation, which I think I can explain so that you can make it, to determine how much bromide of ammonium to use.

In order to get this matter before you properly, I must call your attention to the old and hackneyed question of atoms for just a minute or two. We known that all matter of every kind is composed of atoms. These are extremely small bodies, as you probably heard before. How small they are no one can tell you, but they are, as all agree, extremely small. Now, they have another quality which I want you to bear well in mind. Whether these atoms are of the same diameter or not, no one can tell you; but it is absolutely certain that they are not of the same weight. They are not of the same weight any more than the different individuals before me are of the same weight. Your weight may also increase or diminish; not so with the atoms, however. They always retain the same weight. Each atom has its special weight. Now, we cannot weigh one of them, because we cannot even see them, but we can take masses of them and let them act upon other masses, and considering them in that way find, after many trials, how they compare with each other.

Now, for instance, we find the hydrogen atom has the least weight of any. We do not know how heavy it is. It is the lightest of all, at all events, and we therefore take that as a starting-point, and compare all the rest with it, and we call it 1.

If you have enough of them you have one grain; if you have enough hydrogen atoms you will have one pound—or, of course, you can have a ton of them. No matter what the actual weight is, you may consider the hydrogen atom alone, and you can say the weight is 1. Now, you compare the other atoms with it, and you will find that they have different weights. The atom of potassium, for instance, is 39 times as heavy. The atom of sodium is 23 times as heavy: iodine, 127 times as heavy; silver, 108 times as heavy; bismuth, 210 times as heavy—210 times as heavy as that little atom of hydrogen! You will find this table of atomic weights in the rear part of most of the works on photography—at least, you will find it in all of the works on chemistry. It is a part, though, like the preface, that a great many never read. You don't need to read it, but you have it there for reference. That is the way with most knowledge; it is available and valuable when we know where to lay our hands on it when we want it, and know how to use it when we find it. Now, looking at this table, what does it all mean? Suppose that I unite together one atom of hydrogen and one atom, we will say, of chlorine. I may state that the atom of chlorine is 35½. Upon uniting these atoms together they make what we call a molecule, which is simply a compound of two or more atoms. I think you can all remember that, so when I use the word molecule you will know just what I mean. I mean the combination of two or more atoms—not a mixture, but a compound of two or more atoms in which the atoms have united chemically. Now, suppose that we unite hydrogen with chlorine, what will be the weight of the molecule? The hydrogen atom is 1, and the chlorine is 35½. I expect that you are all mathematicians enough to solve this problem. We add these together, and the result is 36½. That is the molecular weight of hydrochloric acid. Let us take another example. We will say that we wish to find the molecular weight of bromide of silver. Let us represent it by symbols—we have those outlandish symbols that were invented originally to keep folks from understanding the science. Now that we have got them we have to make the best of them that we can. We have Ag representing silver. The old Latin name was argentum. Then we have Br for bromine. Now, what are the weights severally of these atoms? The weight of the bromine atom is 80; the weight of the atom of silver is 108. Now, it does not require much of a mathematician to add them together. We see the result to be 188, and that is the molecular weight of bromide of silver. I think that you could calculate the molecular weight of anything in that way. But let us take a more difficult example. Let us take the nitrate of silver, of which the following is the formula expressed in symbols:

Ag (silver)	108
N (nitrogen)	14
O_3 (oxygen, 3 atoms)	48
	170

We will add these up. It is just as simple as before: 108 for the silver; then the nitrogen, and as the nitrogen atom is fourteen times as heavy as the hydrogen atom, you put down its weight, 14; and lastly, the oxygen atom is sixteen times as heavy as the hydrogen—in other words, 17 is its atomic weight, and, as we have three of it, we must multiply the 16 by 3, of which the result is 48; then, adding these together, we get 170 as the molecular weight of the nitrate of silver.

Now, again, let us find the molecular weight of bromide of ammonium. These are the two substances we are going to use, and we want to know how they will balance, so that each molecule will be decomposed, and there will be no excess on either side. Let us, therefore, examine the bromide of ammonium critically. You will see, by referring to your works on chemistry, that this is the formula for bromide of ammonium: NH_4Br. Let us consider the weight of this molecule. Nitrogen 14, hydrogen 4 (because there are four atoms present), and bromine 80, the total being 98, which is the molecular weight. Now, that means just this, that 98gr. of bromide of ammonium are exactly equivalent to 170gr. of nitrate of silver; and, if you put these two compounds together in this proportion, they will exactly decompose each other—double decomposition will take place, so that there will not be a single atom left on either side.

What occurs when we have put the bromide of ammonium and the nitrate of silver together? You know what occurs in the dance. You change partners. That is all that happens here. There is a change of partners, the ammonium evinces an affinity for the acid radical with the silver, and the bromine and silver unite—a "cross over," as they used to call it. Now, that is a case of decomposition, and it is about as difficult as any example that you may expect to encounter. You will see that there is just enough of each element. Now, the question is, after this is accomplished, what have we formed? Well, in the first place, the silver and the bromine have united together. How much bromide of silver has been formed? That is a question you usually do not wish to determine in the practice of making dry plates. But suppose that you do care. Just think a moment. We have 108 of silver and 80 of bromine, which, added together, give 188, which is the amount of bromide of silver formed. Now, then, what else has been formed? Well, nitrate of ammonia. You see that we could plainly tell how much has been formed if we wished to stop and do it; and now I think that any of you could tell that just as well as I can.

We found that 170 is the molecular weight of nitrate of silver. That is the weight of all the different atoms, and we found that the molecular weight of the bromide of ammonium is 98; very well, now these are the quantities that act upon each other without any excess being left upon either side. Now this serves as a ratio or proportion by which we can determine in what quantities to add these agents to each other in order to effect complete double decomposition. 170 of silver are to 98 bromide of ammonium as any given quantity of silver is to the quantity of bromide of ammonium to be used. Well, let us try an example. We will take the example here: 170 (of silver) is to 98 (that is the bromide of ammonium) as the amount of silver which I have, 464gr., is to the quantity of bromide of ammonium which I must use. I have made the calculation, and find that 267gr. are necessary. I know, then, just the amount to add to make these gelatine plates, but, as you know, if you have tried it, you must use some excess of the bromide of ammonium. I used a very small excess, much less than the books said was necessary, and yet obtained good plates. Now we will leave that and come back to the oxalate of potash.

In the first place, we have the oxalic acid. Let us see if we can write the formula for that. It is a rather hard formula. I may get something wrong. You had better watch me. Here it is: $H_2C_2O_4 2H_2O$. Now let us find the molecular weight. Two of hydrogen is 2, 2 of carbon (1 of carbon is 12, 2 would be 24), 4 of oxygen (4 times 16 are 64), and now we add to this water, and we must always take that into account, because it weighs—it has a definite weight on our balance. We buy it when we buy the oxalic acid. You cannot get rid of it, and when you buy a good many salts you buy more water than anything else—a good deal more sometimes. Carbonate of sodium has 10, alum 24 equivalents of water of crystallisation. They weigh very heavily. Let us try 1 equivalent of water and see what it weighs. One equivalent of water is 2 of hydrogen and 1 of oxygen = 16, that would be 16 altogether. Here we have two of them, this big figure 2 [pointing to 2 in the formula] shows that whatever follows it is taken twice. So we have twice 18, which is 36. Now, perhaps, I have confused you in this. Perhaps I had better do it in another way, by which we may arrive at the same result. I told you that whatever follows the figure is to be taken as many times as the figure indicates; if 2, it is taken twice; if 3, three times; if 10, ten times. Here are 2 of hydrogen; if you take those 2 twice, that will be 4, and we will set that down 4, then we have it. There is 1 of oxygen—that will be 16 by itself, but you take it twice, which will be 32, so that you see that we get the same result whichever way we calculate. Now we are prepared, having added up this combination, to find out what the whole of it weighs—here we have it, 126. Now, that is the molecular weight of oxalic acid—that is the weight of the formula, if you please. It is just like the firm of Brown, Thompson, and Smith—each one has his own special weight. One weighs, say, 100 pounds, another 150 pounds, and another 200 pounds; you add these weights together, and you get the firm's weight, which is analogous to molecular weight, the latter being the joint weight of a firm of atoms of different kinds, the former of men. Very well, having now illustrated that, let us turn to carbonate of potash. To understand carbonate of potash, we will have to write out its formula. K is the hieroglyphic that stands for potash. It used to be called kalium; we have retained the K, but dropped the balance of the name. Two of potash, 1 of carbon, and 3 of oxygen (K_2CO_3). Now, let us add these weights up, and see what the amounts will be. Twice 39 for the potash, 12 for the carbon, and three times 16 for the oxygen will be, altogether, 138.

Now, then, the facts brought before you simply lead to this conclusion, that for every 126 parts of oxalic acid you must use 138 parts of carbonate of potash, or the reverse.

You must remember that carbonate of potash is not absolutely pure, and it sometimes happens that oxalic acid is not absolutely pure, so with ordinary articles you do not arrive at such absolute precision as you may arrive at theoretically, but practically you are near enough right. Now, you might inquire, how can these facts be utilised? We do not wish to weigh out 126 grains of oxalic acid and 138 grains of carbonate of potash each time, but we take that as a ratio, and say as 126 of oxalic acid is to 138 of carbonate of potash, so is the amount of oxalic acid which I propose to use to the amount of carbonate of potash which I must use with it. If we have three members of a proportion, we can get the fourth; so we can turn this problem backward and forward, and work everything out that we wish, and in that way.

IRRITATING EFFECTS OF ANIMAL AND VEGETABLE STINGS.

By Prof. August Vogel.

It is well known that the effect of a stinging nettle on the skin agrees very closely with the sensation produced by the sting of a bee or wasp. But the great similarity is not limited to the feelings it causes; but, what may not be so well known, the cause of the irritation produced on the skin is essentially the same. It may be considered as definitely settled that formic acid is present in the poison sac of the bee sting, in the so-called bee poison. The same corrosive acid also occurs in the sting of the nettle. Some species of caterpillars have formic acid in some of their hairs, which they seem to be able to shake off at will, and when a person touches such a caterpillar the poison penetrates the skin wherever it is moist and causes burning, itching, and inflammation. These poisonous members preserve their irritating powers even after the death of the worm. This accounts for reliable statements that visitors to collections of caterpillars have suffered from exanthematous eruptions on the neck. "Many hairy caterpillars cause itching and burning of the skin when touched, and sometimes it gives rise to swelling and redness. This depends on the fine hairs, which produce the same effect when they float around in the air. Many ladies who visited the caterpillar room of the naturalist Reaumur had a breaking out on the neck."

In the sting of the bee, wasp, hornet, &c., a minute drop of a transparent liquid may be observed on the sting, and is called "bee poison" (formic acid). It penetrates into the wound produced by the sting, and causes the well-known effects. It would, however, be a great mistake to assume that the only object of this is to increase the effect of the sting, that is, that it serves only to injure. It has a far more important purpose, namely, to prevent fermentation and decay. The celebrated bee cultivator, Hole, reports that in his long experience with honey, that which came from what are called "rancorous swarms" (boshaft) had peculiar properties. It always had a bitter, harsh taste, and its smell was sharp too. How can the character of the swarm affect the smell and taste of the honey they gather? We know that bees, when they are disturbed, run out their stings, on the end of which may be seen a tiny drop. This little drop, as we have already said, is bee poison, or formic acid. When the disturbance is at an end they draw in their stings again, but the little drop of liquid does not go back with it, but is wiped off on the comb, and sooner or later gets mixed up with the honey. This explains how honey from such excited bees must taste and smell sharper than from peaceable bees. Excitable bees will rub off this little drop of formic acid more frequently than other bees; perhaps a larger drop is formed by nervous bees than by those that are not nervous, and hence the honey is richer in formic acid. This acid is never absent in genuine honey, but the amount differs. This contamination is not only uninjurious but very useful, in fact necessary, for it keeps the honey from spoiling; we know, indeed, that purified honey, from which the formic acid has been removed, very soon ferments, while unpurified honey will keep unchanged for years. Nature furnishes the bees with this knowledge instinctively, and therefore they do not carry this drop of formic acid away out of the hive. Bee connoisseurs assure me that the bees add it to the nectar which they collect that is free from it so as to make it keep, and they do this in places where they are not disturbed too.

Bee stings are often spoken of in agricultural and popular papers as a remedy for rheumatic affections, and numerous cures are adduced to prove it. If the formic acid that accompanies the sting can be looked upon as the principal agent in the cure, it would be worth while to try the experiment of rubbing the spot with this acid or injecting it under the skin, so as to avoid the somewhat inconvenient method of applying live bees. Two hundred years ago formic acid was made from the brown wood ants, by triturating them with water and distilling it. The acid liquid was used to irritate the skin. The reddening of the skin, by using baths of pine leaves, is also due to the action of the formic acid. The anti-fermentative action of formic acid has also long been recognised. As regards the irritative action of stinging nettles and other similar vegetables, it depends, as already stated, on its formic acid. The point of the nettles is brittle as glass, and by the lightest touch penetrates the skin and breaks off, pouring out its acid and causing the burning sensation. In this little notice frequent mention has been made of formic acid. In conclusion it may be stated that it gets its name from the ant *(formica)*, because it was *first* found in them. If it had been found first in the bee or nettle it would have received another name. If an ant runs over a piece of blue litmus paper he will leave a red streak. Put a stick in an ant hill and they will squirt strong acid on it.—*Humboldt.*

HOW MUCH SHOULD WE EAT?

How, asks Dr. Nicholls in the *Food Reform Magazine*, are we to get at the proper quantity of food? Animals living in a state of nature do not over-eat themselves. They stop eating when they have got enough. There are no prize cattle on the prairies. It is the stalled ox, and the pig in his pen, deprived of exercise, that can be fattened into a diseased and diseasing obesity. Horses escape this diseasing process because men do not to any great extent knowingly devour them. The hunter and racer are not over-fed. All animals expected to do their work are carefully fed as to quality and quantity. If human beings were fed as wisely, they would be as healthy.

There are some good rules for feeding as to quantity. When our food is simple and natural in kind and quality, and mode of preparation, there is little danger of eating too much. There is little danger, for example, of eating too many grapes, apples, pears, or bananas. Salt, sugar, spices, and luxurious cookery tempt to excess. With men, as with animals, a natural diet is self-limiting, and we are disposed to stop when we have got enough. The more artificial the food, the more elaborate and luxurious the feast, the more the liability to overload the stomach, overtask the digestive power, and overweight the forces of life. Simplicity of food is a condition of health, and promotes longevity. The quantity of food which enables a man to do his daily work without loss of weight is precisely what he requires. He supplies the daily waste—no more and no less. This quantity may vary a little with each individual, but everyone can easily ascertain his own measure of requirement by reducing the quantity of daily food until he finds a balance of force and weight. It is my opinion that the average quantity of water-free aliment required, say by business and literary men, is 12 ounces. Men of great muscular activity may require 16 to 20 ounces. I have found myself in very good condition for sedentary work on 8 or 10 ounces. When anyone is in good condition for his work and keeps his normal weight, he has food enough. My advice is, find this quantity by experiment, and then habitually keep to it.

ZINC FOIL IN BOILERS.

Since 1875 experiments have been carried on in the French marine, particularly with boilers having surface condensers, to test the efficacy of zinc leaves in neutralising the effect of fatty acids in the boiler and giving rise to inoffensive products. Commandant Frené has recently given an account of the results obtained on board the *Desaix* to the French Academy of Sciences.

The zinc inside and the iron of the boiler constitute a voltaic element which decomposes the water and liberates oxygen and hydrogen. The oxygen forms oxide of zinc, which combines with the fatty acids mingled with the feed water, thus forming "soaps" of zinc which, coating the tubes of the boilers, prevent the adhesion of the salts left by evaporation. It is easy then to brush away the fixed matter on the tubes which is in a mealy state. As to the hydrogen, it behaves as MM. Gernez and Donny have described in the *Annales de Chimie et de Physique* for 1875. Ebullition takes place by evaporation at the surface of a gas, whether dissolved in the liquid or clinging to the solid envelope of the containing vessel. If the gas is expelled from boiling water the latter can be superheated to 30° or 40° Cent. above the normal boiling point, and in such a case evaporation only takes place at the surface. When the temperature of the vapour emitted corresponds to the tension which equilibrates the pressure exercised at the surface of the liquid, the ebullition can be started at will by introducing a gas bubble into the liquid. Solid bodies operate in the same way by reason of the film of gas adhering to them. When by long boiling all the gas is expelled, the water becomes superheated, and thus an element of danger is introduced. But by the employment of zinc in the boiler a constant supply of gas is maintained, and all danger of superheating is avoided. The hydrogen not only starts the boiling, but keeps it up. It is, however, necessary from time to time to take out the zinc plates from the boiler and clean from them the salts adhering to them, else the galvanic action will dwindle, and perhaps stop altogether.

M. Frené is of opinion that the action of the zinc is, however, not so regular as theory might expect, and advocates the substitution of a sure and constant mechanical action under the form of a moderate but continuous injection of warm air by the lower part of the boiler, or better still, a non-oxidising gas, such as carbonic acid. This plan, he thinks, would produce a perfectly regular ebullition, a rapid evaporation, a saving of fuel, and freedom from risk. Superheating, which he figuratively calls a sleep of the liquid, would be no longer possible. The carbonic acid could be developed by the combination of carbonate of lime and hydrochloric acid.—*Engineering.*

HYDRAULIC MACHINERY.—IV.*

By Prof. Perry.

To further familiarise you with the idea, let us consider the flow of water from an orifice. In Fig. 1 you will see the stream lines along which water flows out of the orifice. The shapes of these stream lines will depend on the shape and position of the orifice.

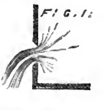


FIG. 1.

Now, a pound of water at A is at atmospheric pressure, and when it reaches B it is also at atmospheric pressure, so that its pressure energy remains the same.

But at A it has fallen h feet; it has lost h foot-pounds of potential energy, and it must therefore have gained h foot-pounds of kinetic energy. If v is its velocity, then $v^2 \div 64$ must be equal to h, so that v may be calculated; hence its velocity is just the same as that of a stone which had fallen freely from A to B.

[To illustrate this a high vessel was shown, from which at different levels tubes came out, ending in nozzles, throwing jets vertically upwards.]

These jets do not rise to the same height, because there is a loss of energy due to friction, and this friction occurs principally at the nozzles. If the jet reaches within a distance h_1 of the level of still water inside, and if the nozzle is the depth h below still water level, then if we may say that all the friction occurs at the nozzles, $h_1 \div h$ expresses the fractional loss as a fraction of the whole kinetic energy at the nozzle.

[This calculation was made for different levels of the water in the vessel, and gave nearly the same result in every case, showing that the frictional loss of energy seemed to be proportional to the kinetic energy there.]

There is very little friction in the case we are considering—and we have a very simple statement of the velocity at B.

Can we say the same about the velocity at C? Certainly not. If we knew the pressure energy at C, we could say how much of the lost potential energy has been invested in this shape, and, therefore, how much has been invested in the shape of kinetic energy; but without knowing the pressure at C, we cannot tell what is the velocity there.

In this subject of flowing water there are more misleading hypotheses, due to perverted ingenuity, than in almost any other, and, unfortunately, the logical conclusions drawn from these hypotheses, when known to be untrue, are said to be the statements of theory as opposed to practice. You often hear the statement; the theoretical velocity at an orifice is the velocity which the water would have acquired if it had fallen freely, as in a vacuum, from still water level, whereas it is evident that we cannot tell the velocity at any point in the jet, unless we know the pressure there, and we only know the pressure on the very outside of the jet.

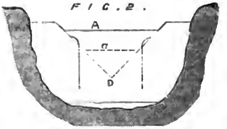
Now, although we do not know the pressure or velocity at every point of water flowing from an orifice, the studies of Professor James Thomson enable us to make certain important statements which agree with experiment. One of these is this:—

When frictionless liquid flows from two similar vessels through similar orifices similarly situated with regard to free water level, the lines of flow are exactly of similar shape; the velocities at similar points are exactly as the square roots of the dimensions of the vessels, and the total quantities of liquid which flow are proportional to the square roots of the fifth powers of the dimensions.

Thus, if we have water flowing similarly from three similar vessels, all made from the same drawings, but to different scales—say one 1ft., another 4ft., and another 9ft. deep—the velocities at similar points are as 1 to 2 to 3, and the quantities of liquid flowing from the three vessels are as 1 : 32 : 243; thus we are quite sure that 243 times as much liquid flows from the third vessel as from the first.

Hence, suppose I want to know how much water is flowing in a small stream, I dam the water up somewhere, and let it flow out of my dam through a notch like this (Fig. 2), (a right angled isosceles notch) in a wooden board with sharp edges. Indeed, I prefer to have the edges of the notch made of metal, so that I shall be sure they are straight and sharp. Measure the height of the still water in the dam above the lowest point of the notch (D). This one measurement tells me how much water is tumbling over. For I know that, suppose there is rather a drought one day, and *a* shows the appearance of the notch; and on another, a rainy day, A shows its appearance, you will observe that the orifices through which the water is flowing are similar, and similarly situated with regard to the still water level; and Thomson's theory enables me to say, that if on one day the height is 1ft., and on another it is 4ft., then 32 times as much water comes over on the second day as on the first. The flow of water is exactly proportional to the square root of the fifth power of the height D A.

FIG. 2.



Now, Thompson measured very accurately how much water is flowing when the height is 1ft. and he found it to be 2·54 cubic feet per second. Hence we have the rule; measure the height D A, at any instant, in feet; raise this to the fifth power, and extract the square root, and multiply by 2·54, and you know how much water is flowing in cubic feet per second.

If we know the cubic feet of water flowing per second, we know the weight of the water, since a cubic feet of water weighs 62·3lb., and the weight of water, multiplied by the number of feet through which we can let it fall, tells us the foot pounds per second—the available power of the stream. The foot-pounds per minute, divided by 33,000, is, as you all know, the horse-power of the stream.

(*To be continued.*)

Detection of Lead in Tinfoil.—A drop of concentrated acetic acid is let fall upon the suspected leaf, and a drop of solution of potassium iodide is added. If there is lead present there is formed in two or three minutes a yellowish spot of lead iodide. Kopp moistens the leaf to be examined with sulphuric acid. If the tin is pure the spot remains white, but if lead is present there is formed a black spot.

SCIENTIFIC NEWS.

Three Dun Echt Circulars have been issued in rapid succession. No. 58 gives elements and ephemeris of Barnard's comet calculated by Dr. Oppenheim. T = 1882. Nov. 12·9497 Berlin M.T.; π − ☊ 253° 38′ 14″; ☊ = 249° 8′ 24″; i 95° 30′ 35″; log. *q* 9·98446. The ephemeris for the following days may be useful; it is for Berlin midnight:

	R.A.			S. Dec.	
Oct. 6	8h.	10m.	17s.	8°	51·1′
8	8	16	35	12	11·8
10	8	23	22	15	43·9
12	8	30	40	19	26·3

The *Science Observer* Special Circular No. 25 gives the elements telegraphed to Lord Crawford (see p. 86) which require correction as printed in the "Scientific News" last week. The inclination of orbit should be 83° 29′, and perihelion distance 1·2012. The comet was discovered by Mr. Barnard at 16h. 31m., Sept. 13, Nashville M.T.

Dun Echt Circular No. 59 gives Mr. Chandler's approximate elements of the great comet, the orbit of which resembles that of Comet I. 1880, closely. T = 1882, Sept. 17·38 G.M.T. π − ☊ 60° 45′; ☊ 342° 29′; i = 140° 17′; log. *q* 7·54407. Dr. Copeland says in Circular No. 60 that on Sept. 29 the comet was found at Dun Echt almost exactly in the place given by Mr. Chandler's elements. He has computed an ephemeris, from which we take the following:—

	R.A.			S. Dec.	
Oct. 6	10h.	35m.	22s.	9°	12′
7	10	34	4	9	37
8	10	32	49	10	2
9	10	31	36	10	26
10	10	30	25	10	50
11	10	29	16	11	14
12	10	28	8	11	38
13	10	27	1	12	1
14	10	25	55	12	24
15	10	24	49	12	46
16	10	23	43	13	9
17	10	22	37	13	31
18	10	21	31	13	54

This comet is visible in clear atmospheres with the naked eye about an hour before sunrise, and has been seen in many parts of Europe. It is increasing in brilliancy. Mr. W. F. Denning writes that the comet was seen at Bristol on Oct. 1, 16h. 45m. to 17h. 30m. The nucleus was nearly as bright as a star of the first magnitude, and the tail fully 10° long. A correspondent writes from Helmsley that the tail was plainly visible to the naked eye above the south-east horizon at 5 a.m. the other day.

Dr. J. Palisa, at Vienna, discovered another small planet on the 10th ult. It is No. 231 in the general list, and the thirty-eighth discovered by him.

The death is announced, on the 25th ult., of Dr. D. Van Monckhoven, on his 48th birthday.

We have received the prospectus of the Popular Evening Classes at Anderson's College, Glasgow. The work in connection with the "Young" Chair of Technical Chemistry appears to be well carried out, and is under the care of Prof. E. J. Mills.

Prof. S. P. Thompson, writing to the *Times*, describes the trial trip of the *Electricity*, a launch propelled by a screw actuated by an electro-motor, the current for which was supplied by storage batteries of the Sellon-Volckmar type. The launch is 26ft. long, about 5ft. wide, and draws about 2ft. of water—the propeller being about 22in. in diameter. She carries 45 storage batteries, each about 10in. cube, said to be capable of supplying four horse-power for six hours. The accumulators have an E.M.F. of 96 volts, and during the run the current through each machine was steadily maintained at 24 ampères. According to Prof. S. P. Thompson, the speed was about eight knots an hour against the tide, while the return journey from London Bridge to Millwall was accomplished in 24 minutes.

At the Munich Electrical Exhibition, M. Deprez works a plough by means of electricity, the current being transmitted over a distance of about 40 miles. Some of the power is, however, obtained from the falls of Hirschau, about three miles from the Exhibition.

The Session of the Liverpool Literary and Philosophical Society was opened by the president, Mr. E. Davies, F.C.S., who delivered an address on the "Unity of Life."

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

When, by long boiling, all trace of air has disappeared from water in a steam-boiler, superheating may occur, with the danger of explosion. The galvanic action of plates of zinc in the liquid, giving hydrogen, should theoretically maintain boiling. For this they must at least be carefully cleansed at short intervals. M. Trève thinks further action is necessary in the French navy for prevention of explosions, and he advises the moderate but continuous injection of hot air, or, better, of a non-oxidising gas, such as carbonic acid, at the bottom of the boiler. This secures more rapid vaporisation, better economy of fuel, and greater security. The superheating, which may be conceived as a kind of sleep of the liquid, is rendered impossible by the constant arousing referred to.

In Vienna, some swallows lately built their nest in the mouth of a horse—a bronze horse, indeed, which is in a galloping attitude. It is that of a statue of Archduke Charles, erected in 1860, before the imperial palace. An Alsatian journal states that at Eguichem certain sparrows recently chose a pillar-box for their domicile; others, at Wattwiller, the wheel of a gun; and near Mulhouse, a lark's nest was found under a rail.

We lately referred to a proposal to stir up the silt near the mouth of the Mississippi with a series of moving wheels, so that the current might carry it away. At the mouth of the Columbia River, the channel recently required deepening. A steam collier was moored on the bar, bow up stream, the stern at the lower edge of the bar, and loaded so that the keel touched the bottom. The propeller was set in action, and in eighteen hours' work a channel 1,000ft. long and 100ft. wide was deepened from a maximum of 18ft. to from 22ft. to 24ft. After finishing the channel through that bar, the steamer was to be taken to Walker's Island for a similar work. It may be mentioned that the sand of the bar is very clean and light, and the current of the river runs two miles per hour at ebb, and three at flood tide. Mr. Prescott, manager of the Oregon Railway and Navigation Company, speaks enthusiastically of the success of the experiment, which he regards as having solved the problem of keeping the river clear of obstructions, and at a nominal cost.

At a Bavarian exhibition in Nürnburg lately, there was shown, from Noell's waggon manufactory at Wurzburg, a tram-car which does not require switch and siding on meeting another car. The car is kept on the rails by means of a fifth wheel in front of the others, and catching in a groove between the rails. The guide-wheel is set in a triangular frame on the fore axle, and when the driver raises this the car readily leaves the rails, and may be drawn over the street-pavement in any direction. Such cars have been successfully used in Hamburg and Lisbon. Of course, the leaving the rails involves greater strain for the horses; but this is only temporary, and without serious inconvenience.

Les Mondes indicates as a real progress in perfumery the employment of alumina by M. Bonamy (Paris) in connection with that art. From a medical point of view, pure alumina is the most wholesome and beneficial of the substances that have been used in perfumery. It is not a caustic, like potash and soda, which enter into the composition of toilet soaps; but it is a neutral, unctuous, inalterable substance, sweetening and refreshing the skin. Most medical men in Germany now use it as a medicament. It associates easily with all products of perfumery, communicating to them its virtues. M. Bonamy thus skilfully prepares glycerine, toilet vinegar, dentifrices, lotions, cold cream, pomade, rice-powder, &c.

The Electrical Exhibition at Munich, opened last month, appears to be a product of large enterprise, and presents many attractive features. The building (Crystal Palace) is of oblong, cruciform shape. As in the Paris Exhibition, the steam-motors are all arranged on one side (the southern front of the east wing), and the electric machines in the gallery in front. The theatre occupies the middle of that wing, and the exhibition of paintings that of the other. *La Lumière Electrique* of 9th Sept. gives a view and plan of the palace, with a plan of the town. It is now stated that the power transmitted from a distance will be partly from the Munich Polytechnikum, partly from the Hirschau, 5km. distant; but an attempt will also be made to utilise through a single telegraph wire the power of the Miesbach, 60km. distant. This experiment is expected to prove that the coals of the Upper Bavarian mines, instead of being brought to Munich, may be burnt in place, and their power brought to the town by electricity. *Inter alia*, a chapel in the palace will be lit electrically, and various methods of (electric) lighting of schoolrooms, and rooms in which lithographers, draughtsmen, &c., work, will be exhibited. A loud-speaking telephone, shown for the first time, will enable an entire audience in a hall to hear a concert piece executed in the English café. A telephone will be connected with the telegraph line (100km.) to Oberammergau (for music, not Passion plays). In several separate chambers persons will have an opportunity of hearing the operas of the Royal Court Theatre, the operettas of the theatre in the Gartner Platz, and the concerts in the Colosseum. In the theatre the testing of the regulability of the incandescent light for different parts of the stage (according to Edison's method) will be of special interest. In the agricultural division a complete dairy will be worked electrically, and experiments will be made as to the growth of plants, both in the electric light, and where electric currents are introduced into the layer of humus. The exhibition, it is known, will not be confined to the precincts of the palace; the streets will be experimentally lit; locomotives carrying electric lights will make trips on the railway lines, &c.

Novelties in the construction of tables are the object of an international competition and special exhibition projected by the Lower Austrian Gewerbe-verein in Vienna. Silver and bronze medals are offered for telescopic dining-tables, folding-tables, card-tables, simple tea-tables, writing-tables, toilet-tables, modes of connecting top and legs, &c. Applications must be made before 1st November, and the exhibition will be held in the first quarter of next year.

A remarkable report, recently published, on the material of railways, at the Paris Exhibition of 1878, states that the six great French railway companies required in 1877, for the maintenance and repair of their lines, about 2,563,000 wooden sleepers. This enormous figure represents 93 sleepers per kilometre, and more than 7,000 sleepers *per day*. Supposing that a tree yields, on an average, ten sleepers (this is small for the beech, and too much for the oak), then, from 1877 till now, more than 700 fine trees must have been cut down daily for the maintenance of the French railway system. When the system will be complete, this figure may be expected to have risen to 1,000 trees a day. To this enormous consumption of wood has to be added that required for maintenance of rolling material, which is estimated for 1877 and near years, at about 140,000 cubic metres of wood on an average, *per annum*. Lastly, it may be expected, that in 10 or 15 years from 1877, the construction of 20,000 kilometres of new lines will require the supply of about 20 million new sleepers. Thus, the reporter has reason for assuming that railways must be regarded as the largest consumers of the wood of a country. The importance attaching to the question of metallic sleepers is proved by the above figures.

One of the most recent novelties on railways is a dancing-car. This was lately arranged on the Chicago, Milwaukee, and St. Paul Railway, for a company of St. Louis excursionists, who engaged in the dance, even when the train was running 40 miles an hour. This ball-car was a spacious luggage-van, 60ft. long and 15ft. broad. The floor was carpeted, the sides elegantly painted, and decorated with pictures, banners and garlands. The orchestra was composed of eight performers, and refreshments were handed round every hour.

With the current of a Holtz machine, Signor Govi has recently been able to decompose water, getting, in three minutes, 1cc. of explosive mixture, to set a Froment siren in vibration, produce magnetic spectra, get bright sparks by interrupting the current with a steel file, generate an arc between two small carbons, and work a Ruhmkorff coil and Geissler tube.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

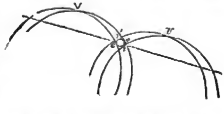
⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

◆

ERRATA—ε ARIETIS—LUNAR CYCLES—THE DISTANCE OF THE SUN DEDUCED FROM OBSERVATIONS OF MARS IN OPPOSITION—FERGUSON'S TABLES OF THE MOON—THE ENDOWMENT OF RESEARCH AT THE SOCIAL SCIENCE CONGRESS.—A TALE OF A COMET—COSMICAL RISING OF LYRA—HERSCHEL'S "OUTLINES OF ASTRONOMY"—EQUATION OF EQUAL ALTITUDES—LEGENDARY ASTRONOMY.

[20590.]—I AM sorry to find that your engraver, by the omission of four small letters in the upper part of Fig. 5 (p. 49) has rendered the context quite unintelligible. May I, then, ask for the reproduction of the erroneous portion of that figure here, and beg my readers to insert the missing letters from it in the original diagram? I may further add that the same engraver would appear to have evolved an inverted Λ from the depths of his moral consciousness to the right of the ε, which appears at the right hand bottom part of the figure. Assuredly this was not in my original sketch.



For another slip I fear that I am myself responsible, as I seem to have written "seven" minutes on line 43 of column 1, p. 60, when I meant six. As a matter of fact, the duration of total phase of the 1868 eclipse, at the most easterly point of the Indian continent, where it was central, was about 5m. 50s.

In reply to "J. H. H." (letter 20541, p. 66), it would appear that recent measures of ε Arietis tend to show that the components of that star are closing rather than separating. In 1876·09 Doberck found their distance to be 1·52″. A year afterwards Schiaparelli made it 1·17″, while Mr. Seabroke, at Rugby, in 1880·05, measured it as 1·14″; in 1880·06, 0·97″; and in 1880·07, 1·09″. That this, however, is by no means an easy star to measure is, I think, shown by the curiously discrepant results arrived at by the long string of observers quoted in Crossley, Gledhill, and Wilson's classical "Handbook." As I can myself just divide it at present, at moments of the finest vision, with a 4¼in. object-glass, I suspect that the distance might be represented at this moment as 1·1″ without much chance of error, either in defect or excess.

Apart from the fact that our Editor would most assuredly refuse, point blank, to fill several columns of the ENGLISH MECHANIC with the mere dates of New and Full Moons for 19 years! the Metonic Cycle of which "Bex" speaks in query 48011, p. 74, would be of no use to him or anybody else in the prediction of eclipses. It is employed for the purpose of fixing the Ecclesiastical Easter, and in such use supplies an instructive illustration of the manner in which a physical phenomenon has been perverted for the perpetuation of a piece of monkish foolery. The fact is that "Bex" (like a good many other people before him), is confusing the Metonic Cycle with the Saros, by the aid of which eclipses really can be predicted. This was discovered by the Chaldæans, and may be thus explained: 223 Lunations = 6585·324 days, *i.e.*, 18 years + 10 (or 11, according to leap-year) days, 7h. 41m. Eclipses, of course, only occur when the

Moon is in, or near, one of her Nodes, and as (from the motion of the Node itself) a *nodical* month, or interval of the Moon's return to the same Node is 27·212 days, while the average time from one New Moon to the next is 29·531 days, it will be seen that 242 nodical months will only exceed 223 lunations by about three-quarters of an hour. Thus, at the end of this period, the Sun, the Moon, and the Lunar Nodes will all return nearly to the same position; so that Eclipses will recur in the same order and magnitude, but not at the same time of day (on account of the odd 7h. 41m.). So that an eclipse, visible, say, at Greenwich 18 years ago, may not be visible there this year, from its happening at a different hour. A period of 669 Lunations supplies us with an even more accurate Saros still.

It is not very easy to explain to "Orion" (query 48040, p. 75) how Mr. Gill made his observations at Ascension, without the aid of illustrations; but I will do my best to make the matter intelligible. Mars being, during his opposition of 1877, very near to the earth, would of course be considerably displaced in the sky, by being viewed from two stations at, say, the opposite extremities of the earth's diameter. Thus, referring to Fig. 2 in my paper on "The Coming Transit of Venus" on p. 1, we may call V Mars, and V′ and S, two fixed stars, at a (practically) infinite distance. Then while an observer at W would see Mars covering the star V′, another one at E would see the planet superposed on S; and the measure of the angle E V W = V′ V S, combined with a knowledge of the distance E W, would enable us to determine at once the lengths of E V or W V. A little consideration will, however, show that if the man at W will only stand still, the mere rotation of the earth will in time bring him to E., and affect the requisite displacement of Mars in the sky. Of course both the earth and Mars will move in the interval, but the effects of their motion is so accurately calculable that we may consider for our present purpose that we have only to deal with the earth's axial rotation, and to determine the amount of that. What Mr. Gill did, then, was to measure, by the aid of a heliometer, the distance of Mars, soon after he had risen in the East, from certain well determined neighbouring stars; and to repeat this observation as the planet was approaching the western horizon. His mass of observations has been most elaborately reduced and discussed, with the result that he determines the Solar parallax to be 8·78″, as against the value 8·85″ obtained from the observations of the transit of Venus in 1874.

I am, I am sorry to say, ignorant of Ferguson's table for calculating New and Full Moons, to which "Virgo" refers in query 48061 (p. 75). I do not possess Ferguson's book, nor have I access to it at the place where I write. "Virgo" can, however, easily satisfy himself (or herself), as to the trustworthiness of these tables, by computing from them the times of New or Full Moon for any selected month in the present year, and comparing the results with those given in your Monthly "Astronomical Notes." I must, in fairness add, that the Lunar Theory has been very greatly improved indeed since Ferguson's time; and that I should hence expect, a priori, that his figures would require correction. Certainly those would for the minor corrections, if he gives such; of which though, I am, of course, ignorant. I know of no modern tables of the same kind as Ferguson's must (almost certainly) be.

If I may be pardoned for the employment of a not over-refined colloquialism, a certain Mr. Rowland Hamilton would seem rather to have "put his foot in it," in connection with the Endowment of Research, at the Social Science Congress at Nottingham on the 22nd ult. His flaming paper, in which he gravely propounded the dogma that "As regarded the endowment of the more special forms of research, as more commonly understood. . . there was hardly any limit which it was desirable to assign to it," &c., was very summarily dealt with, indeed, by those who succeeded him. Certainly, the weighty words of the Rev. J. F. MacCaltan, one of the Honorary Local Secretaries, and of Mr. Walter Wren, the famous Civil Service "Coach," deserve all the prominence that reiteration can give them. Mr. MacCaltan "held that discovery was promoted, not by endowment but by enthusiasm," and that "endowment would give rise to jealousy, and would not comport with the feelings of scientific men." Mr. Wren said that "What they wanted was reward for something done, and not payment for something yet to be done. This agitation was a new form of alms-begging or charity-hunting, and endowment would simply open the door to jobbery on the most gigantic scale." Truly, the impartial outsider has only to study the list of Scientific cadgers and Micawbers of Science, who are alone clamouring for "the Endowment of Research," to be at once convinced that Messrs. MacCallan and Wren simply spoke the bald and literal truth in the remarks they made at the conclusion of Mr. Hamilton's foolish paper. (This was, of course, written before I saw your own remarks on the same subject on p. 87.)

Concurrently with "C. P. S.'s" marvellous letter to the *Scotsman*, to which you refer in your "Scientific News," on p. 87, comes an intimation (in that equally marvellous specimen of journalism, *British Israel*) that "the next expressly God-appointed date marked upon the Great Pyramid was August and September, 1882." Well, August has passed and September has practically ended (I am writing these lines on Michaelmas-day), and nothing has happened yet. I am afraid that the Anglo-Israelites will decline to accept the Comet as a fulfilment of this particular portion of their sermon in stone, even should it produce those terrific results dimly adumbrated by the Arch-Pyramidalist himself. Possibly, though, we shall find (not for the first time) that either the Pyramid or its interpreters are not absolutely infallible. Besides, if nothing does happen it *ought* to have happened—which answers all the purpose.

Writing this away from home, I cannot go into any detail with reference to query 48074 (p. 98); but I may just say that the nodes of the Equator must have travelled between 26° and 27° backwards on the Ecliptic since the time that Ovid wrote. Of course, this shifts the place of the Celestial Equator upon the sphere of Stars, so that the Sun would be in a different constellation at present at any given season to that which he occupied at the beginning of the Christian era.

"O. L." may read Colenso's "Arithmetic," the first four and the sixth book of Euclid, Hunter's little book on "Plane Trigonometry" in Gleig's School Series, and then Todhunter, both on Plane and Spherical Trigonometry, and Ganot's "Physics," for his mechanics and optics. He will then be fairly furnished for an attack upon Sir John Herschel's admirable book. He will, however, find some portions of it beyond him, after the acquisition of this preliminary knowledge; but its acquirement will teach him in what direction to look for further information. Drew's "Astronomy," if it be still in print, forms a pleasant introduction to the "Outlines"; but even this presuppose the possession of some rudimentary mathematics.

As I have just said above, I am writing this away from home, and have not my XXXIInd volume of the English Mechanic he refers to; but the formulæ given in query 48095, p. 98, by "Roi ne puis, Souza je suis," looks like Gauss's, which I do not use myself. Of course, "½-interval" means ½-interval in arc. To find the cosec of 1h. 11m. might well puzzle the incipient user of trigonometrical tables; but the cosec of its equivalent, 17° 45′, is found at once to be 0·5158934. Time is invariably reduced to arc by multiplying by 15. Thus 1 hour = 15°, 1m. = 15′, 1 sec. = 15″, and so on. The $\frac{\text{interval}}{\text{48 hours}}$ is, of course, a decimal to be obtained by performing the division indicated. In this case, obviously both divisor and dividend must be of the same denomination: so we may leave them both in time, there being no object in turning them into arc for this purpose.

"Spica" (query 48144, p. 99) will find a large amount of information on the subject of legendary astronomy in Blake's "Astronomical Myths," published by Macmillan.

A Fellow of the Royal Astronomical Society.

ASTRONOMICAL.

[20591.]—I am glad to see that "F.R.C.S." (letter 20542, No. 913, p. 66 of the English Mechanic), has found, as myself, that μ^2 Boötis has been, during the last season, a much easier object than η Coronæ. Would he kindly say what he has been able to do with this last object, using his full aperture? I am sorry I have no sketch of the star near the annular nebula in Lyra. When the moon is no longer an obstacle to looking for faint stars, I will try what I can do; but, unfortunately, at present, my silver is old, and cannot give that fulness of light the mirror is capable of.

My best thanks to T. E. Espin for his prompt answer (letter 20543): I will look at those stars again. The very evening I sent my last letter I found a beautiful close double, well-worth looking at. It is not in the various lists of doubles given by Gledhill, nor in Webb's, and it is not marked in Proctor's small atlas. Its position, as given by my circles, is 20h 35m. + 40° 6′, mag. 6, 5 and 7 — P. 200° — D. 0·7″ + bright yellow. It is situated between γ and ν Cygni, nearer γ. It is surprising that so beautiful an object has not found its place in "Celestial Objects." Last night I looked at two stars of the new list of doubles given by Perry. β 139 was found not difficult; but I found λ Cygni not easy at all. It is true the air was fluttering a good deal at the time. **C. Gaudibert.**

CRULS' COMET.

[20592.]—The suggestion made by Prof. Lewis Boss that the comet of M. Cruls is the comet of 1843 and 1880 is quite possible — perhaps probable; although one might have expected the period to have been about fifteen years rather than two years. The statement has indeed come from a quarter prone to sensational utterances (I am in no respect alluding to America). The comets of 1843 and 1880 were retrograde, but the motion of Cruls' comet, if the same as that seen by Mr. Common, September 17th, was direct. This, however, was geocentric motion, and the heliocentric might be retrograde if it were moving to perihelion on the 12th.

It is not easy to say how the comet observed by M. Cruls came to be supposed to be Pons' comet of 1812, for that comet has an inclination to the ecliptic of about 73°, and its descending node has about 72° of longitude, so that it would be, as seen from the earth, 30° or 40° to the south of the position in which it was seen on Sept. 11—12 by M. Cruls. It would have been a very interesting event if the comet had been that of Pons.

As regards the entry of a comet into the sun, I do not think it would produce any material result noticeable by us.

Various hypotheses have been put forth to account for that portion of a comet's light which is not reflected solar light. Prof. Tait's is, as I have before observed, to me the most reasonable. A modification of it is, however, possible, perhaps, which may be worth mentioning. The collision, if not sufficient to produce incandescence visible from the earth, might be sufficient to expel considerable portions of the occluded carbo-hydrogens or other gases; so that the superior layers of the nucleus and the coma in totality would consist of the expelled gases and a spray of dust-like solid fragments, the result of innumerable collisions. These fragments would be in general moving, roughly speaking, with considerable velocities in ellipses having the nucleus-centre as the centre or focus of the ellipse, according to their position.

Why, then, may not these fragments become incandescent through friction with the expelled gases, just as meteors become so in the upper regions of the earth's atmosphere, where the medium is almost a vacuum. Whether, also, the friction of solid fragments moving with a great velocity in a gas would produce on the surface of such fragments electric charges of sensible potential I am unable to say. If it does, the charges might be expected to be all of the same name, but yet of very different potentials. Consequently, two continuous fragments would occasion a mutual discharge. An immense number of these discharges would be constantly taking place, which, in their totality, might be visible to us as a continuous light whose bright lines would be those of the medium. The result of all these collisions would, of course, be a subsidence and absorption of the coma into the nucleus, so that the bright lines would tend to become fainter with age, were it not that the fragments of the meteor-train are continually overtaking the comet at its inner surface and being overtaken at its outer surface, and so keep up the supply of energy.

W. C. E.

DYNAMICAL PROBLEM—"A. S. L.'s" PARADOX, &c.

[20593.]—I have read "B. A.'s" letters and investigations with much interest, as treating my paradox in a somewhat different way from the way I looked at it myself, and as the subject has also called forth letters from two other correspondents, I may as well recur to it.

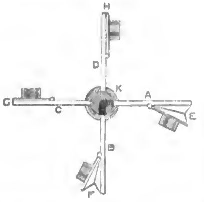
Probably "G. B. T." has never seen the curious "balance paradox" in which the two weights can be shifted further or nearer the points of support of the beams (there are two) without disturbing the equilibrium; if not, I will send a sketch. It is in one respect analogous to mine, as the strain is passed through a fixed point in the beam, corresponding to the axis of the pulley in my diagram.

"B. A." has answered this correspondent and "Scotch Working Mechanic" so clearly, that I need not add to his remarks. I think, however, "B. A." may like to know how the paradox came to suggest itself to me, as it was itself the outcome of something else.

A B C D are four tubes fixed in the ring K, which ring revolves on the central fixed boss L. This boss has a curved passage through it, so that, in the position shown, the tubes A and B are placed in communication with each other, while C and D are cut off.

At the outer end of each tube is a small pair of bellows, the movable board of which is loaded with a certain weight. Now suppose the bellows F to be full of water, then the bellows at E will open (being caused to do so by the weight attached), and in opening will suck up the water out of F, being assisted in so doing by the weight on F tending to close the latter.

E being thus filled will descend and take the place of F, while H will arrive (closed) at the place of E, and the action will be repeated and the whole system will revolve continuously. But this becomes perpetual motion, and is, therefore, absurd. Where, then, is the fallacy? It lies in assuming that the weight attached to the bellows E can balance two things at once—viz., the water that is being sucked up from F to E, and the weight attached to the opposite bellows G. Supposing such an apparatus constructed, the action would commence as described, but as soon as the water began to be drawn up from F to E a certain proportion of the weight on E would be neutralised as regards its counterposing action to the opposite weight on the bellows, G, and the system would find for itself a position of equilibrium depending on the relative weight of the water as compared to the weights attached to the bellows. Just in the same way, then, that the weight on E can't do the work of raising the water, and at the same time acting as a counterpoise to its opposite weight G, so in my balanced-lever paradox, the descending weight can't do the work of lifting the companion weight, and at the same time balancing the weight at the opposite end of the lever. Irrespective of any questions of string tension, &c., this forms, I think, the simplest way of looking at it, though wanting in the demonstrative accuracy of "B. A.'s" investigation. **A. S. L.**



DYNAMICAL PROBLEM.

[20594.]—I did not regard the question of the pulley and beam (letter 20470, p. 13) as purely dynamical, but as a question distinct from the original dynamical problem, and as the practical results of an experiment made by "A. S. L." in attempting to solve the problem of perpetual motion, while the results I arrived at in my former letter (20510, p. 39) were those to be deduced from the condition of things there expressed—i.e., after the motion of the unequal weights had subsided in a statical suspension. The original tension of the string would then, of course, be resumed, with this important difference—viz., that the centre of gravity of the pulley would be shifted from its axis to a point nearer to its outer-rim; and hence that increase of the leverage of the D end of the beam that I spoke of. When the unequal weights are in motion, the question fundamentally differs, for the superadded weight is practically dissevered from the string in its passage towards the ground, and the tension of the string being proportionally less, the D end of the beam ascends, and, by consequence, the end C weighs down. In this respect "A. S. L." and "B. A., Cantab" (letters 20558, 20559, p. 68) are undoubtedly correct.

G. B. T.

BOOT AND SHOEMAKING.—I.

[20595.]—Having given the general outline of tools wanted (see reply 47727), there is one you may require if you are going to get up your own uppers, that is a clams. You can make this of two battens of any wood 2½in. wide, or 3in. perhaps would be better, 3ft. long and ½in. thick; at the one end of these glue and screw from the outside a little fillet of hard wood, such as birch, beech, or mahogany, letting it project over the end a quarter of an inch, a piece 1in. wide and ½in. thick. When this is done, stand these two ends fillet to fillet uppermost, and thus form the mouth of clams; screw the tail ends together; the top parts and side fillets should be chamfered off from the outside. This will furnish you with a vice or clams to hold your uppers in, to stab or close, stab or stitch lace hole linings in or side-springs and counters, and around the tops. Now the question is, do you want a fashionable boot or shoe, or one for comfort? I think I hear most of you say comfort. Well, then, to proceed. Some of you have a washing-day, and know what a blue-bag means; if not, get at the grocer's or oil-shop a ball of stone-blue; tie it up in a flannel, and soak it in water until soft; take it out and squeeze it, and wherever you dab it it will leave a mark. Well, being thus armed, strip your foot and place a piece of sugar-paper upon the ground. Now turn your foot-sole up and dab it with the blue-bag pretty wet, and transfer your foot to the sugar-paper, and you will have a print resembling Fig. 1, with the exception of the line. This you must put around it to the best of your judgment, which is no very difficult matter. Fig. 2 is an ordinary block men's last. Please fancy a foot, as it will spare me another illustration; and I might not be good at understandings, &c., &c., you know—and I might have cause to blush. Now, to take measurement, you will require a size-stick—cost 1s. Take the length from heel to toe easy; compare that with the length given upon paper. Note.—I have given the left foot because the majority of the *genus homo* have left foot largest; and if you measure the right foot you are very likely to make a misfit. *It is a fact.* Having taken the length—not less than two sizes longer should be allowed for the last, but this should be full rather than bare—that is, from A to B; now take an inch tape, and measure around the joint C and D. Mark that down in your pocket-book, so as to refer to. The same E F instep; the same G H for heel, and instep and I J. This completes the measurement, unless for wellingtons or ladies' knickerbockers, when—well, then, you proceed to where you want them to reach; but in wellingtons it is rarely that the top exceeds the measurement round heel. I have seen instances where it has, but very rare. With these dimensions, and the paper pattern cut out, go to a last-maker's or leather-cutter's, and get a pair of lasts—cost from 2s. to 2s. 6d. Let your principal study be the shape and tread of bottom and length. The other can be reduced with a rasp if too large; if too thin, can be best made up with instep leathers. As the generality of lasts will run long, according to the tread you require, you can cut a piece off the toe, and get what you require. In some shops you will run against some old shop-keepers that they will be glad to get shut of—called, in some instances, full last or old comfortables, &c. Get these two sizes longer than the foot measure; or if too long, shorten to that bare, and make up with a stout heel-pin; the advantage of this is in repairs. Make up with the heel-pin on, and if this is taken off you can use the same last for repairs with safety, or otherwise you cannot get the same last in without tearing your old comfortables all to pieces, and it does not mar the last for making. Now, I like a strip of cartridge paper for measure—i.e., old style, and will give you a sketch how to proceed when you have your last.

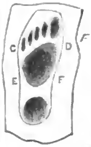


FIG. 2

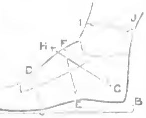
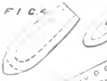


FIG. 1

FIG. 4



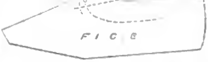


FIG. 6

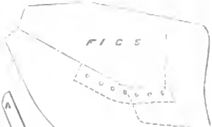


FIG. 5

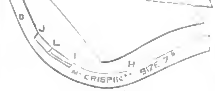


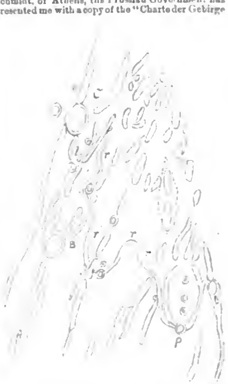
FIG. 3

Draw a line with ink down the centre of instep to centre of toe, and centre of sole to heel. Now take a strip of cartridge paper; if you have to take the measurement of the foot for upper, see Fig. 3, cut the end as at A; this is the gauge-point end. Pass over and around the joints of foot, and at the junction snip a little and turn down, see J. Take the same for instep, tear and turn down, see I, take the same at heel, tear and turn down, take the leg or ankle, tear and turn down. Having done so, double your paper to those respective notches, and test your last from centre of top to sole, and see what you require upon last to fit up to the size required. Instep leathers can be purchased for that purpose, but if not comeatable, proceed to make them as follows. Get some hard shanks of crop, four pieces about the size of your hand, and well wet them, and stretch them well with the pincers, and tap them lightly with the hammer upon the lap iron upon the flesh side; lay them out flat upon a board, and cut them out about the shape of Fig. 4, and skive the edges thin all round. With the exception of the square end, as shown by dotted lines, for shape, and thickness, and length, you must use your own judgment until you have got packing enough to measure full to measurement; when you have, put a tack in just below the block in front to hold them there while you take measurement for the cutting out your uppers. Now for the first patterns. I will give you those that require least trouble and least work; nevertheless, the most durable and comfortable, and, therefore, will amply repay for any other drawback, if there is any. I designed them and made them some forty years ago, and would wear nothing else if I could make them now. I have a pair as slippers, same as Fig. 6, that have been kicking about this eleven years, the last pair I ever attempted to make, when I met with an accident which spoilt my shoemaking. There are no seams to interfere with pet corns or bunions; old ladies liked them made of lasting and sealskin, or Cordovan, and old gents of Pannus corium, buckskin, and seal, as well as French calf, which is next to buckskin for wear. Sealskin I have not seen in the market for years the same as I used to get it, but Pannus corium I see is still advertised. Fig. 5 is an ankle or half-boot, more generally known as Balmorals, or lace-ups. Fig. 6 as low shoe ties, but more properly speaking Oxonians, and, I believe, as nice a shoe as can be worn, more especially in summer or indoors, as slippers, to my fancy, for outdoor amusements upon lawn, &c., &c.

Jack of All Trades.

SELENOGRAPHICAL.

[20596.]—Through the kindness of Dr. J. Schmidt, of Athens, the Prussian Government has presented me with a copy of the "Charte der Gebirge des Mondes" with the Text-book, by that celebrated selenographer. I am, therefore, able to send you an outline of a region between Aristarchus and Marius, where on May 10, 1862, Schmidt found a serpentine rill, not seen, I believe, by any other observer until the present time. On Sept. 23, 1882, at 9.30 p.m., I saw it myself for the first time, and can, therefore, confirm the existence of this difficult object. I found the portion running east of



craters C and B much more easy than the rest of the rill running north-east towards *p*. The air was fluttering a good deal at the time. I believe this object would be comparatively easy if the moon was high and the air good. **C. Gaudibert.**

VEGETARIANISM.

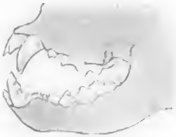
[20597.]—Your vegetarian readers may perhaps be interested by the following facts respecting man's adaptation for vegetable diet:—

Man belongs to that class which is termed by naturalists *gregarious*, and like all other animals of that kind is naturally frugivorous. Nor does this assumption rest on the analogy observable between man and other gregarious species alone, for it is supported by the construction of his nutritive organs. Carnivorous species possess teeth peculiarly formed for the tearing and masticating of flesh food. The canine teeth are sharp, largely developed, and curved; as are also the incisors. The molars, or rather the teeth which take the place of molars, are edged and sharp, and close side by side like a pair of shears, or scissors. Thus we see that this dentile apparatus is well adapted to tearing and cutting the flesh before it passes into the stomach.

On the other hand, the teeth of frugivorous animals consist of incisors and molars. It is true that the canine teeth exist; but they are not sufficiently developed to distinguish them from incisors, as in the carnivorous species. The molars are nearly flat at the end, and come into direct contact like two milling-stones, and are caused, by a small lateral motion, to grind the food that passes between them. It will be seen that this operation is all that is required for the mastication of vegetable, but not animal food.

A drawing of the jaw of the carnivorous species is given herewith.

Anyone will discover that the last description of dentile apparatus is synonymous with the human teeth. As far as they are a guide to man's proper food, no other conclusion should be arrived at than that they are intended for the mastication of vegetable food, and that man should be frugivorous.



This evidence is not alone; for if we examine the digestive apparatus, we find there similar evidence: or, I should say, evidence supporting the same end. In the carnivorous species the intestine is only about three or four times the length of the body, through which the food passes; but in the herbivorous classes it is not unfrequently ten or twelve times the length of the body. In the sheep the intestine is actually 28 times the length of the body! Thus we see that the human intestine, like the teeth, is suited to vegetable aliment, seeing that it has a length in proportion to the body corresponding with other frugivorous species. How then is it that man is omnivorous? The answer is evident. We cannot eat animal food unless it is cooked; and even then it is not his natural, or would appear not to be his natural, food. According to the Divine Book the early inhabitants of the world ate of the fruits of the earth only, and not of the flesh until God issued the fiat, "Every moving thing that liveth shall be meat for you." Man, however, appears to have been created as a vegetarian. The fiat was accompanied by an order to bleed the animal; but nothing is said about the cooking, and no one can repudiate the greater applicability of our organs to vegetable food. Of course, it must be assumed that our forerunners discovered at once that the food must be cooked to be efficacious and digestible! **H. Stooke.**

GRINDING AND POLISHING GLASS SPECULA.

[20598.]—The machine that I am about to describe is constructed to make specula up to 12in. diameter, which is, I presume, the limit of most amateur's ideas. I have attempted to make it as simply as possible, and out of materials that amateurs can easily get. I have not sought elaborate finish; but great carefulness in all the important parts, and to the importance of this I would direct the attention of the amateur in his making of the machine. Fig. 1 is intended to show the general construction of the machine, with a 6in. speculum on it, the making of which I shall describe as an example of how specula are worked. The foundation of the machine is a piece of 11 by 3in. plank 3ft. long, A A; it need not even be planed; it is supported on four legs, B B B B, each pair being crossed and screwed together at their crossings to steady them sideways; and to steady them lengthways there are four laths, 1in. by ½in., such as slates are put on the roofs of houses with; each lath extends from the lower end of one leg to the upper end of the opposite leg; the laths are screwed together where they cross. Altogether this forms a most steady bench 25in. from the ground to its top; but this is intended for a tall stool 22in. high, to be used to sit on when working; if the amateur wishes to use a chair, let him make the top of the bench as much lower than 25in. as his chair is lower than 22in., and it will then be a convenient

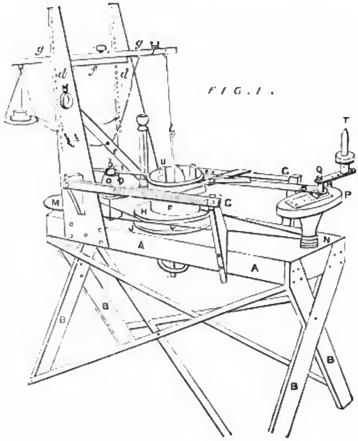


FIG. 1.

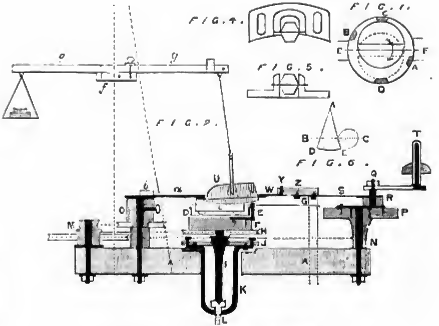


FIG. 4.

FIG. 1.

FIG. 5.

FIG. 2.

FIG. 6.

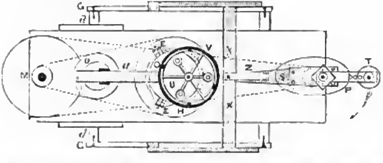


FIG. 3.

height. The stool is best placed in front of the machine in a line with G S G, Fig. 3. Fig. 2 is a section to scale of the plank and the working parts of the machine, in a line passing through the centre of the plank; the dotted lines represent the parts behind this line, so as to give a better idea to the amateur of the whole. Fig. 3 is a ground-plan of the plank and the working parts of it; it is with Fig. 2 on the scale of 1in. for a foot, and the same letters refer to the same parts in all three figures. The speculum C is supported on a system of triangles and levers, which I shall describe fully hereafter, and in a circular trough, D, which just slips inside the three angle pieces E E E, which will be understood by reference to Vol. XXXIV., p. 67, and I may add the horizontal part of these three angle-pieces are let flush into, and screwed to the block F, which may be of any shape, so that it is thick enough to raise the face of the speculum to within ⅜in. of the top of the guide-bars G G, seen in dotted lines in Fig. 2; this block, F, allows space to accommodate any thickness of speculum up 12in. diameter. The height from the top of the plank A A to the top of the guide-bars is 6¼in. in my machine. These guide-bars are in my machine simply laths 1in. by ⅝in., planed; perhaps a little stronger would be better for larger specula. The tops of the angle-pieces E E are ⅛ below the top of the speculum, so as just to allow the polisher to miss them; the three screws that tighten the string that holds the speculum in its place are a little over ⅛in. diameter, the three nuts that push them outwards are about ½in. diameter, and round, they are turned so as to force out the screws by a pair of pliers, the holes in the tops of the angle pieces E E E are as high as they can be without carrying the edges of the nuts above the tops of the angle-pieces, which are made out of ¾in. by ⅛in. iron; their horizontal parts extend to within about 1in. of the centre of the block F; the inside of the perpendicular part of these angle-pieces are about ¼in. from the outside of the speculum. The trough D is of sheet-zinc, and is as large as the inside of the angle-pieces E E will allow, and in height so as just to come under the three screws that tighten the string that holds the speculum in position; the trough has a piece of 1in. broad tape wrapped round it, and sewed together at its ends. The necessity for the trough and tape I shall explain further on. Their use is to contain water and expose a large evaporating surface, so that the under side of the speculum may be kept at the same, or as nearly as possible the same, temperature as the wet top of the speculum. I have now got as far down as the block F, which is screwed on to the face-plate H, which is, in my machine, of iron, ⅜in. thick and 10½in. diameter; a groove is turned in its edge, and it is tapped in the centre to receive the ⅝in. screw of the mandrel I. This face-plate may be of hard wood, provided it is well, i.e., tightly, screwed on to the mandrel I; of course, if of wood, it ought to be from 1in. to 1¼in. thick. The mandrel is taper, as shown, where it fits into the foundation-plate J, which has a taper hole turned in it to fit the taper of the mandrel I; this may be ground in with a little emery, though no great amount of work need be bestowed upon it, as the motion is very slow. This plate, J, is iron in my machine, but may be of hard wood, 1in. thick, with a piece of iron let in to receive the taper hole; a taper hole in the hard wood, extending about ⅜in. from its top, would do very well. Of course, an inch-thick would take up more room than ⅜in. iron, but the guide-bars could be put 1in. higher to allow for the extra ⅝in. of the wood face-plate H, and the extra ⅝in. in the wood-plate J. To the underside of J is screwed the bracket K, which has a ⅜in. screw L, tightly fitting into it. The head of this screw is countersunk, to receive the pointed end of the mandrel I; by raising this screw L, or lowering it, the taper part of the mandrel can be made to fit without shake, and yet move easily in the taper hole in the plate J; this makes a good fit, and allows the shake from the wear to be taken out instantly, and all is made without any great skill in fitting. There is, of course, a hole cut in the plank to let K through, which rests against the left-hand end of the hole; since the gut, which passes round H is always pulling to the left; the plank is cut away on its face, as shown, to receive the ends of the bracket K, so as to allow the plate J to rest on the upper surface of the plank; there are three screws (two only are seen) passing through J near its edge, and equidistant from one another, whose points press on the plank, and enable it to be raised, so as to be adjusted to the exact height, and to be thrown level; the weight of the whole is sufficient to keep all in place. The width of the hole in the plank is such as to allow the speculum to be put full ½in. on one side of the centre of the polisher for experimenting. The gut from the face-plate H passes round a small pulley near M, which has attached to it the grooved wheel M, both of which are of wood; the gut from this wheel M passes round the pulley N, where there are several grooves turned to form pulleys different heights, so as to allow the gut to go between the plates H and J; N is a hollow piece of wood with a brass tube cemented into it in this way. I bored the hole in N, so as just to receive the tube (which is ⅜in. internal diameter). I then put some bits of shellac into the hole, and melted it round the sides with a ⅜in. round iron heated, but not too hot, so as to burn the shellac. I then put the tube on the hot iron, and rubbed it all over with shellac, and then inserted it into the hole in N, and forced it in place, the hot iron keeping all hot. I had, of course, to heat the iron several times. I think I used two pieces of iron—one to heat while the other was in use. The end of the brass tube is plugged up lightly, so as to prevent the shellac getting into it during the insertion. I allowed all to cool, and then turned the iron shaft that it had to revolve on, being careful to make it smooth and a good—i.e., rather tight—fit: it will wear all right. I then turned the wood, N, on it. This was the way I made M and O also: though I really believe both M and O would do without the brass tube, if they had smooth and parallel holes in the wood. On the top of N is glued a piece of wood, P. I made it oval to try an experiment; but any shape will do. It is simply to carry a flat piece of 1½in. by ⅜in. iron, about 6in. long, screwed on its face. This iron is to carry the turned upright pin, Q, which has a piece of brass tube fitting it. To the lower half of this tube a large—i.e., 1¼in. in square—nut is soft-soldered by first being turned out to fit the outside of the tube, and then the nut and the tube, after being filed bright, heated, and with soldering solution and soft solder (half-lead and half-tin) soldered together. On the top of the two opposite corners of this nut are put two 3-16in. pins, about ¼in. projecting, and over these fit the two holes in the end of the connecting rod S, so that the nut is kept from turning round, as the handle T makes the whole from Q to N revolve. This handle turns on the upright pin shown, and has a projecting ring put on to it for the hand to rest on while turning it. The bar to which the handle pin is screwed has several tapped holes to allow the handle pin to be put at any distance from the centre of N, for a 6in. speculum—5¾in. I find to be the best. The direction the handle is turned in is shown by the arrow in Fig. 3. The piece on which R rests is screwed by a series of holes to any distance from the centre of N, and so any length of straight stroke can be given to the speculum. The polisher U is moved by a ring V, which is about ⅛in. thick and about ½in. wide; it need not be turned, but is about ⅛in. larger in internal diameter than the outside of the polisher. It has a piece of iron, W, ⅛in. thick screwed or riveted on to its upper side; this W has a stud on its under side going into the cross-piece X X by a hole that just fits it, and allows the ring to move from side to side on it as a centre, and thus the side motion is provided for. On the upper part of the piece W is screwed or riveted a slightly taper pin, Y, about ⅝in. long, and ⅜ or a little more in diameter; on this taper pin fits the taper hole in the piece, Z, which is ½in. square, and screwed to S by two screws (seen on each side of the letter G in Fig. 2), through long slotted holes in S, so as to allow the distance between the centre of the ring and the crank-pin, Q, to be varied for experimenting, so that the polisher can be carried further over the edge of the speculum on one side than on the other, if needed. The other side of the ring has a piece, *a*, riveted or screwed to its upper side; this slides in a piece of hoop-iron, *b*, that is bent up at each end about ½in., and made just to fit it. This piece of bent up hoop-iron has a hole in its centre, countersunk so that it will take the head of a wood screw flush; this wood screw is screwed into the top of O, which has a number of holes at different distances from its centre to receive the screw, which is just screwed down tight enough to allow the piece *b* to turn without shake; thus, as O turns round, being driven by the gut from M, on the wheel at the bottom of O, the piece, *b*, is carried from side to side, which carries the hoop-iron, and with it the ring, V, from side to side; thus the side motion is obtained. I have something to say in the future as to the side motion, in the way of denouncing its indiscriminate use as a cure for rings, &c., on the face of the speculum, which rings, &c., ought to be dealt with at their source, and not when they have produced their evil effects;—but this, when I treat of the theory and the practical working of the specula. In O is a screw (shown in Fig. 2), to clamp it in any place when the side-motion is not being used, and the gut from M taken off from the wheel below O. At the bottom of the hole in which this clamping-screw works, is a piece of brass wire about ¼in. long, flat at the end against the upright centre pin, and countersunk with the point of a drill at the other end; this is to receive the point of the wood screw; thus the centre pin on which O revolves is not damaged when O is clamped by the screw. This fly-screw is made out of a wood screw, with a bit of tin-plate, 1in. square, doubled, and its edges put into the nick of the screw, which was intended for the screwdriver when the screw is used in the ordinary way, the tin is soldered into the nick, the corners rounded off, and thus a very useful fly-screw for wood is made that answers every purpose. I am indebted to, and wish here to publicly thank an old correspondent "A. J. S.," for this good idea. I saw it in the stand of his "Sterling Silver Newtonian Reflector," in which he ingeniously and largely uses it. I utilise this handy contrivance in four other places in the machine. The cross piece XX is bent down at the ends, and screwed to the two slide-pieces *c c*, that slide outside the guide-bars G G; at the ends of *c c*, are screwed to their top two pieces of sheet iron, and extending over the guide-bars to keep *c c* from falling below the top of the guide-bars, and at each end on their inside are glued pieces of wood about ⅛in. thick, and about 1in. long, so as to allow the turn-down ends of the cross-piece X X to clear the outside of the guide-bars G G. The small space thus formed between the guide-bars and the sliding bars is too small to be represented to scale in Fig. 3 it must be understood. Before leaving the working parts, I may add that under M, O, and N are washers made of ⅛in. thick iron, on which the shoulders of the upright turned shafts or pins rest, and are clamped by the nuts and washers seen under the plank A A, Fig. 2. Under O there is a block of wood seen; this is simply to raise O to its proper height. I think all the rest of the working parts will be understood from the figures, and will be seen to be of comparatively easy construction. As to the rate of the revolving parts, compared with the handle T, I find the following to answer well:—M revolves once to 6¼ revolutions of the handle, O once to 28 of the handle, and the face-plate H once to 35, when its gut is on the large pulley near M, and once to 50 of the handle when the gut is on the smaller pulley near M. I use the 50 pulley generally. I have a very deep groove in N, which allows me the very slow motion of the speculum of 75 turns of the handle to one of the speculum; but this I consider too slow, and the amateur need not go to the trouble to make it.

In my next letter I shall take up the polisher and ring and rollers that make up the space between the ring and polisher, and perhaps may get as far as the balancing. To understand the principles and laws belonging to these is very important. I shall then use Figs. 4, 5, 6, and 7.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

THE ELECTRO-MAGNETIC UNIT OF POWER

[20599.]—"Milverton" (letter 20573, page 89) has evidently not yet got to the bottom of the absolute system of measurement. The "Watt" is not estimated to be 10^7 C.G.S. units of power, but is the name proposed to be given to that quantity. The volt being 10^8 C.G.S. units of electro-motive force, and the coulomb being 10^{-1} C.G.S. units of electric quantity, the product of the two (which is the mechanical energy of a coulomb transferred through a conductor under an electromotive force of one volt) is 10^7 C.G.S. units of energy—that is, 10^7 ergs. The ampère being one coulomb per second, the product of one volt by one ampère is similarly 10^7 C.G.S. units of power, or, as it is now proposed to call it, one "Watt."

To come to the point where "Milverton" has gone astray, the English horse-power is, as he says, 746 by 10^7 C.G.S. units of power, or 746 Watts, and the French H.P. is 75 kilogrammetres per second; but the latter is *not* the same thing as 750 by 10^4 centimetre-gramme second units. In the first place, the kilogrammetre of energy is like the foot-pound, not an absolute unit, but a gravitational unit, its value varying according to the intensity of gravitational force at the place. It is g times as large as the absolute kilogramme-metre second unit of energy, and therefore to convert it into the latter units it must be multiplied by g, that is by 9·81 metres per second. Hence 75 kilogrammetres of energy are equal to about 736 kilogramme-metre second units of energy; and similarly 75 kilogrammetres per second of power are equal to about 736 K M S. units of power. Secondly, if "Milverton" will study the theory of dimensions of units, he will find that the dimensions of the unit of power (energy per second, or rate of doing work) are L^2MT^{-3}, and that, in changing a quantity from one system of units to another, as he wishes to do in this case, the numerical value of the quantity varies inversely, not simply as the fundamental units which we change, but also in the ratio of the exponents which they possess in the dimensional part of the quantity. Thus, when we convert a quantity of the dimensions L^2MT^{-3}, as above, from K M S. units into C.G.S. units, M being decreased 1,000-fold, and L being decreased 100-fold; the numerical value of the quantity is correspondingly increased 1,000-fold on account of M, and 10,000-fold on account of L^2. Finally, therefore, one French horse-power is equal to 736×10^7 C.G.S. units of power, or to 736 Watts.

It may prove convenient to have a distinct name for the electro-magnetic unit of power; but, to my mind, the terms volt-coulomb, and volt-ampère express the electro-magnetic units of energy and power respectively, equally well, and have the advantage that they also indicate their origin.

H. G. Moberly.

"A GLIMPSE THROUGH THE CORRIDORS OF TIME."

[20600.]—In reply to "Interest" (letter 20575, p. 90), I would say I believe I called attention (in the letter to which he refers) to his quotation, or use, of the word "diminishing," where it should have been "increasing." Now, again, will he, in his last letter, use the words, "the diurnal period will become slower most rapidly," instead of the words he uses, "the diurnal period will be slowest." The present friction of the tides is increasing the diurnal period, this will drive the moon further away, into a larger orbit (and, therefore, longer period of revolution). The moon receding, tides will diminish, friction of tides, therefore, diminishing, and their retarding effect on the diurnal period also diminishing. That is to say, as the diurnal period is increased by the tides, the decreasing tides cause the *rate* of this increase to diminish. "Interest" appears only to have considered the changes, and not the *changes in the rates* of these changes. I believe his difficulty lies here. I shall be glad to help him further if necessary.

Paugul.

THE BERLINER VIOLIN.

[20601.]—I have received the finished instrument, which, in my opinion, is very effective indeed. It is an ordinary cheap violin, with the exception of the belly, which Mr. Berliner has replaced with one made by himself, and which, he says, only differs from the original in being the same thickness throughout instead of being graduated. There is also a great improvement undoubtedly caused by a steel band or tension-bar, which is attached to the resonator or string-carrier, and passing through the breast under the finger-board passes round a pin situated in a block glued to the inside of the back. This block is simply a carrier for the steel band, which then is continued to the end of the violin (inside) and comes out at the button-hole where the tail piece used to be hung. At the end of the steel band or tension-bar is a screw length and nut, which can be gradually screwed tight and so hold the resonator down and apply tension to the back or larger end of the violin. This, I think, is what Mr. Schucht contended was necessary, and I must say it has produced good results, not only in the above first-class instrument, but in two other violins to which it has been applied. One of these was injured in transit, which I managed to put together just to prove the case; the other has the thickness of wood in the middle of the soundboard, and though sounding well has not the power of the plainer instrument. Mind, I am only stating what is the fact, but no doubt the better the wood the finer will be the result. I intend thinking over this matter of tension. In the way of "patents" I read a curious idea thus: "The inventor immerses the sounding-boards in a tank of urine for a month, until they are thoroughly soaked with the salts, they are then slowly dried in an oven of low temperature, and when dry they are ready for use." Has this been proved, I wonder, and with what results—perhaps there is something in it that I have no notion of, if any of "ours" know, please tell? The date of said patent, Oct. 16, 1867.

Fiddler.

LEGAL REPLIES.

[20602.]—House—Ejectment (48077).—If house was let at a rent payable at stated times, of course, the landlord can distrain upon the tenant's goods for all arrears. The question does not state the most important points as to what was the letting, and what notice to quit he has given. If that notice was sufficient in time, and was served upon the tenant, no witness is necessary, and should the tenant refuse to quit upon the expiration of that notice, the landlord can bring an action of ejectment against him in the County Court, and upon proof of these facts he would get an order for possession of the premises.

Rent—Assessment (48088).—The assessment of property is always according to its value, and it may thus be higher than its rental. The rent paid is not conclusive of the value, though it is certainly a strong point of presumption. But as the letting value of the farm has gone down, it would be as well for the present tenant to appeal against the assessment, and upon proof of the rent he paid, and any other facts showing that its value had depreciated, this would probably be reduced.

Nuisance—Adjoining House (48094).—There can, as a rule and independently of contract, be no remedy for a private annoyance, unless it is also a public nuisance; and I do not think the fried-fish-shop would legally come within this term. In leases of new streets or rows, it is generally provided that none of the shops adjoining shall be let to any such a trade; but I presume this is not so here. Unless the querist can get his neighbour's landlord or the freeholder to interfere, I do not see that he has any remedy, though the loss is doubtless serious. But he might as well apply to the sanitary authorities, and see if anything can be done in that direction; but I cannot advise him to rush into an action.

Will—"Issue" (48100).—It is certain that "issue," as a technical and legal term, includes grandchildren. But, on the other hand, it has been held that the meaning must be qualified if the testator only meant "children," though he used the word "issue." It seems that in the will both expressions are used; and it would, therefore, appear as if the testator must be taken to have known the difference, and to have meant that C.'s grandchildren should share when he employed the word "issue." I could judge better by reading the whole will and hearing all the facts; but at present, I think the grandchildren are right. But if the parties like, they can quickly and cheaply obtain a construction of the will by taking proper proceedings in the Chancery Division.

Married Woman's Property Act (48104).—The new statute cannot in any way affect existing settlements, which are expressly exempted from its operation; and, indeed, it would be very strange if a statute were to set aside the deliberate deeds of individuals agreed to before it was passed or proposed; nor will the Act prevent settlements being made for the future.

Land Tax—Deduction (48119).—Where the tenant agrees to pay all rates and taxes except property tax, I do not see that land tax is included in the exception. Certainly land tax must be deducted from the next quarter's rent that becomes due after it has been paid. If the querist means land tax which has accrued due since the agreement ran out, he can deduct it from his next payment, but not otherwise.

Equitable Mortgage (48120).—Being desirous of telling this querist the best practicable way of setting about the business, I must adjourn answering until next week, as I am just now away from town for a holiday, and have no books or papers with me.

Minority—Women (48121).—Minority ceases in females, as in males, at the age of 21, as a general rule, and according to the common law. But for the purposes of marriage settlements, and under the direction of the Chancery Division, a girl of 18 is deemed to be of age.

Will—Real Property (48127).—It is difficult to determine the exact construction of a will without reading it. But presuming the property to be given to George without any limitation, he would take the fee simple, and could leave it by will as he pleased. It is necessary in a deed to convey property to the "heirs" of a man if he is to take the freehold; but in a will this is not requisite. George, therefore, had the right to leave the land to his wife, and she alone is the person absolutely entitled.

Income-tax—Interest (48125).—I do not see how income-tax can be deducted from interest payable upon a loan, unless it be by way of a mortgage upon land; so that the further complications suggested here would not arise.

Copyright—Registered Design (48142).—It would be an offence to copy a registered design, even though it were slightly altered and adapted to another fabric; and it is an offence which is within the jurisdiction of the police-courts. But the querist really seems desirous of learning how far he can go in adopting as his own the pattern of another; and, for this purpose, I must decline to give any further information of a general character.

Fred. Wetherfield.

2, Gresham-buildings, Guildhall, E.C.

DEATH NOT UNIVERSAL.

[20603.]—On page 542, last vol., is an article headed "Death not Universal." I think if any reader of the English Mechanic who possesses a microscope will carefully observe any one of the single-cell creatures referred to, he will find that the same laws of life and death that control the existence of higher forms of life control also the lowest. The multiplication of a single cell creature by subdivision can certainly not continue indefinitely. Isolate one, and when subdivision takes place isolate again and again; the power of subdivision will soon become exhausted, and death will ensue.

T. S.

VIBRATIONS IN PIPES.

[20604.]—On p. 36 is noticed M. Serra-Carpi's application of the microphone to determine the position of nodes in columns of vibrating air in pipes. As he let his petite drum down into the pipe it must have been an open pipe, and this is allowed to vibrate as an elongated figure of 8, making 3 nodes and 2 bellying segments. It will be perceived that there is only one node in the middle of the pipe, yet in the notice many nodes seem to be inferred and actuated with the microphone. Now, if the pipe was many times its own fundamental length, there would be as many nodes; but an open pipe, as I understand it, is half its proper or fundamental length, and has only one node—viz., at the mouthpiece, from whence the vibrations open out till they reach the end of the top, or open part, forming a cone like the half of a violin string. But if the pipe is twice as long, and blown as a flute, through a hole in its middle, then the widest part would be in the middle, with a node at each end. This is contrary to the usual idea, for it is said that if an open pipe is stopped only at one end by the mouthpiece, the other end being open, then there is a node at the open end. Now, I am going to ask a question. If this is the case, how is it that in tuning open pipes (metal) the tuner enlarges or contracts the open end? He either pinches it closer, or presses it out, which act would be useless if the vibration was in the middle and not at the side of the pipe. Either the diameter of the vibrations at the larger end of the cone are too large or small, and have to be rectified according to the tone-pitch required. It is the same with a stopped wooden pipe, only, to make the diameter of the vibrations less, the stop is pushed down. This, then, is easily understood. I humbly apologise for contradicting the faculty; but they should remember that their fathers had to do the same, and were asked very seriously, Why they did not let things alone? The answer is, Because things would not let them alone. However, it is a very sensible warfare—the subjugation of nature to man.

Fiddler.

A COMPARISON BETWEEN TAYLOR'S AND NORTHCOTT'S LATHES, AND THEIR RESPECTIVE CAPABILITIES.

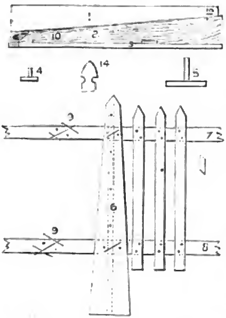
[20605.]—"F. A. M." in his letter on the above, asks if the geared Rose engine can make figures really looped. Yes, certainly—loops being of all sizes. But it is essential to use a drill to cut the figures nicely, as the motion is necessarily a slow one. This is, as I think I stated, the only drawback to the system; but one counterbalanced by ease and cheapness of the fittings. We are got so used to costly appliances, that we have lost sight, in a great measure, of the simpler chucks (the Epicycloidal, for instance) and simpler modes of ornamentation, of which the lathe is capable. To compare such modes with the geometric chuck is, of course, absurd. The results must, as a matter of course, be vastly inferior; but for all that we can produce, by various inexpensive appliances, very pleasing and sufficiently accurate work, and of such appliances the geared rose-engine is one. Of Mr. Northcott's I have no personal experience. I did not know it was for productions of this class of work. If so, it is probably satisfactory. The inventor's name is a guarantee that it is a practical machine.

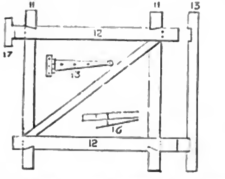
J. L.

GARDEN CARPENTRY.

[20606.]—In answer to "Oliver Twist" (letter 20551), and relative to a portion of his queries, I furnish him with a sketch for fence to keep kitchen garden within bounds; and the cheapest stuff I found was spruce battens, 8in. by 2½in., two cuts, and durable, if treated the same as I did some for the same purpose. 1 and 2 is a piece of board, 8in. wide, marked off 2in. at A and B for the sake of space in lieu of another illustration. Suppose 1 taken away and transferred to the outer edge 3 of the other piece, only the edge sawn should be reversed, see grain, and nailed and screwed by the centre line. This is for the posts; the section of which I show for top and bottom, 4 and 5. This should be 5ft. long, to allow 18in. to go into the ground. (See the post in position, 6.) The rails, 7 and 8, should be of the section shown under 7, to throw off the wet; 2¼in. wide when finished: that will be 2½in. before the edges are bevelled; the pallisades 2in. wide; the post-top 8in. from first rail; the points of the others on a line with the shoulder of point. 9 9 show the splicing of rail, which should come behind the post, and skew-nailed, with wire nails passed through, 10 10, in the post, and fixed with two screws or nails. Below this is the gate-frame; the stiles, 11 11, 1½in. or 2in. square stuff, the rails to be dovetailed, as shown, and of the same section as the rails for fencing, and the stretcher-stay let in the same, as shown, all flush; over this put your palisades to correspond with the rest. 13 is edge-view of stile. You can make the tops of palisades more ornamental as 14, the gate to be hung with two cross garnell hinges from the web of posts and back of rail, with a taper piece to fill up level, 16, and a packing piece upon the leafs of post for the butt to be screwed to, or inserted between the stile and rail before putting gate together. In one I put up, to preserve it, I painted all the junctions with the following: 1 gallon of gas-tar, ½ gallon of boiled oil, 4 balls of whiting, and 1lb. of litharge; the last is mixed with the oil; the whiting, well dried and sifted in the oil, and well mixed, and then mixed with the tar. The bottom of the post was made hot over the kitchen-fire, and dressed before putting in the ground. I found this compost more durable than tar, and dries well. All junctions were painted with it before nailing or screwing up. The stuff rough as came from the saw, and 2in. screws (No. 12) used both sides of the mortise, in lieu of post for rails. It is nasty stuff to drive a nail into: use a small gimlet for all nails, &c. For nails, use the compressed rose-headed post, 2in. and palisade 1½in., and snap-headed screws for hinges. Finish for paint with the composition.

Jack of All Trades.





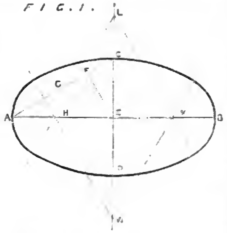
CONSTRUCTION OF ELLIPTIC FIGURES.

[20607.]—With the exception of the circle there is no curve of more frequent application in the constructive arts than the ellipse, and in view of this circumstance it must appear singular that in treatises upon practical geometry the methods inserted of constructing elliptic figures should be of a description so unsatisfactory in practical draughtsmanship. In the requirements of the case, the more important conditions evidently are that the figure be composed of arcs of circles, and that it be applicable to cases in which the lengths of each of the diameters are given. In all the published methods I have seen, in which the latter condition has professedly been complied with, it has been impossible to make the arcs meet fairly in all the proportions which the lengths of the two diameters might reasonably bear to one another; and, moreover, the construction lines drawn from the centres of the arcs to determine their limits and points of junction, are fixed at angles of 60°, which arrangement must evidently be faulty, except for one particular case. These considerations led me some time ago to seek a method free from these drawbacks, and to work out the following construction, which, with the exception of the arcs, of which the finished figure consists, may be very expeditiously executed with the T-square, pitch-rule, or isograph, set square, and dividers.

Place the given diameters A B and C D in position at right angles, their centres coinciding at E. Join A C. Let fall from E upon A C the perpendicular E F, which may be done with pitch rule and set-square. From F A cut off F G equal to F C. With dividers take the remainder A G, and set it off on each side from E, cutting A B in H and K, which points will be the centres for the smaller arcs.

From H draw H M parallel to F E, intersecting the diameter C D produced in M. Make E L equal E M. L and M will be the other centres required.

FIG. 1.

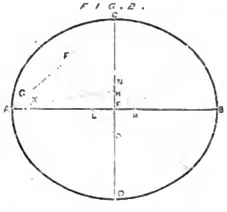


Draw the lines connecting the four centres, and produce them to determine the points of junction of the arcs.

In cases in which the angle C A E is one of about 30°, the above simple construction will be found sufficient; but in other cases, as when the required figure more resembles a circle in its proportions, the additional construction shown in Fig. 2 will be required.

Having set off F G along F A, as before, with the distance A G, set off E H from E along E C.

FIG. 2.



Join A H. From G draw G K perpendicular to A C, cutting A H in K. From E on each side with the distance A K, set off E L and E M along the diameter A B. L and M will be the centres for the smaller arcs.

Complete the construction as in Fig. 1.

Bertram A. Raves.

MEDICAL REPLIES.

[20608.]—Ague (47719).—But little specific influence upon ague is to be obtained by any special diet. The point is to live in a high, dry atmosphere, away altogether from conditions such as those which produce ague. Practically, the atmosphere of London is a powerful antagoniser to the ague taint. If "Unhappy Jack" have enlarged spleen, or other chronic disease, induced by the ague influence, he must get critically examined and advised, with a view to get cured of such conditions, before he can hope to shake off the ague. A man once affected with ague will have all subsequent illnesses more or less modified by the ague taint.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

Tannin Soap.—Cocoa-nut oil, 18lb.; solution of soda (38° B.), 9lb.; tannic-acid, ¼lb.; alcohol, q.s.; balsam of Peru, 1oz.; oil of cinnamon, ¼oz.; oil of cloves, ¼oz. Saponify the cocoa-nut oil with the solution of soda, then add the tannic-acid previously dissolved in alcohol, and add the other ingredients.—*Seifenfab.*

An Iron Man.—Launceston, Tasmania, can boast of being the first town which has produced an iron man who can walk without the aid of steam. It is the invention of Mr. Hornburg, a mechanical engineer. The figure, which is dressed as a footman, is 5ft. 10in. in height, and weighs 160lb. Its action rises from the powers of a spring concealed in its inside, which enables it to walk with the greatest ease, and wheel a man's perambulator before it.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46198.]—**Hydrometer Scales (U.Q.)**—Scales ought to be made to the instruments, not instruments to scales. Of those in possession of "Aphone Jham," one is certainly incorrect, if not both. I should not advise him to try and alter them, unless he is a good workman, and has plenty of appliances, and then it will almost certainly end in failure. If not for acids, use metal instruments, as they are far more reliable, and should he require any information respecting their manufacture, I shall be pleased to furnish it, with the kind permission of our Editor, but I must warn him it will be a tedious and delicate operation, and afraid of not much interest to the bulk of our readers, beside requiring a considerable amount of space.—Plug.

[47239.]—**Deafness.**—I thank "F. R. C. S." for his reply; but I used iodine liniment behind the ears for a fortnight without the slightest effect on the skin. The condition of the hearing organs, two years, ago, was, from the diagnosis of a London aurist, as follows:—"Membrane—somewhat injected, expressly at margin; Tympanic cavity—mucus membrane œdematous; Eust. tube—pervious to Politzer." He was of opinion that the disease was caused by a stomach derangement, but there is nothing the matter in that region that I am aware of; and advised the use of the air-douche, but I have not tried it, as I cannot afford to buy one. Can "F. R. C. S." assist me further? and may I ask his opinion of perforation of the membrane? Does it leave any ill effects, or does the membrane attain its normal condition when the wound cicatrises?—Politzer.

[47458.]—**Reeds for Jacquard Looms (U.Q.)**—The wefts can be made to cross the warps in manner described, but no arrangement of springs in the reed will make it keep that form when beat up. If there were any great advantage in it, no doubt it could be done, but would all depend upon the width and class of fabric being woven.—Marlow.

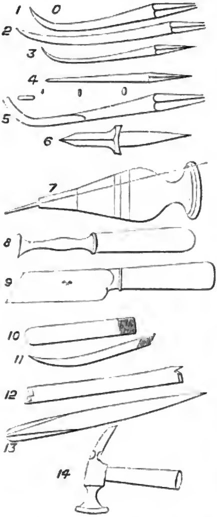
[47685.]—**Photography.**—Freckles can usually be obliterated in the process of re-touching with a blacklead pencil. If you cannot obtain sufficient bite on the surface of the film or varnish, try the effect of roughing the latter.—W. Robinson, Jun.

[47690.]—**Enamelling Photographs.**—Take a clean sheet of glass (preferably patent plate), rub it over with a little beeswax dissolved in methylated ether, coat with plain collodion; immerse in a dish of water until all greasiness has disappeared, and then lay the prints carefully upon it, so as to avoid inclosing any air-bubbles. If the prints are not to be mounted, they may then be left until dry, and stripped from the glass. If to be mounted, however, they should be backed up with one or two thicknesses of paper; otherwise the damp of the mountant penetrating through, would destroy the gloss. Gelatinised paper, similar to the double transfer paper used in carbon printing, is most convenient to use. It should be well soaked in cold water, and laid over the prints immediately after placing them upon the collodionised glass. Allow to dry and strip as before. If preferred, of course, sufficient backing may be used to form a cardboard, and so avoid the necessity of after-mounting.—W. Robinson, Jun.

[47704.] — **Hydro-Kinone.** — Captain Abney speaks of using solution containing from 4 to 12 grains per ounce, while Dr. Eder recommends solutions of from 4 to 6 per cent. It is said not to require any restrainer, or should any be required in any particular instance, it should be added very cautiously and sparingly.—W. Robinson, Jun.

[47727.]—**Boot and Shoe Making.**—I will give instructions for shoemaking, with tools, in a series of articles weekly. The sketch will give a general idea and the best form to use. 1, sewing-awl; 2, heel-awl; 3, closing; 4, stabbing; 5, French stitching; 6, pegging awls; 7, handles in general use; and the awls to be put in at the angle shown to be worked easy without breaking, except the pegging awl, which should be straight. The sections of awls are shown, and good work—i.e., strong work,—cannot be insured without proper attention is paid to that; a lance-pointed awl, with a cutting edge, should never be used, or the work is sure to rip; 8, is a channel-opener, made of a broken table-fork; 9, is a knife; a good old dinner-knife that is worn too thin for anything else, and dangerous for any other use, may be cut off 3in. long, and make good tool; 10, is a bone, for placing before the point of knife when paring off the rags to keep the knife from entering the upper. 11 is a bone seat file, it is a portion of a marrow-bone with notches filed in one end, and the other the shape as shown. This is used for striking the seat and welt down; 12 is a shoulder stick, for rubbing the edge down;

and 13, long stick, flat and oval at one end, round in the middle, tapering round from there to end; 14, the civiliser, or hammer, for a lap-stone; get a stone, kidney shaped, or what has served my purpose, a large flat-iron with the handle off—the handle on will make no difference, as that can be dropped between the knees and will not be in the way. Two pairs of penny welts will make a good stirrup, if double, and that is 18in. long by 1¼in. wide; these stitched together, end on, so as to make a continuous stirrup that may fit tight from the waist



of foot over the knee, will furnish the means of holding the shoe upon the lap, if proposed to make them upon the lap; but I will, in these instructions, furnish a sketch of machine or bench upon which they can be made in a standing position, which I constructed some years ago, and upon which I made perfect boots and shoes from 1½in. long up to large tights for navvies and agricultural labourers. —Jack of All Trades.

[47752.]—**The Flux of Soap.**—As I see this phrase does not seem to be understood, I send you a cutting which will help to explain. In hard soap, the flux appears in the form of a fibrous opaque square separation, and by its presence the homogeneous mass acquires a pleasing effect. It may be separated from the mass by treatment with a large quantity of water, says the *Oil and Paint Review*, and forms a skeleton of shining, white, fibrous, slightly adhesive masses, exhibiting after drying a mother-of-pearl lustre. In 1873, Fricke made some investigations in reference to this substance, and recently Dege has taken up the subject. A very fine white soap is now brought into the European market, prepared from tallow and cocoanut oil, and exhibits the above-described appearance in a very striking manner. The flux was separated by lixiviating the soap with a large quantity of water, pressing the residue, treating it with salt water, then boiling out with water, and finally extracting with hot alcohol. The residue forming the flux of the soap is perfectly white, fibrous, has a mother-of-pearl lustre, and is insoluble in water at all temperatures. It dissolves in a solution of soda-soap, its solubility depending on the concentration and the temperature of the soap solution. This circumstance explains the development and formation of the flux. The boiling hot finished soap holds the whole of the mother-of-pearl-like body in solution, whilst on cooling in frames a portion separates in the form of silky fibres, forming the flux. A sample of cocoanut-oil soap was analysed, giving 76·27 per cent. fatty acids, 8·21 per cent. soda, 0·30 per cent. lime, and 15·22 per cent. water. The quantity of 0·3 per cent. of lime corresponds with 3·8 per cent. of lime soap, its presence being explained by its existence in commercial sodium carbonate, which is still largely used in soap-making. It would be imprudent to attribute the flux of soap solely to the formation of a crystallised lime salt of the fatty acid, although it may be fairly assumed that generally the flux owes its origin to this salt. —C. F.

[47755.]—**Heating Hen-house.**—It would do if the lamp were large enough, and the hen-house is carefully closed in from cold winds. The lamp itself must not be in the house; or if so, must have a chimney to carry off the carbonic acid. The question is one of those that cannot be answered without almost seeing the place.—T. P.

[47761.] — **Steam-Launch.** — Seriously, with every desire to help "Indigo Planter," who has "no experience in working with iron," and wants to build a launch to go at 20 miles an hour, presumably without the assistance of the tide, I think he had better communicate with some of the torpedo-boat builders. It is quite possible to build and engine a boat to go at that speed, and possibly with about the dimensions given; but I suspect if she carried enough coal to last eight days, there would be little room for anything else. She would be all engines and coal below deck. — J. P., Surbiton.

[47762.]—**Insects in Fernery.**—It depends to a certain extent on what is meant by "insects": but if fly, then you have nothing to do but to fill the shade with tobacco-smoke. As the fernery is nearly air-tight, don't water while the soil is really moist, but mind that it is moist.—Osmundo.

[47765.]—**Preserving Eggs.**—Many methods of preserving eggs have been given in this paper, and I have no doubt that silicate of soda would answer well, if care were taken to thoroughly coat them. The method usually adopted by the merchants is to coat them with lime, by placing in a rather thick lime-water; but if it is required to keep them only for home use, I think you will find it better to melt some paraffin and just roll the eggs through that. The paraffin is perfectly tasteless. In Vol. XXXIII., p. 469, are described a variety of processes, and to them you may add one recently utilised in America, in which the eggs are kept in a barrel of water, to which a dose of salicylic-acid has been added, about an ounce to a gallon. The rationale of the processes is the closure of the pores in the shell, and the prevention of air access to the substance of the egg.—Nun. Don.

[47777.]—**Cloud Negatives.**—No, separately. First strike a print, cut out the landscape portion, and use it as a mask to shield the others while the clouds are being printed in.—W. Robinson, Jun.

[47780.]—**F. C. S.**—In the replies to queries (47780) in to-day's issue (Sept. 29th) will be found a reply from "E. M." in reference to the qualifications necessary to be elected. What "E. M." says is not correct by a long way; let him try and see if he can become a "Fellow" in the way he mentions. Personally, I think it an insult, for I am a member of several societies, but was not elected in the simple off-hand manner described by "E. M." Are the learned societies of England and Scotland composed of men who know nothing of the science the society is formed to advance? And as to the mode of election, by requiring the proposer's signature and that of five or six others, is the method adopted in the election of the Fellows of the Royal Society; they have to be personally known to those who sign, and some of the works they have been engaged in, or the books they have written, have to be mentioned.—J. J. G.

[47787.]—**Marine Engineer at Woolwich Arsenal.**—What does "S. H. F." mean by "marine engineer"? If sea-going engineer, they don't want them at Woolwich; if maker of marine engines, they don't make engines there.—Essar.

[47798.]—**Heating by Steam.**—This question can be answered only by a practical trial, for nothing is said as to whether temperature is absolutely necessary, although it is stated that the articles have to be subjected to a temperature of 212°. I see, however, that either boiling water or steam will do, so I will suggest that it is the moist heat that produces the desired effect, and that it is possible the influence of the elevation will effect the articles as much as it does the temperature of the water. But if 212° is absolutely necessary, a steam-chest will be wanted.—Essar.

[47807.]—**Gas Water-heaters.**—To answer this query, in the form it is put, would be an advertisement. If "M. D." would state explicitly what he wanted to do, he might be told how to do it.—Essar.

[47814.]—**Photographic.**—1. Your prints not being sufficiently washed, would, of course, account for the gold being precipitated. They should be washed (immersed, not floated) in three or four changes of water, before being placed in the toning bath. If this should not prove a remedy, it is probable the acetate of soda contains some impurity which throws down the gold. The formula given appears to me to be unnecessarily strong. I should not use above half the quantity of gold named. 2. Probably some defect in the plates, but could not say for certain without personal examination. 3. Do you dust the plates before placing them in your dark slides? If dust is not the cause, state particulars of development, and I might be able to point out some other reason.—W. Robinson, Jun.

[47829.]—**Lantern Slides.**—On the whole, ferrous oxalate is perhaps the best and most easily-managed developer for this particular purpose, but pyro may also be used with equally satisfactory results, if properly managed.—W. Robinson, Jun.

[47835.]—**Turbine Pit.**—If I understand your query, you have a shaft near pit, which is driven by steam-power at 20 revs. per minute, and you desire to drive your pump off this by a belt. To give a reply, I must ask you to tell me depth of water in pit, and height above surface of ground-level to which water must be raised in order that it may flow away. If you have a pump which you wish to use, tell me its diameter and stroke, and I will then tell you at what speed to drive it. The 5½in. shaft, running at 20 revs., should transmit about 92 h.p., so that pump may be driven at as high a speed as the water will rise at (but see reply No. 47886). Give dia. of suction-pipe, as well as the other data.—Glatton.

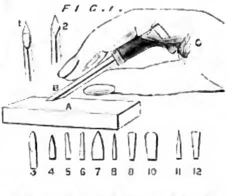
[47839.]—**View Lens.**—You might perhaps be able to use a little larger aperture with the larger lens, but not necessarily; it would depend upon its quality. Sharpness of definition does not depend upon aperture (in fact, the smaller the aperture the better the definition, as a rule), but upon the perfection with which the actinic and visual foci are combined.—W. Robinson, Jun.

[47850.]—**Sensitised Paper.**—There are occasional metallic particles in photographic papers which give rise to black spots; but if these are at all numerous the paper must be of very inferior quality. Better try another make.—W. Robinson, Jun.

[47861.] — **Photography.** — 1. Wet-plate development is altogether different in principle to dry. The image in the former case being formed by the reduction of the nitrate of silver with which the plate is sensitised, the silver haloid contained in the body of the film being altogether unaffected: whereas in the latter case it is the silver haloid itself which is reduced, and that cannot be effected by either iron or pyro. alone, because there is nothing to absorb the hydracid which is liberated. 2. Cyanide of potassium is too powerful for use in fixing dry plates. 3. Ferrous oxalate development is no doubt the easiest; but on the whole I prefer pyro. as being the best, and most under control.—W. Robinson, Jun.

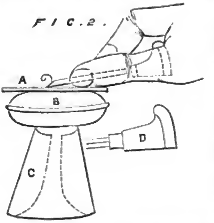
[47877.]—**Dusting-on Process.** —I am not aware of any such process as you speak of, and do not see how it can well be, as it is the action of the light which prevents the adhesion of the powder to those parts of the plate which have been exposed to it, and so enables us to form a negative from a negative, a positive from a positive.—W. Robinson, Jun.

[47882.]—**Amateur Engraving.**—I differ on this subject from others. It is a very easy matter when you know how, and practice makes nearly perfection. Now, "the how" I will explain to "Young Amateur," and if he perseveres he will be able, in less than a week, to make a decent letter. It will seem to him strange when I tell him that he will find round writing better than Roman. To commence with, Fig. 1 represents the various



gravers: 12 are the ordinary lozenge-shape or square, 1 is ground to an angle of 45° or 50°, which is the best; 2 is shown, in which I dispense so much labour on the oilstone by grinding the top half higher up. The others are called scorpers, split sticks. &c.; but the proper names are gravers and sculptures. These can be got of Buck's, with handles to suit. They are mushroom-headed, the lower part of which are removed to bring the tool down as near the work as possible. The figures 34, &c., are more generally used for endorsing stamps, bookbinder's tools, letter-cutting, and deep work. A is oilstone; should be good Turkey or Arkansas. A soft stone is of no use. B is the graver and face of the tool, which should be preserved in its original form, and never allowed to get rusty or touched with a stone. C gives the hand and position for sharping same. In practice, it is as well, I have found, to lean the hand over from you for left-hand cut, and to you for right-hand cut; but if the tool is kept perfectly square, it will cut. When sharpened, job the tool into a piece of boxwood, that it may remove the wire edge, if any. Fig. 2 is the proper way to hold the tool when using it. Now, the next to sharpening the tool is the action in cutting. Do not drive your hand bodily as you would a carpenter's chisel, but place the handle against the heel of palm of your hand, and the blade between the thumb and forefinger letting your thumb and forefinger rest upon the work. Now, to make the tool cut, raise the heel of the hand until the tool bites, making the thumb and finger a fulcrum as it were; bring the heel forward by muscular contraction, your tool slides through thumb and finger, and you will find it cut quite easy. When cutting you can either turn your tool to right or left; but that is not the proper way of doing business. Turn your work; it is there shown upon a sand-cushion B, which can be purchased or made. It is leather; I usually make mine—the bottom of a piece of shoulder-grain leather, and top of a tight piece of basil, filled with common floor-sand. The cone C is of wood, about 3½in. at bottom, and 1½in. at top, with a taper hole through, and top and bottom are hollow, that the thing may stand firm, and for the purpose of dropping anything into that may have a tang to, as bookbinders' tools, &c.; it is about 4in. high. Any wood will do. D is the handle.—Jack of All Trades.

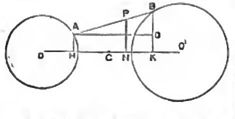
FIG. 2.



[47886.]—**Pumps.**—Make valves as large as possible, and area of suction-pipe rather more—say, one and a quarter times area of valves. Speed depends a good deal on size of pipes. Spon recommends that velocity of water in pipes should not exceed 4ft. per second. this gives as velocity of piston $\left(4\,\dfrac{\text{area of pipe}}{\text{area of piston}}\right)$ feet per second. —Glatton.

[47891.]—**Engine Query.**—The vibration of the draw-bar causes the link to slide slightly, and with an overhung link this is a great disadvantage. It is not of such importance with the ordinary link.—Glatton.

[47907.]—**Problem in Co-ordinate Geometry.**—It was only late in the present week that I saw A. J. Smith's and "M.I.C.E.'s" queries with reference to my solution of this problem, or I would have given an earlier reply. The steps asked for by Mr. Smith are as follows:—Let AB be the straight line, AP = l, BP = l', the co-ordinates of A and B being $x_1\ y_1$ and $x_2,\ y_2$, and those of P, $x\ y$. The origin being at C, the middle point of OO', CO' = d, CO = $-d$. The equations to the two circles will be respectively—



$$(x_1 + d)^2 + y_1^2 = r^2$$
$$(x_2 - d)^2 + y_2^2 = r'^2$$

Draw AD parallel to OO' and let θ be the angle BAD. Then—

$$x_1 = x - l\cos.\theta \qquad y_1 = y - l\sin.\theta$$
$$x_2 = x + l'\cos.\theta \qquad y_2 = y + l'\sin.\theta$$

Substituting these values of the co-ordinates in the equation and reducing, we have—

$$2l\,(x + d)\cos.\theta + 2ly\sin.\theta = (x + d)^2 + y^2 + l^2 - r^2$$

and $2l'\,(x - d)\cos.\theta + 2l'y\sin.\theta = -\,(x - d)^2 - y^2 - l'^2 + r'^2$

From which equations we find—

$$\text{Cos.}\,\theta = \frac{(l + l')\,(x^2 + y^2 + d^2 + ll') + 2\,(l' - l)\,dx - l'r^2 - lr'^2}{4ll'd}$$

$$\text{and sin.}\,\theta = \frac{l\,(x + d)\,(r'^2 - l'^2) + l'\,(x - d)\,(r^2 - l^2) - (x^2 + y^2 - d^2)\,[l(x + d) + l'(x - d)]}{4ll'dy}$$

Hence, we find the equation to the curve by substituting these values of cos. θ and sin. θ in the equation—

$$\text{Sin.}^2\theta + \cos.^2\theta = 1.$$

—Milverton.

[47907.]—**Problem in Co-ordinate Geometry.**—Mr. Smith asks if the equation would not assume a simpler form, if the origin were taken at the point, where P meets OO'. To find this point, we should have to solve the equation.

$$(l + l')\,Z^3 - 2d\,(l' + 2l)\,Z^2 + [4\,ld^2 + ll'\,(l + l') - lr'^2 - l'r^2]\,Z + 2\,l'd\,(r'^2 - l'^2) = 0.$$

Where Z is the distance from O (the centre of the circle) to the point where P meets OO'. There are therefore three such points, and if the general values of Z could be found, the complex form, of any one of them, when substituted for d in the general equation would render that equation still less simple. For the particular case, when $l = l'$ and $r = r'$, the equation reduces to the simple form.

$$(Z - d)\,[Z^2 - 2d\,Z + l^2 - r^2] = 0$$

In which $Z = d$ and $Z = d \pm \sqrt{d^2 + r^2 - l^2}$. The first value shows that P meets OO' in the middle point. Although it may not be easy to place the origin at the point suggested, yet there are other particular forms of the equation in which one or more branches of the curve may pass through the origin when placed at the middle point of OO', for when the general equation is reduced it assumes the form.

$$[L\,(x^3 + xy^2) + D\,(x^2 + y^2) - Ax - B]^2 + y^2\,[L\,(x^2 + y^2) + 2\,Dx + C]^2 = My^2$$

where A, B, C, &c., are constants. The condition that this shall represent a curve passing through the origin is

$$B = 0.$$

$$\text{But } B = (l - l')\,(d^2 + l\,l') + l\,r'^2 - l'\,r^2 = 0.$$

If in this we assume $l = l'$, then it results that $r = r'$, which is the particular case already given. But we are permitted to make other assumptions with reference to $l\ l'$, $r\ r'$, consistent with the existence of the equation B = 0, and in each case the curve will pass through the origin. I had made out a number of cases to illustrate this point, but I am warned of the length to which these replies are extending, and must for the present leave them out. With reference to the last question of A. F. Smith, as to how to make the looped part of the curve, in the particular case, deviate least from a straight line, so as nearly to realise Watts' parallel motion? Since, in the particular case, the origin is a double point, through which two branches of the curve pass; if at that point we can bring the branches nearer together, the branch in which P moves will possibly be made nearer a straight line. Now, each curve is inclined to the axis of x at angles whose tangents are respectively

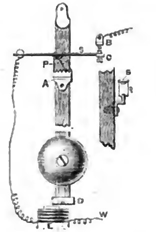
$$= \pm\,\frac{l^2 - r^2 - d^2}{\sqrt{4\,l^2 d^2 - (l^2 + d^2 - r^2)^2}}.$$

The larger this is, the nearer the branches approach, and the closeness will depend on making the numerator of the above fraction as large as possible, and the denominator as small as possible. In reply to "M.I.C.E.," it will, perhaps, be easier to trace the curve from its equation, referred to polar co-ordinates ρ and θ, which is as follows:—

$$[L\rho^3\cos\theta + D\rho^2 - A\rho\cos\theta - B]^2 + \rho^2\sin^2\theta\,[L\rho^2 + 2D\rho\cos\theta + C]^2 = M^2\rho^2\sin^2\theta$$

Assuming values of θ = 0, 30°, 45°, 60°, 90°, we shall have equations for determining ρ, of the third and sixth degrees, some of which, when supplied with numerical coefficients, might be solved approximately. I have written out a number of such equations, from which a general idea of the curve might be obtained. To differentiate the equation, "M.I.C.E." would not, I think, find much difficulty in forming it into factors, and taking logarithms of both sides of the equation, from which the different coefficient could be easily obtained. Of course, nothing definite could be arrived at until the equation was supplied with numerical coefficients.—Milverton.

[47910.]—**Electric Clock.**—You should have sent a sketch. I can only guess at your arrangement. *s* (see sketch), shows the spring you mention, one end of which is fixed and connected with electro-magnet E, and the other carries a platinum contact piece *c*, which rests on a platinum plate fixed to a brass bracket *b*. These should nearly, but not quite, touch one another. *p* is the pendant hanging from centre of spring, and you must fix a bit of sheet metal, bent to shape, and cut with teeth, like *a* on pendulum, so that the teeth catch pendant and push the spring up to make contact at *b c*, when pendulum passes middle point of its beat. If pendulum swings far it will pass pendant without pushing spring, but as stroke diminishes the pendant catches on *a*, and a fresh impulse is given by magnet to pendulum. *d* is armature of magnet. Battery wires are connected to *ww*. The spring should be fixed so that pendant is a little on one side of pendulum when at rest.—Glatton.



[47914.]—**L.B.S.C. Engines.**—On referring to list, I find the following differences to above: 284, Ashburnham; 345, Hurstmonceux, single expresses; 232, Buckhurst, terrier; 303, Nice; 304, Milan, "Grosvenor" class. Can "Carstairs" oblige with particulars of 10, 12, 20, 32, 34, 37, 41, 42, 48, 52, 65, 70, 76, 99, 100, 105, 106, 194, 195, 201, 204, 213, 216, 232, 252, 273, 296, 297, 302, 305, 328, 344, 350.—Coridaeus.

[47916.]—**M.R. Engines.**—Thanks to "Camomile" for his corrections. What I have stated about the 890 class was obtained from information supplied by Mr. Stretton in earlier volumes. The numbers and dates I obtained from personal observation of the engines. "Camomile" and "A Driver" have included the 134 class in their replies. These engines are similar to the 890 class in their principal dimensions, but, being designed by Mr. Johnson, I did not include them in the 890 class proper, which are of Mr. Kirtley's design. The numbers of the 134 class are: 67—69, 130, 132—136, and another. Is "Camomile" sure of Nos. 121 and 122? I saw these engines a few weeks ago, and then they were small double-framed coupled engines, with wheels about 5ft. 9in. or 6ft. What are the dates of 126—128 and 123? What I said about Mr. Johnson's dome and manhole cover applies to No. 148 only. The date is 1872, and it cannot, therefore, be one of Mr. Johnson's engines. It is not a "rebuilt." On page 514, Vol. XXX., "Gorostiza" gave the numbers and size of cylinders of the rebuilt 800 class rebuilt up to 1877. I understand that the engines of this class rebuilt after this date have cylinders 18in. by 26in. I should be very glad if "Camomile" would inform me as to what became of the other Somerset and Dorset engines. Will he also give further particulars of these engines? Are the frames outside or inside? Also, of the Hereford and Swansea engines?—Meteor.

[47921.]—**Magic Lantern.**—You can grind 4½in. condensers out of colourless plate: grind two planos 4 by 0; these, mounted, will be just what you want for a good lantern. If you will let me know what kind of front you want to make, I will tell you how to make it. A pair of planos 2in. diameter, 3 by 0, will work well, but if you want to make an achromatic combination, let me know in another query.—W. J. Lancaster.

[47929.]—**Ernest's Coil.**—If "J. W." possesses the back volumes of this journal, he will do well to study "Inductorium's" letter on page 473 of Vol. XI.; also the two letters by Mr. J. Brown, of Belfast (page 611 of Vol. XXX., and page 310 of

Vol. XXXI.), and the letter by Mr. J. S. Hewitt, on page 352 of Vol. XXXI. These letters contain exceedingly clear descriptions of coils wound upon the disc or vertical method. Nothing is placed between the layers of secondary wire, which are so narrow that no pair of layers can generate spark enough to break through the paraffined silk covering. A sectional sketch of the secondary would simply show the insulating discs, arranged at equal distances upon the ebonite tube, and this "J. W." will be able to picture to himself quite clearly. If discs of paraffined paper are used they must be carefully fitted to the tube; and I found it necessary to cover the bottom of each division or space with a layer of paraffin wax, laid on with a camel's hair brush, and rendered smooth and regular by the application of a warm iron wire. This prevents the spark from passing underneath the partitions at those points where it has a strong tendency to do so. "J. W." will, of course, understand that the wire must run in the same direction through all the spaces; and to bring this about the coil must be turned round in the winding-stand at the commencement of each space. A little thought on the part of the constructor is, perhaps, better than a great deal of elaborate description. With regard to the condenser, I am sorry to say I cannot put the matter more simply than was done on page 598, because the number and size of the tin-foil plates is not the only element which determines the capacity of a condenser. The simplest and safest plan is to ascertain by experiments with the finished coil the number of plates which the instrument requires.—Ernest, Haverfordwest, Pem.

[47934.]—**Induction Coil Failure.**—You have done right in removing one of the layers of primary; three are ample, and you have done right in carefully insulating, but I am afraid you have gone wrong in the coupling. Now test the primary by coupling it directly to the batteries, and see what weight the core will lift; if it pulls a small iron weight to it, and holds it, then it is right, and the other connections are wrong. You must, of course, have a contact breaker: otherwise you will get no induced current at all.—W. J. Lancaster.

[47935.]—**Ventilation of Room.**—If the querist will introduce a sufficient supply of fresh air into his room, below the ceiling, he will find that it will drive out the heated air through the perforations in the ceilings over the gas-lights. This he can test by opening a window. If there be a fire burning in the room he will have to provide as much air as is carried away by the fire and chimney—or by the chimney, if there is no fire—before any is available for driving out the heated air through the ceiling. It will then be all the better to carry a wooden-tube up the side of the house, as he suggests, and either put a ventilator or not on the top. But unless he provides an adequate supply of air into his room, neither an "Eclipse" ventilator nor any other kind will produce "a steady up-draught" at all times. Provision can easily be made for preventing down-draught, if necessary, when the inlets are closed. — D. Crossley.

[47938.]—**Photography.**—You can photograph easily with my magnesium lamp. This is made in the form of a paraboloid, and, consequently, collects all the light from the wire, and reflects it out more like sunshine than an artificial light. With it you can take a good negative in one second at a cost of less than one farthing. I shall be pleased to send you full particulars and a drawing, if you would like to make one.—W. J. Lancaster.

[47938.]—**Photography.**—Certainly; but I should recommend you to substitute a quick-acting portrait-lens for the Ross symmetrical. As to the length of ribbon required, so much depends upon circumstances, you had better make one or two preliminary trials; and as to the gas, provided no direct light from the flame entered the camera, it probably would not matter whether it were lit or not. Your other difficulty appears to be so much a question of skill, I am afraid nothing but practice will enable you to overcome it; but if you will give details of development I will endeavour to assist you if possible.—W. Robinson, Jun.

[47941.]—**Coating for Leather Disc.**—I have not misunderstood your query: I knew what you were at as well as if I had seen your appliance. Your leather disc should be coned as well as your metal wheel; then you would dispense with the wearing that you complain of. There is a continual fret going on because your metal wheel on the front and back edge is the same diameter, or square with line of shaft, and your leather disc is the same. The consequence is your vertical plane is running at the same speed, outer and inner edge, the while the position upon the leather disc is running faster outside than in, causing a continual fret which, if coned, would be avoided.—Jack of All Trades.

[47947.]—**Land Reclamation.**—"Warping" is the process of retaining artificially, by means of wattled groins, the sediment deposited by the ebb and flow of the tide. Having raised the ground in this manner as far as possible, it is inclosed by sea-dykes and drained, either by pumps or by a canal with flood-gates, which are opened at low water.—Glatton.

[47948.]—**Cold-Air Machinery.**—In 1880, the Bell-Coleman Mechanical Refrigeration Company supplied a machine for cooling a large room at Sydney. The machine had two compressors, 24in. diam. by 3ft. stroke. With 60 revs. per min. the air was delivered at over 70° below zero, the air-pressure being 45lb. I am unable to give particulars of horse-power used, &c.—Glatton.

[47951.]—**Wheel-Barometer.**—The quantity of mercury necessary to fill your tube will depend upon the size of tube. About ½lb. ought to fill an ordinary tube. See that the tube is quite dry; then make a note-paper funnel, with a pin-hole. Put this into open leg of tube, and pour mercury through it until the short leg is full; then place finger on the top of open end, and invert the tube. Shake the whole of the mercury over into long leg; then fill short leg again, and shake over as before. Continue this until the long leg is full; then put a little more into short leg, and allow the mercury to fall in long leg, and bump against the top several times, until all the small bubbles of air have collected at the top of the tube; then invert tube, and, by gently tapping, get the bubble of air over the bend and out of short leg. Put into case and weights in position, and set the finger to the right height, and the barometer will be all right again.—W. J. Lancaster.

[47972.]—**Metal-work.**—I do not know how the cheaper kinds are made, but the best sort is made by a sort of "dolly," which is held inside the work, and the metal hammered outside. As it expands under the hammer, it is made, by skilful manipulation, to take the form desired.—Glatton.

[47972.]—**Metal-work.**—Comparatively little of the metal-work supposed to be genuine repoussé is such, much being produced by stamping and by electro-deposition. Another means of saving labour, and thus cost, is by stamping in a roughly-finished cast iron die (the cost of which is only a few shillings), and afterwards having the surface of article touched up by embosser. It would occupy too much space to give detailed explanation of the process of embossing. I will give a rough idea which may be of service. Supposing you require a brass finger or door-plate, *en repoussé*, take a piece of sheet-brass of required size, thickness, 1-30in., or thicker, and draw your design upon the surface of the metal, the lines of which should be traversed with a sharp steel point, to prevent obliteration. After you have fixed plate upon the pitch block, which is simply a piece of wood coated with a mixture of resin and pitch, you may proceed to trace in your design, which is done by the aid of the hammer and a small tool called a tracer, similar to steel chisel, but having its edge slightly convex and very smooth, so that it will lead nicely. Having traversed your outline, you may now proceed with the detail of your design, and next the making, which is done with a punch, circular and trianguler, or star-shaped, as the case may be, and consists of nothing else but a mass of small punctures covering the plain surface of the metal, and forming a ground for your design. You have now to turn your plate upside down upon the pitch-block, when you will find the marks of your tracer distinctly visible upon the back of the metal. The beating, which is the life of the work, is the next process, and is done with tools various in shape, a balled or round-nosed tool being the principal. Much depends upon the modulations in the raised parts of the work, and as you cannot keep looking at the effects of every blow, it is only by continual practice that the process can be successfully carried out. In some cases, where the price will allow of it, the work is re-turned on the pitch-block, and more highly burnished in detail. I may say that as many as 300 tools are used by some embossers for various classes of work. In the case of hollow ware, required to be beaten, the design is simply drawn upon the outside, the tracer not being used, and the raised parts are thrown up by means of an instrument called a snarling iron, the one end of which is held in a vice, while the other end, which has a smooth turned-up point, is brought to bear from the inside upon the parts to be raised. By a repetition of blows varying in sharpness and force upon the iron near where held in the vice, at the same time moving the article upon which we are speaking about, so as to keep the turned-up point in the proper place, the metal can be raised to any reasonable required height. The outside has now to be operated upon, and to do this the article has to be filled with melted pitch, which must, of course, set before we can proceed further. The first thing to be done is to work upon the outline of your drawing, and afterwards the detail of your work, which varies according to the class of work required. Embossing is a most interesting process, and it has often occurred to me that it is quite in the province of the amateur possessing a knowledge of, and taste for drawing, to attempt it. The conventionalised foliage, &c., of the Mediæval school now so much in fashion is very simple in treatment, and may be attempted with very few tools. Shall be pleased to give "Fel" further information if acceptable.—A. Francois.

[47982.]—**Field-Glass.**—The three lenses in each eyepiece of your field-glass are of different foci. You cannot use the concave eye-lenses for photographic purposes, and the object-lens will not be of much use, their diameters being much too great for their foci. Better get a cheap lens made on purpose for photographic work.—W. J. Lancaster.

[47984.]—**Dry-Plate Transparencies.**—You can use any of the ordinary dry plates, or my specially prepared 3¼in. by 3¼in. plates. Expose them behind a thin negative, and develop with ferrous oxalate, or pyro ammonia and ammonium bromide; then fix, and well wash for some time. You can tone with chloride of gold, or with chloride of platinum, in the usual way.—W. J. Lancaster.

[47985.]—**Measuring Atmospheric Pressure.**—An ordinary mercurial barometer, fitted with a vernier, may be read to 1-100th of an inch. A water barometer would have a scale about 12 times as long, and would, therefore, read to 1-1200th of an inch.—Glatton.

[47985.]—**Measuring Atmospheric Pressure.**—You cannot do it under the circumstances you mention. The water, I have no doubt, is always changing its depth, and to make a water barometer, with an oscillating cistern, would be practically useless. Better get a rain-water tube, and an iron pipe, 25ft. long, with a glass tube in the top, 10ft. long, hermetically sealed; then fill this. But the glycerine barometer is even better for gentle fluctuations of atmospheric pressure.—W. J. Lancaster.

[47991.]—**Photographic.**—You can write the name on the bottom of the negative in Indian ink, then in the print the name will appear white. The name has, of course, to be written backwards, so that it shall print in the right way on the photo. The easiest way is to do what the lads call print the name on the negative, thus, NOᗡ. It can be easily written, and when printed on photo will, of course, read "don." You will soon become proficient with a little care.—W. J. Lancaster.

[47992.]—**Commutator for Small Dynamo.**—To Mr. Lancaster.—You should use blocks of ebonite. These can be sawn and filed up into any shape you may want them, and, as you know, will perfectly insulate one part from the other.—W. J. Lancaster.

[47992.]—**Commutator for Small Dynamo.**—Around the end of the shaft fix an ebonite ring. Screw the metal for commutator on to this ring, taking care that the screws do not go through to the shaft, their threads being only imbedded in the ebonite. See answer to 47937, by "Conrad," for sketch; but modify by making the severance between the two commutator plates slightly slanting.—H. Stooke.

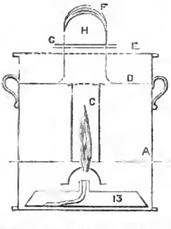
[47993.]—**Manganiferous Ore.**—To Mr. Belcher.—The reason that 44 of CO_2 equals 43·5 of MnO_2 is that (when treated in the manner described) one molecule of MnO_2 (= 43·5) liberates two molecules of CO_2 (= 44). I am reckoning by the old atomic weights. The reaction of sulphuric acid (concent.) on manganese di-oxide and oxalic acid is as follows:—

$$MnO_2 + H_2C_2O_4 + H_2SO_4 = MnSO_4 + 2H_2O + 2CO_2.$$

With regard to the other query, I meant to have said that the quantity thus found × by 50 (because you took 2 grammes of the ore, and 2 × 50 = 100) equals the percentage of MnO_2 in the sample, instead of saying "equals the quantity of MnO_2 in the sample."—J. C. Belcher.

[47999.]—**Electric Locomotive.**—To Mr. Lancaster.—The simplest and really most efficient motor you can fit to your truck is a rotating circular one. The motor should be about 8in. long and 2in. diameter. It is made of first an iron core ¾in. diameter, with six square ends, or rather having six inclined planes round each circumference; these should be so filed up as to rotate just inside six iron rods, making frame which carries the motor. Around the iron core you will wind wire in the usual way, and at one end you must have a commutator with six points of contact. The rotation is produced in this way: Close the circuit, and you will have an electro-magnet, the ends of the core being larger than the bobbin, and forming inclined planes will attract, and be attracted by, the iron rods forming frame of motor; the electro-magnet will rotate until the tops of inclined planes are just opposite iron rods, then circuit is broken and joined directly after, when another pull takes place, and so a continuous rotation is obtained. This rotation is conveyed to driving wheel of engine by two crown wheels. With such a motor a good speed can be obtained.—W. J. Lancaster.

[48001.]—**Heating Soldering-Iron.**—I here forward a sketch. A, casing of stove: 13, lamp



and uptake; D, baffle-plate; E, top of stove; F, the tilt mentioned; G, wires; and H, place for the bit. Make the tilt just high enough for your purpose, and let it rise at the back an inch higher. I have got things at a red heat; but you must adjust your lamp that the article is not smothered with carbon. —JACK OF ALL TRADES.

[48002.]—**Heating Soldering-Iron.**—See reply 48001. No; you would come to grief with spirits.—JACK OF ALL TRADES.

[48010.]—**Oil on the Waves.**—It will take a long, long time to cover the sea with even a thin layer of oil, too long, in fact, to approximately calculate; but even if it was covered it would be assimilated very quickly by all sorts of animal life. I should be sorry for the inhabitants of the globe when the waves of the ocean have been stilled by throwing oil upon the waters. The air that has passed through the particles of a huge wave broken into spray is the purest and most health-giving you can find anywhere. A south-west gale fresh from a stormy sea is productive of more good than anybody can picture. The oxygen, ozone, and traces of iodine, bromine, &c., taken up by the air after travelling over miles of foaming sea, is of the utmost value to human and other life, and it will be a very sorry time for the people when every mad-brained navigator pours all the oil he can get on to the surface of the ocean; before then, many generations will have passed away and other methods of sailing will be invented, doing away with the horrors of sea-sickness and the discomforts of a stormy voyage.—W. J. LANCASTER.

[48013.]—**Tricycle.**—Steel or iron tire would cause too much vibration. Strengthen steering rod, and have handle working rather tight.—CORIDAEUS.

[48013.]—**Tricycle.**—You have evidently a poor tricycle, and a very slow express, I should imagine. The brake on the back wheel is bad—very bad indeed. You should either have a brake on the hub, or, next best, two brakes at the back of the hind large wheels. I am afraid your hind wheel is too small; if it is, you will be unable to cure its erratic motions. A great many tricycles have been made with a small wheel; it is altogether wrong, the hind wheel is even better too large than too small. You cannot beat the indiarubber tires. They ought never to shift with ordinary treatment; of course, they won't carry you over a five-barred gate, or even ten miles an hour over rough stones. I have been a long, long way on my machine, and although the rubber is cut here and there, still, the tires are as firm as the day I had it; in fact, my machine, a best "Swallow," has never cost me one penny in repairs. This is a great deal to be thankful for, but it is always best to have a good thing, especially where life and limb are at stake. You must get thoroughly used to the steering-handle, and don't turn it too abruptly when it skids, or you will go over; let it have its own way under your control.—W. J. LANCASTER.

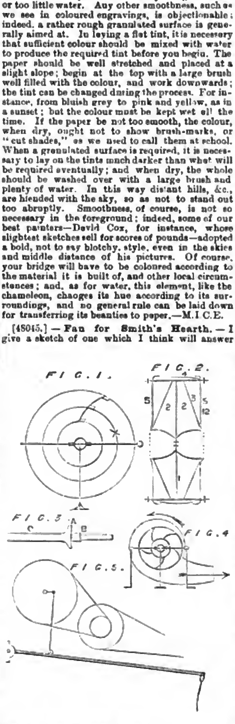
[48014.]—**Magic Lantern.**—Use a mixture of lampblack and good shellac varnish. This gives a good dull black, and dries quick.—J. R. E.

[48014.]—**Paints for Lantern-Slides.**—The best yellows for painting on glass are, I believe, Italian pink and gamboge; the former appears to be called a pink on the "lucus a non lucendo" principle, as it is not a pink, but a bright yellow. The chromes and cadmiums are of no use, as they are not transparent. The only transparent reds are, I believe, the lakes, crimson and scarlet. Any tint of orange can be obtained by mixing the lake with the yellow. I have tried both oil and water-colours, but I do not find any difference in brilliancy, and as the water-colours are more easily managed, I prefer to work with them; but in using water-colours, the picture must be varnished with Canada balsam and turpentine, which dries in a quarter of an hour, and you can always again paint with water-colours on the picture so varnished; but do not attempt to paint over the first coat before it is protected by the varnish. I don't think there is any way of re-moistening the colours after they have become hard. When I was in India, I used the water-colours in tubes. You can get them, I think, by writing to Newman and Co., booksellers, Dalhousie-square, Calcutta.—M. I. C. E.

[48019.]—**Polishing Rock Crystal.**—This is past the hand of an amateur. You could not at all do it successfully, and the cost of the necessary apparatus for cutting would be immensely more than the cost of having the crystal cut and polished by someone in the trade.—W. J. LANCASTER.

[48024.]—**Water-Colour Painting.**—By "smoothness," I presume is meant a tint either flat or graduated, so produced as not to show marks of the brush or inequalities caused by using too much or too little water. Any other smoothness, such as we see in coloured engravings, is objectionable; indeed, a rather rough granulated surface is generally aimed at. In laying a flat tint, it is necessary that sufficient colour should be mixed with water to produce the required tint before you begin. The paper should be well stretched and placed at a slight slope; begin at the top with a large brush well filled with the colour, and work downwards; the tint can be changed during the process. For instance, from bluish grey to pink and yellow, as in a sunset; but the colour must be kept wet all the time. If the paper be not too smooth, the colour, when dry, ought not to show brush-marks, or "cut shades," as we used to call them at school. When a granulated surface is required, it is necessary to lay on the tints much darker than what will be required eventually; and when dry, the whole should be washed over with a large brush and plenty of water. In this way distant hills, &c., are blended with the sky, so as not to stand out too abruptly. Smoothness, of course, is not so necessary in the foreground; indeed, some of our best painters—David Cox, for instance, whose slightest sketches sell for scores of pounds—adopted a bold, not to say blotchy, style, even in the skies and middle distance of his pictures. Of course, your bridge will have to be coloured according to the material it is built of, and other local circumstances; and, as for water, this element, like the chameleon, changes its hue according to its surroundings, and no general rule can be laid down for transferring its beauties to paper.—M. I. C. E.

[48045.]—**Fan for Smith's Hearth.**—I give a sketch of one which I think will answer your purpose:—Outside diameter of fan, 15in., the eye 4½in.; the blades are in two, as the fan is constructed with a central web point 1in. at the eye, 3in.; with these figures you will be able to work to Fig. 1 the cross stem distance from centre, and the same distance gives the curve and position of blades. These should be five on both sides of web; you may put them alternate or opposite. Fig. 2 shows edge view of fan blades and box; 1 web, 22 blades, 3 diaphragm, or covering over the blades, 4 distance piece of box or casing, 55 cheeks; Fig. 3 shaft 1in., forged with a collar on; B may be square to go into a square hole in the web, and bolted to the collar with 4⅜ bolts, the other ⅜. Fig. 4, a conglomeration of elevation, section, and crowding as much in the space as I can; but still I think readable. The casing should be 4in. larger in diameter than the fan and eccentric, as shown; the arrows show the way it should run; the stays and crutches that carry the casing and bearings made of quarter iron bar by 1¼, the web of sheet iron No. 12 gauge; the cheeks of casing the same, the blades of No. 16, the distance piece of the same, the diaphragms of 20. Let your outlet of casing be about 4in. square, and you can contract that from there, and make it round from the next piece. Fig. 5 gives you an idea of the driving gear: first wheel, 3ft. 6in.; crank, 4in.; throw this on to small wheel 6in.; or 2ft. wheel on the same shaft; drive the fan with a 4in. fulcrum to Pitman, 2ft. length of pole over all 8ft., giving a rise of 32in. in action, and at 20 strokes will give you 840 revolutions of fan.—JACK OF ALL TRADES.



[48062.]—**Watch-Repairing.**—If the lever watch referred to by "J. B." has the spring at top of balance, and supposing it is on the gaining rate, to correct proceed thus: Unpin spring from stud (before removing from plate), then remove balance and spring from movement, and taking balance in left hand, supporting centre with the thumb-nail, turn the roller with a smooth pair of pliers a little to the left; place balance, &c., in movement, and repin spring in stud, so that the watch ticks equally. You will here observe there is more spring in action than before—hence the desired effect; *vice versâ* if losing.—CORNELICUS.

[48062.]—**Watch-Repairing.**—If you have got the regulator of your watch all the way towards the word "Fast," you must take up the spring in precisely the same manner as was described in a recent letter respecting verge watches—i.e., you must turn the collet round with a steel point in the direction the end of the hairspring points. If the roller jewel is set in a line with a bar of the balance, do not move the roller. By getting that particular bar exactly over the pallets hole when the hairspring and balance are replaced, and the cock screwed down, you will be sure to get the watch on beat without trouble or doubt. The hairspring should be set free from the balance on one side, and from the plate and regulator on the other, being left free to play between the pins without friction of any kind. I have an assistant who persistently neglects this most important item, and, consequently, watches leaving his hands are frequently very erratic in their action. Too much attention cannot be paid to the correct setting of the hairspring. In one of the trade journals a correspondent asserted he could judge of the abilities of a workman by the manner in which he fitted new hands to a watch. I think such an estimation of ability could be more easily formed from the manner in which a hairspring was fitted or set in action. Pardon this digression. Jewels are bought already drilled for the pivots, and are fitted by specially adapted tools, or appliances in connection with a mandrel, which is a tool costing from £5 upwards.—ALFOJOE.

[48066.]—**Verge Watch.**—The fault may probably be in the mainspring binding in barrel, or not set up enough. Are you sure that the chain is free of potence and pillars, and also that barrel is free in plates? You can close the verge, but you would have to reduce pallets to allow wheel to escape off. Some workmen soften the verge body, and twist pallets; but I do not like that plan. I should recommend turning in a new verge, as by softening verge it is generally spoilt; and if verge is hard it would very likely break with the alterations. To bush centre hole use a bush, if you have not a mandrel. The adjusting-rod is used to get the equal pull of mainspring. Place the barrel and fusee in frame, and put the rod on fusee square, set the spring up a little, turn rod round, and see that it balances like a pair of troyes at each turn of fusee, until it is wound up; the ball is to make rod-balance for different size springs. If you will advertise your address, I will give you any information free of charge.—WORKING BLACKSMITH.

[48066.]—**Verge Watch.**—Evidently the escapement, or else the train of wheels, in the verge watch referred to in your letter is not free in some way. If it stopped when the first coil only was on the barrel, I should suspect the accuracy of the stop-work action. It may be that the chain or hook rubs against the potence hollow: the potence being that part which carries the verge, and screwed under the top-plate. I advise you to let the verge pallet-angles alone; they seldom or never need alteration. It is a risky job even to a practical hand: so I am sure you would get into trouble in doing it, and in the end do no good. I venture to assert that the fault will not be found in the pallet-angles. It may be that the pallets are too broad, or that the escape-wheel teeth are incorrect. In either case, you will need to use great care in altering them. When you listen to the watch while going, do you hear a sort of secondary tick? If so, the follower should be very slightly drawn. This will, in many instances, correct the little fault here mentioned. So many little faults may bring about the trouble complained of, that it is difficult to assign a particular one. The better plan would be to take the watch entirely to pieces, and carefully try each wheel singly, and then again in pairs. Should any wheel be bound in one or both holes, free it out with a fine pivot-broach or burnisher. I have found it an excellent plan, in trying the freedom of wheels, to pin the plates together as they ordinarily are; and for this purpose I keep three or four long housepins, filed up fine, to insert in the pillars. In holding together in the fingers, the plates are sometimes not pressed together flat. If you do not possess an uprighting-tool, you can only guess at the correctness of the centre-wheel depth. Under those circumstances, if you have inserted a new bushing, set the centre-wheel in the plates and pin them up; then reverse the cannon pinion, and push it on the stump of the wheel: this gives you something to twirl it by. Give it a good spin round, and observe if the wheel runs parallel or not to the plates, or whether there is any wobbling at the stump. All should run perfectly true and flat. Should the wheel be a little out of truth, it is best to remove the bushing and insert another, the hole in which has been drilled a little out of the centre. This should be left sufficiently long to be able to twist round until the wheel is found to be perfectly right. It should then be cut off close and riveted. The adjusting rod is used when a new mainspring has been fitted to a watch. By means of it, it can be ascertained whether or not the spring is sufficiently strong and lengthy to draw the train fully down with an equal pull from the winding-up. If the springs are not properly fitted, it may be found that they "block" when fully wound up, or are slack when nearly down. In use, the squared part is screwed upon the fusee arbor, after the spring has been set up—the train of small wheels being left out—and the sliding ball is so set that the spring shall be able to carry the rod round and round until the chain is delivered on to the barrel with a constant and steady motion. To thoroughly understand its correct manipulation you would need to see it in use. I find it somewhat difficult to give a more lucid explanation than I have without giving illustrations. It is a tool that few watchmakers habitually use, so you could easily dispense with its services.—Alfojoe.

[48067.]—**Silver Watch-Case Repairs.**—Respecting the discolouration on your silver after soldering, you must have had iron or the like present in some form. Such a discolouration is precisely what *would* happen then. The "pickle" should be kept in an earthenware jar or pot, and nothing in the shape of iron wire or steel tools should touch it. Joint-wire may be procured in any size, and in any of the ordinary metals—gold, silver, brass, German, &c. The size most in use is such as you may observe in brooch joints or lever-watch joints. I give you a wrinkle to rub in respecting joint soldering. It is frequently found that the solder runs into the joint-hole, and nearly, if not quite, stops it up. This may be effectually prevented by cutting a piece of pegwood to fill it up. The act of soldering burns it to charcoal; so it is easily removed afterwards, and, as I have said, it prevents the solder running in.—Alfojoe.

[48070.]—**Prospects in Western Australia.**—Referring to the last question of "A Mechanic," land order warrants, of the value of £20, are granted by the agent-general of South Australia, to persons who pay their own passage direct to Adelaide, and obtain his approval before sailing. On arriving in the colony, the warrants are exchanged for land orders, which are immediately obtainable in the purchase of Crown lands. After a two years' residence in the colony, the land orders may be transferred. Pamphlets and all information can be obtained at 8, Victoria-chambers, Westminster. I think this would suit "A Mechanic."—T Mackenzie.

[48081.]—**Small Blower.**—This is hardly a reply to this query; but as I am making one myself for blowpipe use, I would suggest to "H. W. W." that hinges are unnecessary, if the boards are left ⅝in. or 1in. apart at that end. The leather will act as a hinge with less risk, I think, of cracking it. I intend to try it thus, and to make the join in the leather at the middle of this end. I should be glad to know if Prout's elastic glue would do for cementing it, or if there is any better kind, and if any necessity for sewing it as well: also what is the best way of making the leather fold properly in closing. In using gas for a blower, is there any danger of it being drawn in and exploding?—Nemo.

[48089.]—**Fish Tank.**—Try 2 or 3 coats of zinc-white paint.—J. R. E.

[48109.]—**Zinc.**—The solder is ordinary tinman's solder; the fluid, spirits of salts. First scrape dirt off zinc, wet the parts with the spirits (a cane flattened out makes a good brush) and apply the solder and the bit. You must keep the latter well tinned, and the solder will follow it.—T. P.

[48109.]—**Zinc.**—This can be soldered very well by the ordinary soft-solder, such as is used for tin-plate—that is what I have used, and I find no difficulty. In order to make the solder run, use a solution of chloride of zinc; this is made by dissolving zinc scrap in muriatic acid till the acid will dissolve no more; a little sal-ammoniac may be added with advantage. With a small brush or piece of wood or wire (or anything handy), paint this over the part where you wish the solder to run. Of course, you can tin and use the soldering-bit?—Os

[48092.]—**Property of the Number Nine.**—A number—say, of five places, whose digits are a, b, c, d, e, may be written thus:—

$$10000\,a + 1000\,b + 100\,c + 10\,d + e.$$

Subtract the sum of the digits:—

$$a + \quad b + \quad c + \quad d + e.$$

There remains:—

$$9999\,a + 999\,b + 99\,c + 9\,d$$

a sum evidently divisible by 9, whatever the values of a, b, c, &c., may be.—M. A.

[48117.]—**Electro-plating Solution.**—There is no necessity to throw it away; you can recover the silver. I should not attempt to doctor it in any way, as you will only waste time and money. I presume, of course, that you have tried it, and found that it will not plate properly. When answering your other query, I forgot to say that a gold anode should be used for gilding.—Os.

[48118.]—**Electro-plating.**—Personally I don't think either lead or pewter worth plating, and I would not waste my time over such rubbish; but that is not the question. I don't know how many batteries you have; but you might join them up for intensity—that is, zinc to copper, and copper to zinc, and get a little more electromotive force. Don't put a very thick coating on, as a thin one will, I think, burnish better on pewter than the former. You can deepen the colour of gilding by heating the solution.—Os.

[48123.]—**Reed Organ.**—If you intend constructing a reed organ on the suction principle, do not use the ordinary harmonium reeds, as, for this, they will require some alteration which would be a rather delicate job for an amateur. American organ reeds are the reeds which you will require, as they will only require voicing. If I were about to construct an instrument to contain 3½ rows of vibrators, I should select the following specification as the best for general musical purposes:—Treble stop: clarionet, 16ft.; dulciana, 8ft.; celeste, 8ft.; flute, 4ft. Bass stops: Bourdon, 16ft.; diapason, 8ft.; principal, 4ft. If any mechanical stops are required, I should select the following: Octave coupler, Vox Humana, and two stops to subdue the power of the diapason and principal in the base. The 16ft. sets should be placed nearest the back of the instrument, the principal and flute sets in the front. The diapason, dulciana, and celeste sets may be placed between the 16ft. and 4ft. sets. I do not think that any real advantage will be gained in having the reeds situated above the keys, in this case. You will not require any channels, if constructed on the suction principle. One reed valve in connection with each key will suffice to cover the corresponding reed apertures. You can purchase the various tube-boards to hold the reeds at a moderate cost from any respectable manufacturer, which will save you a deal of trouble. Any further information if necessary.—G. Fryer.

[48125.]—**Electric Bell.**—One of the wires from bobbin should be taken to one binding screw, the other wire (from bobbin) to the armature, and another wire from contact breaker to other binding screw.—Electrician.

[48126.]—**Electro-Deposition.**—Guttapercha must not be used for cyanide solution. Cyanide of potassium dissolves it very fast; and what it does not dissolve it will leave quite rotten. It will answer better for an acid solution of copper; but I should not care to use it, even for this. Don't divide your trough into two (or any other number of parts: you will find it very inconvenient. The brass-covered stair-rods will do very well. I don't understand your question about fixing them one above the other. Read four letters of mine on "Electroplating" in Vol. XXXIV. of the English Mechanic (Nos. 866, 869, 868, 874). You will not find a Grove's battery at all suitable for ordinary electroplating. Daniell's is the proper battery.—Os.

[48130.]—**Steam-Boiler Manhole-Doors.**—Use asbestos cardboard; nothing like it.—Os.

[48130.]—**Manhole Doors.**—Let "Steam User" make his joints with rubber and canvas packing, ½in. or ⅝in. diam. (round), such as is used for piston-rods, scarf each end taper, about 1½in. long, and tack together with copper tacks ¼in. longer than diam. of packing. After placing on door, use a strand of white spunyarn, teased out, and smear with black-lead and tallow, to prevent sticking to boiler. Don't screw up too tight. Will stand any pressure and last any time. When re-made, use fresh spunyarn, &c.—W. Beaulah.

[48133.]—**Locomotives.**—L. and N.W. engines, Nos. 1010 and 2342, are coal engines, 4ft. 3in. wheels 6-coupled; 2003 is a 4 coupled 6ft. 6in. passenger engine, named "Alecto."—Thunderbolt.

[48133.]—**Locomotives.**—The cylinders of the "Princess Alexandra" are 16 by 24. Midland; 883 is a side-tank goods engine of a powerful class, built by Beyer, Peacock, and Co. 1871, for the London traffic. I am sorry to say I do not know the dimensions. 1212 is a 6-coupled goods engine, built by Beyer, Peacock and Co., 1876; cylinders, 17½ by 26; coupled wheels, 4ft. 10in. No. 1466 is a 6-coupled goods engine, built by Stephenson and Co., 1881; cylinders, 17½ by 26; coupled-wheels, 5ft. 2½in. diameter. This engine is fitted with a steam-brake. Great Western: "Aluca" is one of the 8ft. broad-gauge singles. If it originally belonged to the Great Western Railway, the cylinders are 18 by 24, but I am not sure whether it was not obtained from the B. and E. Co. If this is so, the cylinders are not so large. L.N.W.: 1010 is one of Mr. Ramsbottom's 6-coupled goods; cylinders, 17 by 24; coupled-wheels, 5ft. 2in. No. 2003 ("Alecto") is one of Mr. Ramsbottom's 4-coupled passenger engines; cylinders, 17 by 24; coupled-wheels, 6ft. 7½in. diameter. It was built at Crewe in 1871. I am sorry to say I do not know the Brighton engines.—Metror.

[48138.]—**Child's Ankle**.—I have a son, now in his 40th year, who was lamed by a blow of a stone, when about three years old. I consulted half a dozen surgeons, but the child's leg became more and more useless; so, after the lapse of three years of suffering and helplessness, I took the management into my own hands, and have most thankfully to state its success. I had to get up the child's strength by every possible means, such as judicious food, baths, and exercise supply; at the same time keeping his mind suitably amused. The principal secret of the cure consists in the persevering use of wet bandages. Take a fine towel—a diaper one is nicest, and it should be of flax, not cotton; fold it narrow, then dip it in clean cold water, and wring almost dry; then wrap it, perfectly smooth, round the weak limb, beginning at the toes, and ending above the knee; this wet bandage must be laid on without tightening, so that circulation shall not be impeded; have ready a thicker and longer towel (or two towels) to wrap over the wet one, covering the whole limb, and overlapping a few inches, to keep in the moisture; finally, secure all with a few safety-pins. Prepare the dear little fellow for a momentary chill—it will do him good to give a loud shout! and in five minutes he will feel the limb warm and comfortable. A few nights' practice will give skill in the application. The water "plumps" and strengthens the flesh. In the morning, wash the towels in clean water, and dry for next night.—An Experienced Mother.

[48139.]—**Locomotives.—L. C. D. Engines.**—Passenger engines (1) Express bogie-engines, numbered 157—162, cylinders 17½ by 26, driving-wheels 6ft. 6in.; built by Neilson and Co., 1877. (2) Mail engines, 53—58, built by Sharp, Stewart and Co., 1873 (57 and 58 rebuilt 1876), outside framing, driving-wheels 6ft. 6in., cylinders 17 by 24. (3) Ordinary passenger engines, Nos. 1—26, 32—52; these are all outside-framed four-coupled engines, built by Sharp, Stewart and Co., and at Canada Works, Birkenhead. The cylinders of Nos. 1 and 2 (Sharp, Stewart and Co., 1861), are 16 by 20. (4) Nos. 27—31, outside-framed bogie-engines, driving-wheels 6ft. 6in., cylinders 16 by 22. Goods engines.—(1) Single-framed goods, Nos. 135—140, 151—156, cylinders 17½ by 26, coupled wheels 4ft. 10in. (2) Outside-framed goods, Sharp, Stewart and Co., 1862, coupled wheels 5ft. dia., cylinders 17 by 24. These goods engines, one of which was in the exhibition of 1862, have Cudworth's fire-box. Passenger tank-engines (1) Bogie tanks, single frames, cylinders 17½ by 26, leading and driving-wheels 5ft. 3in.; numbered 101—100 (Neilson, 1875), 65—70, and 110—112 (Vulcan Foundry Co., 1875), 163—174 (Kitson). (2) Scotchmen. Leading and driving-wheels (coupled) 5ft. 6in., cylinders 16 by 22 (some 16½ by 22), outside frames, numbered 81—91; built by Neilson, 1866. (3) Nos. 71—80, four-coupled, outside framed side-tank engines, built by Hawthorn, 1863, driving and trailing-wheels (coupled) 5ft. 6in., cylinders 15 by 20. Nos. 59—61, and 145—149, are of a similar class, but I do not know dimensions. They were rebuilt 1876-8. Nos. 95—100 are single-framed tank-engines. The M. S. and L. engines have for the most part outside framing. A good many of the goods engines built 1870-3, have inside framing, but very few of the passenger engines have inside frames. The chief express engines are the bogies built 1877-9 by the company, cylinders 17½ by 26, driving and trailing-wheels 6ft. 4in., numbered 423—446, also 4 by 129, and a few others. Nos. 356—365 (1875), 310—320 (1873), have a single pair of leading-wheels. I am not sure of dimensions, but was informed that the coupled wheels were 6ft. dia., and cylinders 17 by 24. No. 256—266 (1868) and others are of a similar class. The other coupled engines are smaller. I have seen only 3 single-framed passenger engines, viz., No. 64, 74, and 97. They were small engines, with 16in. cylinders. There is also one single engine with outside cylinders (No. 399), driving wheels 7ft. 6in., cylinders 18 by 26. Goods engines: The latest class have double frames. The cylinders, I was informed, are 17½ by 26. These are 460—483 (1881—2) and 380—399 (1876), 340—354 (1875). The single-framed goods engines have wheels 5ft. dia., cylinders 17 by 24, and were built 1870—3, Nos. 1, 2, 3, 33, 34, 40, 42, 280—309, 330—339, and many others. The older class of double-framed goods engine have 16in. cylinders, but I do not know dimensions. They were built 1860—1869 by different makers. Nos. 188—190 (Neilson, 1865), 210, 219, 240, 249 (Beyer, Peacock, 1866—8), 220—239 (Sharp, Stewart, and Co., 1866), are a few of this class. There are a great many others.—Meteor.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Plug" has replied to 46198; "Marlow" 47458.

47499. Model Electric Railway, p. 484.
47512. To Mr. Lancaster, 484.
47514. Tennis Balls, 484.
47516. Splitting Stone, 484.
47520. Inspecting Weights and Measures, 484.
47525. Hay Barn, 484.
47526. Quickest Railway Run, 484.
47534. Dutch Rhenish Locomotives, 484.
47539. Wear of Brake Blocks, 485.
47560. Self-Acting Feed to Planing Machine, 485.
47564. Photographic Lens, 485.
47565. Valve Motion, 485.

47746. Terra-cotta Painting, p. 580.
47763. Osier-growing and Basket-making, 580.
47764. Greenhouse, 580.
47774. Cutters for Use in Lathe, 583.
47777. Clouds in Negatives, 580.
47782. Confectioners' Oven, 580.
47790. Mechanical Lantern Slides, 581.
47792. Staining Glass Green, 581.
47796. Electrical, 581.
47803. Third Grade Art, 581.
47806. Chemical Lung or Sanitary Punka, 581.

USEFUL AND SCIENTIFIC NOTES.

A Philadelphia gentleman has recently had a sad experience with his telephone. According to the Boston *Journal*, in using the instrument he stood with his face quite close to "the hooks which hold the transmitter," and perhaps unconsciously touched them. "Suddenly he seemed to see a bright blue and white fire shoot out of the very body of the instrument, and at the same moment he experienced a sensation like having a claw seize and drag up the skin of his forehead, and holding him by it, shake him to and fro with great violence." He was partially stunned, and on recovering himself, after the lapse of half-an-hour, found his watch hopelessly disordered. There was no storm at the time, or the transmission of lightning over the wire would seem to be the most probable explanation of the phenomenon, but in default of that, the crossing of the line with an electric-light wire might easily account for it. However that may be, it seems quite time that lightning-arresters should be applied to all telephones. As usually introduced in the country, with several subscribers on each circuit, the crackling of the instrument during a thunder-shower, unless the wire is disconnected, is quite sufficient to alarm a nervous person, and the possibility of an unexpected shock at any time certainly does little to encourage the spread of the system.

The Growth of American Trees.—Some notes have been published on the native trees of the lower Wabash and White River Valleys, the result of long and careful observations, made by Mr. Robert Ridgway and other naturalists, upon the forest growth of Southern Indiana and Illinois. Nowhere in the whole of Eastern America have as many large specimens of as many species been recorded as Mr. Ridgway found in the lower Wabash Valley. Nearly all the largest and most valuable broad-leaved trees are there found associated together, and in a single square mile of woods 75 species of trees, nearly all of the first-class, were tabulated, being nearly as many as grow on the whole European Continent. By actual measurement 34 species were found to occasionally exceed 100ft. in height, while 17 others, although not measured, were apparently at least 100ft. high. The tallest specimen measured, a tulip tree, was 190ft. in height, and individuals of 10 other species exceeded 150ft.

QUERIES.

[48145.]—**Cleaning Morocco Leather.**—How can I clean and renovate some Morocco leather recently removed from an easy-chair? It is very dirty, and has been saturated with water; it is not stiffened, but has a dirty brown appearance.—J. C. S.

[48146.]—**Legal.**—To Mr. Fred. Wetherfield.—Would your obliging correspondent kindly reply further on the subject of query 47485, p. 461, on the two following points—viz., (1) The nieces of the testator whose will is contested in Chancery, become possessed of property above £200 which, by their marriage settlement, follows original trust, but as rents for about 12 mos. will have accrued since testator's death, and will, I suppose, form part of the Chancery award, will it not be just and proper that such sum derivable from such rents be considered as income, and as such, not to follow original trust? (2) The trustees are exempt from the duty of seeing to the settlement of funds, such as above, and their not seeing to it is not to be breach of trust—this is carefully laid down in deed; therefore, the agreement to invest such property in the trust exists only as between the husband and wife; the question has therefore arisen, Can they (the husband and wife) waive the carrying out of this agreement, and mutually agree not to invest such property under the deed? It is thought that such proceeding is the spirit in which the clause is drawn or, in other words, optional.—Married and Done For.

[48147.]—**Fixing Fretwork.**—Will some kind reader of the "E. M." inform me what is the best method of fixing fine fretwork panels to a background of solid wood which has been well polished? I find glue does not stick well on the polished surface, and the work being fine, would not admit of nails, or even brads.—Rydal Mount.

[48148.]—**Harmonium Couplers, &c.**—I have nearly completed a two-manual harmonium with pedals. Will any correspondent tell me how to make the best kind of couplers, and what reeds would be suitable for each manual of 3½ rows reeds each?—B. J. T.

[48149.]—**Dynamo for Electro-Plating.**—Could any one give me a description of a dynamo as above for plating spoons and such things? Please say what the number of wire should be used for the armature and magnets, &c., and a drawing of the machine, if possible.—H. L. Rutter.

[48150.]—**Zinc Castings.**—Would some correspondent who knows kindly give particulars of above? When I have made castings of zinc bolts in plaster-of-Paris moulds, they are all honeycombed. Is there anything used along with zinc to stop the honeycombing?—R. B.

[48151.]—**Flax, Hemp, and Jute Spinning.**—Can any reader inform me where I can procure practical treatises on the above subjects, with diagrams, of the machines used? Also, if it is possible to get working drawings of the machines?—Glasgow.

[48152.]—**Violin.**—Am making one. Will "Fiddler," or some other correspondent, kindly assist me? Have understood that ⅛in. is the right thickness for back and belly; the latter to be a shade thicker, the whole length of middle to support pressure of bridge; the ribs about 1-16in. thickness; have sycamore for back and ribs, and reputed Swiss pine for the belly. (1) Will any other wood than Linden do for the horizontal fastenings? (2) What does Berlioz mean (alluding to good fiddles) by "graduated"? To what part or parts does it apply? Lastly: Is it right to give a coat of size two days before varnishing?—Mallorca.

[48153.]—**Removing Black Stains from Marble Tablet.**—Would any reader of the "E. M." kindly help me out of my difficulty—viz., having used some black japan to blacken letters on marble tablet, I find it has penetrated the stone to such an extent that I find it impossible to remove the black round the letters. I have done it before, and have been successful in making a good job; but I think this black Japan is a bad quality. I did this job the usual way—i.e., painting the stone all over where the letters are cut; then when dry scour off with water and fine stone, leaving the letters untouched. Perhaps there are some chemicals that would clean the stone; as if not, I must go to the expense of new tablet.—Church-Hill.

[48154.]—**Rudder.**—Can some one inform me, from recollection of the published accounts, as to the nature of the accident which happened to the rudder or steering gear of H.M.S. Bacchante, some months ago, during her last cruise? Also, as to the nature of the "jury" rudder or steering-gear then substituted?—R. M. Stable.

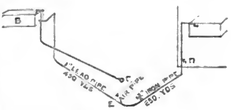
[48155.]—**Substitute for Hops.**—What is the best substitute for hops? Their price this year is almost prohibitive.—J. C. A.

[48156.]—**Geneva Watch.**—After winding a ¾-plate Geneva watch it stopped, and thinking that it was overwound, I took out the balance-wheel and allowed it to run down; but on replacing and winding it still does not move. What is the cause and remedy?—Amateur.

[48157.]—**Gas from Petroleum.**—Will some correspondent acquainted with making the above kindly give size and shape of vessel to be filled with sponge for eight lights? Is common petro. or spirit used? Is there much danger connected with it? Can a light be got equal to gas, and if motive power adds nothing to the expense, is there anything to be saved where gas is 5s.—O.

[48158.]—**Short Sight.**—Being rather short-sighted, and my eyes aching after reading or writing much, I was suited at the ophthalmic hospital for a pair of spectacles—No. 10 concave English—and told to always keep them on. I object to always keeping them on, but am willing to wear them during the time I am reading or writing. Will my eyesight be at all saved by so doing, or had I better not put them on at all? If I wear them while reading and writing, shall I be any more near-sighted when I take them off to attend to my out-door duties and amusements? I have been told by friends that if once I wear them I shall be unable to do without them. Is that correct? If so, I prefer to remain as I am, and not wear them at all.—A Clerk.

[48159.]—**A Water Question.**—Will any of your readers solve this problem, and suggest a remedy?—A. is cistern at house; B. large tank at lodge; C. is well in valley; D. tap in scullery; E. air-pipe at lowest point of main. The water is pumped up from C. to B., and runs itself from B. to A. For fifteen years there has been a continual supply. Lately, it suddenly stopped. Finding the main (¾-iron) corroded between B. and E., we laid in a 1in. lead pipe so far, and connected it to the old main running up to A. For a few days it ran better than ever, but suddenly stopped running at the cistern A., though ran very well at D. in scullery, the pipe between D. and A. being perfectly clear. After filling tank B. to overflow, it started again, but has since kept stopping and starting itself. We have lowered the cistern A. 18in., and put in an air-pipe E.—with no better results. Would the laying in of a larger pipe part way cause the stoppage? Is it air that stops it? If so, where does it accumulate? We find no air at E.—Plumber.



[48160.]—**Hood for Camera.**—To Mr. Lancaster.—I have lately purchased a Le Merveilleux camera, with which I am very much pleased. It has no hood, however, for covering the operator's head when focussing; and as I do not know the right way to make and attach one, I shall be obliged to Mr. Lancaster if he will kindly give instructions.—Assoc.M.I.C.E.

[48161.]—**Secondary Batteries or Accumulators.**—I have made two model Faure accumulators by laying side by side 12 plates of tea-lead coated with red-lead and dilute sulphuric acid. These plates are separated by sheets of blotting-paper, and each group of 12 plates wrapped in some woollen stuff, and placed in a separate jar filled with the dilute acid. Not having a dynamo-machine, I linked the accumulators with a 2-cell Bunsen battery, and after a quarter of an hour, on disconnecting the accumulators, I found they had retained sufficient of the electric energy to deflect the needle when I applied the galvanometer. I reversed the current several times at intervals of a quarter of an hour; and finally left the accumulator connected with the Bunsen battery during the night. In the morning I could not get a current from the accumulators, nor yet through them when the battery was connected; but after about an hour I found that the current would flow through them again, but they would not retain sufficient of it to deflect the needle. The only theory I can form is, that the blotting-paper, when once it was thoroughly saturated, did not offer sufficient resistance to the current. But this theory will not account for the current refusing to pass through the accumulators, as it did for about an hour. I would also be glad to know if an electro-magnetic machine, such as used for medical purposes, would serve to charge the accumulators if driven at a high rate of speed? And also how I may know when the accumulator is filled to its utmost extent? Also, if it is dangerous to touch the connecting-wires when the accumulators are fully charged?—Puzzled.

[48162.]—**Telephone and Indicator.**—I should be glad to know if the "Simplex" telephone is really good and loud? I require to make, as I cannot obtain, an electric arm indicator as used in the railway cabins. Will someone kindly oblige with instructions?—Gerald Hawley.

[48163.]—**Brake for Dog-cart.**—Can any of your readers give detailed information of a really good effective brake for a dog-cart? The prize brake of the Newcastle Competition throws the weight on the horse's back down hill. I want it taken off.—W. Lodia.

[48164.]—**Waterproof Dressing.**—Will some reader inform me how to make a waterproof dressing similar to that used for railway-sheets, &c.?—H. B. S.

[48165.]—**Valve Trumpet.**—I have just commenced to learn this instrument, having substituted it for the cornet in an amateur orchestra. So far, I am able to produce most of the notes on the scales, but find it very untractable and laborious as compared with its offspring—the cornet. Would some reader who has experience of the trumpet, kindly inform me if I may hope for fair proficiency in a year or so with a daily practice of an hour? I would also be glad of any hints as to production of the notes, fingering, and general management.—Clarini.

[48166.]—**Income-Tax.**—I have been paying Income-tax for some years, but my income being below £50, and have been told that I should not pay it. Can I recover this tax for the last three years? If so, would I require to get certificates for each payment of interest on money invested, and where should I apply for exemption?—Inland Revenue.

[48167.]—**Intestate.**—A. is a widower with two daughters; B. is a widow with one daughter. They marry and have issue—two sons and one daughter. A. dies without a will, and the law decides that the widow gets one-third the effects, and the remainder to be equally divided between A.'s two daughters by first marriage, and the three children by last marriage; the daughter of B. by first marriage getting nothing. Soon after A.'s death his oldest daughter by first marriage also dies without a will. To whom does her share of the fortune revert? Does the widow or any of the children by second marriage get any, or does the whole belong to remaining daughter of A. by first marriage?—Snob.

[48168.]—**Legal.**—A married lady will have, in her own right (by her father's will), £2,500. She has already mortgaged £500 of her right to a person for borrowed money until the landed property is realised, that has been left by her deceased father. I lend her £100 for the above purpose, upon a bill on demand, signed by herself and her husband. The husband is now trying to do a swindle by representing to all his creditors that he cannot meet his engagements. Can I sue the lady and recover at law from her private estate the £100 I lent her upon her signature to the bill on demand?—Edward Turner.

[48169.]—**Star Magnitudes.**—To "F.R.A.S."—Would you kindly inform me what magnitudes are assigned to the following stars by Flammarion in "Les Etoiles"?—Ophiuchus, σ; Aries, δ, ζ; Aquila, ε, Aquarius, β, ζ; Delphinus, α, β; Pegasus, θ, 56; Triangulum, β; Cepheus, ι, κ, η; Cygnus, κ; Boötes, ξ, γ; Pisces, ε; Ursa Major, κ, ο, θ; Draco, μ, τ, θ, χ, 15, υ.—Draco.

[48170.]—**Electrical.**—Will "Sigma," or some other practical electrician who knows, kindly inform me whether silver-plates can be used instead of carbon in the ordinary bichromate cell, and if so, whether there would not be some advantage on account of its greater conducting power? Also, whether there are any known drawbacks to its use except expense?—Silver-Plates.

[48171.]—**Married Woman's Property Act.**—To Mr. Wetherfield.—Under the new Act, what will a husband be entitled to out of the separate estate of his wife, should she die without leaving a will? To whom would her real property, if any, go?—Agaroso.

[48172.]—**Opera-Glasses.**—Can any of your readers tell me whether I can do anything to remedy the defects of a pair of opera-glasses? When I first tried them I found I could not see clearly through them until I screwed up one of the eyepieces a little; but having fixed that, I can see fairly with them now. On looking at the moon, however, the other night, I found that the orb appeared oval instead of round when I used both eyes, but quite round when I used one. What is the reason of that? It shows there is something amiss. Can it be remedied? The glasses are slightly too wide for me between the eyes. Would that account for it? And why is it that some glasses are so exceedingly clear, and others make the eyes ache, and put everything in a mist?—L. B. B.

[48173.] — **Locomotives.** — To "Metsor." — I perused with interest your reply re locomotives in the "E. M." of Sept. 22. Could you not, however, give a sketch of one or two of those mentioned? And might I suggest that if some of your correspondents who answer engine queries would more frequently give sketches, it would be more satisfactory and interesting.—E. E. R. Trayman.

[48174.]—**Astronomy.**—A few days since a friend drew my attention to one of the science primers on the above subject, edited by Professors Huxley, Roscoe, and Balfour Stewart. At pp. 29, 30, 31, and 32 respectively, the editors give four diagrams representing the earth as seen from the sun in four positions in its annual orbit round that body—viz., the earth at the summer and winter solstice, and at the vernal and autumnal equinox. If I rightly understand the direction of the earth's axis in its annual orbit through the ecliptic, that is, from the summer to the winter solstice, the north pole always inclines to that part of the ecliptic to which the earth is approaching, and from the winter to the summer solstice in a contrary direction. If this be the case, it appears to me that each of the diagrams in the above work, representing the vernal, and the autumnal equinox will require to be reversed to give them their true position as seen from the sun. Will "A Fellow of the R.A.S.," or some one else, kindly state his opinion on the subject?—J. Firth.

[48175.]—**Legal.**—Can Mr. Wetherfield advise me in the following case?—I am an engineer's assistant, and receive my pay monthly—sometimes not till it is long overdue, however. As I have a better engagement in view, I intend to leave shortly, but am uncertain as to the notice required. (1) Must I give a month's notice, and if so, can I give it at any day, or only on pay-day? (2) If he objects to my leaving, can he compel me to stay a month after I give notice, or can I leave at a week's notice, or without notice at all, by forfeiting the pay due to me?—Assistant.

[48176.]—**Platinotype Printing.**—I should feel obliged to any correspondent who would either give a brief description of the above process, or say what book or publication contains a description? Also, I should like to know what advantages other than permanency this process presents?—Ll. B. A.

[48177.]—**French Polishing.**—Would any correspondent tell me whether any particular size or stopping is used before French polishing, particularly mahogany?—Ll. B. A.

[48178.]—**Best Form of Forge.**—Will some one give a sketch of a cast or wrought-iron smith's hearth for iron up to 2½in. square, for gates, &c., and which can be set up in a place where space is limited? Also, say if Root's blower (hand-driven) gives a superior blast to bellows, and the best shape of tuyere for it?—Lyre.

[48179.]—**Handy Punch.**—Will some one give a sketch of a handy and cheaply-made hand-power punch or press for punching ⅜in. holes in ⅜in. and ¼in. plates about 4in. from edge?—Lynx.

[48180.]—**Wood-Splitting Machine.** — Would any fellow-reader describe the above, such as is used by firewood manufacturers? I have never seen any of them, but I am told they are constructed something like a mortising machine. A sketch would oblige—Nemo Solus Sapit.

[48181.]—**Legal.**—X. dies without leaving a will. During his illness his business has been carried on by Y. (his son, who has two sisters older than himself). The business was carried on under the style of X. and Son, but no deed or agreement of partnership was ever executed. X. being dead, what is Y.'s status, and are his sisters and brothers entitled to a share in what is left? Must the business be put in liquidation, &c.? The oldest member of the family is a sister, married, and Y. is assisted in the business by a younger brother and sister.—T. Mackenzie.

[48182.]—**Gold Bronze Powder.**—Will any reader kindly inform me how the above is manufactured, and how the brilliancy is given to the better sorts? Are there any makers in England, or is it all imported from Germany?—T. Mackenzie.

[48183.]—**Engine Queries.**—Would any reader kindly give me the size of steam-ports, diam. of piston-rods, thickness of piston, and the size of slide-valve for a 5in. bore, 10in. stroke cylinder? Also, a good simple boring-bar to bore same?—Amateur.

[48184.]—**Leather Bellows for Camera.**—Will any reader kindly inform me how to make parallel and taper bellows with the neat square folds without using two plies of material and strips of cardboard between?—Midlothian.

[48185.]—**Electric Engine.**—Will F. Walker kindly give further instructions respecting the commutators of his electric engine described Sept. 29? Does the circuit close, as armature faces are in line with the permanent magnet? He has not made this quite clear to—Elecira.

[48186.]—**Magneto-Electric Light Machine.**—In making a magneto-electric light machine on a small scale, like Holmes, on the Gramme principle, in which the steel magnets are fixed and the electros revolve, how is the commutator arranged to use one current only, and which of the induced currents is employed—the one formed on the approach of the armature coils to the fixed magnets, or the current inducing upon their receding from the fixed magnets? — Faraday's discovery.—Electra.

[48187.]—**Glue or Paste for Skins.**—Could any of our practical readers give a good recipe for fastening dog-skin to muslin lining for ladies' jacket, so as to leave it pliable and not liable to crack?—One in Want.

[48188.]—**Organ Blower.**—Will any one kindly oblige me with drawings to show how the valves are arranged in Bailey's hydraulic organ blower, and oblige?—Valve-Engine.

[48189.]—**Commutator.**—To Mr. Geo. Tolman.—Will you please give fuller instructions how to make the commutator of your small dynamo? Will you also tell me how the + and − electricity in the ordinary commutator is prevented from mixing? Also, kindly answer my query under heading of coil, on p. 508, No. 906, last vol., at your earliest convenience.—Electrician.

[48190.]—**Boiler.**—I have an egg-end boiler laid in brickwork. The end plate is cracked from three of the bottom rivets. I cannot get at it to caulk it for brickwork. Can I put anything inside boiler to stop leakage for a short time, as I cannot spare time to pull out brickwork for a few weeks? It does not leak much while working, but puts fire out when banked up for the night. The boiler is worked at 30lb. pressure.—Leakage.

[48191.] — **Sulphate of Copper.** — Will some chemical friend kindly say whether sulphate of copper deprived of its water of crystallisation would, upon further roasting, become an oxide of copper, and insoluble in water? Also, what percentage of copper would it contain, and how can copper precipitate be reduced to an impalpable powder?—H. W.

[48192.]—**Civil Service Exam. (Class I.).**—Can any reader oblige by telling me the best books to read on logic, mental, and moral philosophy, to enable me to pass the above exam.?—H. L. R.

[48193.]—**Medical Coil.**—Will some fellow-reader please give me the instructions how to make the connections, so as to be able to take the primary or secondary currents? I understand how to make all the other parts.—J. R. B.

[48194.]—**Cleaning Brass Cartridge-cases.**—Will some kind friend give reliable recipe for cleaning brass-drawn rifle cartridge-cases, and keeping same free from verdigris?—J. C. L.

[48195.]—**Cambridge University.**—Are the lists of the dates of the open scholarships examination out, and if so, where can they be obtained? Also, rules for coming Oxford and Cambridge certificate examinations, and subjects taken?—Conidarte.

[48196.]—**Teeth of Mortise-Wheel.**—Will "Jack of All Trades," or any other able reader, tell me how to strike out the teeth of a mortise-wheel for bevel and spur-gear? Also, how to put the cogs in?—One Wishing to be a Millwright.

[48197.]—**L. & N.W.R. Engines.**—Would any of our readers kindly inform me of what kind and where stationed are the following engines?—8, 22, 109, 251, 252, 255, 518, 555, 758, 744, 755, 777, 819, 981, 1092, 1121, 1148, 1437, 2000, and 2230. Also, any L.N.W. engines stationed at Carlisle and Holyhead.—Atlas.

[48198.]—**Small Brass Castings.**—I want to make a few very small brass castings. I have got moulding-sand and boxes, but do not know how to go about it. I have made two or three attempts, but have not been able to make the mould in the sand. Is there anything mixed with the sand? If some correspondent would give me the information, I should be much obliged.—Amateur Engineer.

[48199.]—**Copper Boiler.**—A friend of mine abroad has had constructed a boiler fitted with a head for distilling herbs. He could only procure copper sheets 1-16 thick, and as his boiler is 5ft. 6in. high, and 30in. in diam., fears it is not strong enough; and besides that, he is at a loss how to suspend this boiler properly. He got two pieces of bar iron crossing each other at the bottom of the boiler, and let up on four sides, with a horizontal flange at the upper end of each of these bars about half-way up the boiler, to rest on the top of the masonry surrounding it, and which is bellied out to admit the play of the flame on to the lower part of the boiler. Will any reader skilled in such matters kindly give me any hints as to how my friend can overcome the difficulty into which he has plunged?—J. G. B.

[48200.]—**Legal.**—I should esteem it a great favour if Mr. F. Wetherfield would help me. Six years ago I was first engaged by my present master, and a verbal agreement was made for the salary to be £1 for the first year, which was duly paid. Since then, no arrangement has been made as regards a fixed salary—merely money paid on account. (1) Can a master under such circumstances fix the salary according to his discretion? (2) Will the workman's claim be paid in full in a case of bankruptcy? (3) How will his claim stand if the master made a bill of sale?—J. B.

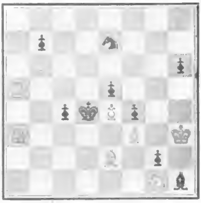
[48201.]—**Married Woman's Property Act.**—Will some one kindly tell me whether the Married Woman's Property Act recently passed is in force now? If not, when does it come into operation?—Waiting.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXXVII.—By J. W. Abbott.

Black.



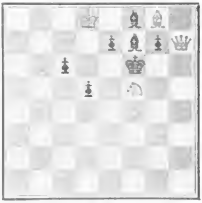
White.

White to play and mate in four moves.

PROBLEM DCCLXXXVIII.—By G. Hume.

First prize in Third Problem Tourney of *Boy's Newspaper.*

Black.



White.

White to play and mate in two moves.

Solution to 783.

White.	*Black.*
1. K to Q 3	1. Anything
2. Mates	

Solution to 784.

White.	*Black.*
1. Q to Q B sq	1. R takes Q (a)
2. R to Q 2 (ch)	2. Moves
3. P mates	
	(a) 1. Q to Q Kt 3 (ch)
2. Kt takes Q (ch)	2. P takes Kt (b)
3. Q mates	
	(b) R to Q Kt sq (ch) (c)
2. P takes R becoming Kt (ch) &c.	
	(c) B takes Kt &c.
3. P-Q B 8 becoming Q &c.	

There are other obvious variations.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 779, 780, 781, 782, by "F. M."; to 779 and 782 by W. T. Bayne; to 784 by Schmucke.

Schmucke.—In your solution to 783 you have overlooked that if 1. $\frac{\quad}{\text{Kt Q Kt 3}}$, when 2 B to Q Kt 3 (ch), the Kt can cover.

W. T. Bayne.—We are unable to follow your solution of 780. You say 1. $\frac{\text{Kt takes Q P}}{\text{Q takes Kt}}$; but Black has no Q; nor can any other piece take the Kt. The proper and only solution is B to B 6.

J. W. Abbott.—Thanks for problem.

The following gentlemen have entered for the Game Tourney by correspondence:—H. B. Reynolds, jun., A. E. Studd, W. T. Pierce, H. Vivian, E. Baron, J. Russell, H. M. Vincent, Rev. F. T. Gill, J. H. Blake, J. Pierce, J. Clothier. Play has already begun. We subjoin the rules of the Tourney:—

1. Two games must be played simultaneously by each player: return move to be sent not more than 48 hours after receipt of opponent's move.

2. Each competitor must play every other, and the winner of most games will gain the first prize. A drawn game will count one-half to each player.

3. If any player withdraws before the match is over, all the games he has played in the match will be cancelled, with their corresponding scores.

4. The winner of each game must send it to the Chess Editor of the English Mechanic, to be published if of sufficient interest.

5. All disputes must be referred to the Chess Editor, whose decision will be final.

6. The prizes are (1) £1 10s.; (2) £1 1s.; (3) Miles's new book of problems.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the Editor of the English Mechanic, 31, Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 4, and unacknowledged elsewhere:—

Lurgan Mechanics' Institute.—W. Walker.—Mottershead and Co.—H. Palmer.—Barford and Perkins.—Jabez Francis.—Archibald and Peck.—R. A. Lee.—J. Lucas.—W. C. Bancroft.—T. Fletcher.—J. T. Gent and Co.—Th. Gladden.—W. A. M'Clintock.—D. H. Babbage.—J. and B. Leach.—W. G. Stretton.—R. Mills.—Boyd Moss.—C. E. Stretton.—Dick.—W. J.—Barnum.—J. Marshall.—Rustic.—H. S.—J. Jones.—A Would-be Maker.—Ll.B.A.—Fides.—Koenning.—C. H.—W. A. Thoms.—Zuma.—Doubtful.—J. C. Franks.—Rev. J. Pearson.—F. W.—Fan.—Firer.—Decorator.—C. E. Archer.

Young Smith. (There is nothing remarkable in the cracking. See many places in back volumes; but the simple process is to heat to a cherry-red in the dark, and harden by simply dipping in water. Then place on a block of red-hot iron, and as the colour changes be ready to drop them into water when the temper you require has been reached. 2. See answer to "R. P. G.," p. 76.)—Small Cures. (Probably the water is very hard.)—Wm. Harris. (We fear all the space we can devote to the subject has been given.)—J. K. B. (Will you say what you wish to know about meteorology? We do not quite understand how meteorology can be useful to a landscape painter. The information proffered had better be given, if at all, through these pages.)—The Tenant. (We fear our legal column would be indefinitely extended if we printed long explanations from correspondents who fancy they are the persons denoted in queries put to Mr. Wetherfield. We have no possible means of deciding as to the rights of your quarrel with "Schoolmaster," and could not undertake the part of arbitrator.)—Hermann. (We are compelled to refuse insertion to queries about the age and value of violins.)—P. A. G. is a Fix. (Three years at least to do any good. Five would be better if you can spare the time.)—M. A. Oxon. (The company has the right, acting for the time as the agent of the vendor. If the mistake is his, your remedy is against him; if the company's, against the company. The system generally works very well, but of course mistakes will happen.)—J. B. Jobson. (We know of no such society.) W. Humphreys. (See Mr. Lancaster's advertisement in this number, in the back page.)—Microphaead. (No one could say without seeing it. The chances are, at least, 99 to 1 that the label is a forgery.)—F. D. Oldham. (Impossible to say. The symptoms may be those of ordinary dyspepsia, which the child will probably outgrow with the aid of good medical advice.)—A Constant Reader. (You need not register it, but you must affix the Government stamp to every bottle you sell.)—Aqua Regia. (1. If "ours" do not satisfy you, we know of nothing else likely to. 2. There is no such review published.)—Kenyon. (1. The *Chemists' Journal*, price 1d., is published at 2, Dorset-buildings, E.C.; the *Chemical News*, price 4d., at Boy-court, Ludgate-hill. 2. There is no paper devoted to both subjects. You had better take the *Chemical News* and the *Electrician*. 3. There are no examinations that we know of specially designed to test such candidate. The best way would be to enter the laboratory of a good analyst as a pupil.)—Novica. (Why do you wish to japan it? However, you will find full directions for japanning in Nos. 663 and 808.)—Ironmonger. (We presume you mean tables with the weights set out for different dimensions. Lockwood and Spons publish such books. See Mr. Calvert's Catalogue, to be had at 99, Great Jackson-street, Manchester.)—R. (Much would depend on the examiner. Green's, Macaulay's, and Lingard's are all good.)—Fan. (Yes, that will do. You must be rather an inattentive reader.)—Penelope. (The "scientific" readers have already given it several times. The composition varies with different makers, but the following is probably as good as any:—Boil 7lb. of glue in about a gallon of water; melt 3lb. of clean resin in 3 pints of linseed oil. Simmer the two together, with frequent stirring, for about half an hour, and then mix with some finely-sifted whiting to the desired consistency. It is poured into moulds, or stamped with patterns by applying heated moulds.)—Taxus. (You want a solder, not a cement. Why not have said what metals?)—New Amateur. (The numbers containing instructions for making an American organ have long been out of print. They can be had only in volume form—Vol. XXVI. There is no book on the subject.)—Rob. W. (We have heard of Trouvé's electric tricycle, but they are not "commonly used in France." You should look through recent back numbers.)—Electrician. (Just so, and it would save still more "endless trouble" if some one would make it for you. Apparently, you will not even refer to a page where you can find particulars, and if you would only read up your back numbers you would find that gutta-percha-covered wire is not suited for electro-magnets, the object being to keep the coils as close as possible to the core.)—A. Chapman. (Yes, it should be; but have you ever referred to the many descriptions of built coils we have published? See recent numbers, and the index published Sept. 22.)—Albert E. Mitton. (The query is indefinite. Enamel for what? You will, however, find many recipes in back volumes.)—Disappointed. (Why not look through our recent numbers, including the advertisement columns?)—W. W. A. W. (See pp. 578, 622, Vol. XXIX. The simplest form is a small box—a cigar-box, say—in which a lamp is placed.)—L. L. (The spawn is placed in a suitable heap of manure, and when it has run through it the heap is cut and pressed into blocks, which are dried.)—A Singer. (Take plenty of open-air exercise, and if that does not effect a change, consult a medical man.)—Pilgrim. (The question has been answered many times. A similar query was inserted on p. 75.)—D. W. L. (See indices of back volumes, also replies to query 49014, p. 75.)—Wirt Plush. (None at all.)—John Thompson. (1. An advertisement, but any dealer in chemicals would supply you. 2. No, they were not invented.)—Electricity. (Plates 8in. by 6in. would do. 2. This question was explicitly answered in the article where the E.M.F. is stated to be 1·5 volt. A Bunsen is about 1·8.)—Bird Cage. (For a method of straightening wire, see p. 431, No. 850.)—Thos. Millar. Did you look in the index of Vol. XXXIII.? Under "Bootmaking," you will find a reference to p. 383, and there a list of the books which are published at 50, Booksellers-row, W.C.)—Agricola. (It has been frequently stated that they can be kept in that manner. They are simply strung up by the roots. As a matter of fact, however, it is very late in the summer before they recover themselves.)—C. Humphrey Wingfield. (There is no likelihood of it being done, although it would be more useful here than to any one.)—Viscot. (Lockwood and Co., Stationers' Hall-court, E.C., publish a book on the subject, and so do G. Routledge and Co. If you went to the largest bookseller in your town you would probably find he had them and others in stock.)—Mahoney. (The safe method for a novice is to place them in a pan with rainwater, and expose to the sun for a month. Some take longer than others to soften, but when the soft parts are sufficiently decayed, lay the leaves on a board and pour water on them from the rose of a watering-pot or with a garden syringe. A quicker method is to dip into boiling solution of potash, but some experience is required in working that process. The chloride of lime solution is used for bleaching the skeletons; but peroxide of hydrogen gives better results.)—E. J. Neal. (If you will kindly look through back numbers you will find we have given not one, but twenty, different kinds. See index of last volume, under heads "Telephone" and "Microphone.")—Turco-Englishman. (Such a query would produce replies resembling advertisements. Placed as you are in Constantinople, you cannot do better than rely on the respectability of a firm with a reputation to lose. As a rule, price is a guide as to value, and in the case you mention you would do well to inquire, before purchasing, what is meant by a "set.")—J. D. (The printers would decidedly prefer a clean draught of the slips; but at any rate the slips should be pasted on sheets of paper in their order. Merely held together at one end they would be liable to be lost, and would certainly not be convenient.)—B. (Use an ordinary drill kept wet with turpentine, in which a bit of camphor has been dissolved. Clear out to size with a rat-tail file.)—Improver. (Multiply the area in inches by twice the length of stroke in feet. Multiply that by the pressure in the cylinder, and by the number of revolutions per minute. Divide the product by 33,000.)—T. Johnson. (The principle, or a modification of it, has some time been applied to the seats of tram-cars in London, and probably elsewhere.)—Aurora. (We regret our want of space prevents the insertion of numerous letters from observers of the display of aurora witnessed in various parts of the country on Monday evening.)—W. Berks. (Better apply to the Superintendent of the Department.)—W. Jones. (No. 513 is out of print. We have sent you instead number containing description of microphone. For rest, you must search indices of recent vols.)—Unbeliever. (The journal referred to, or any other, could be forbidden to do what you refer to; but no newspaper objects to be quoted, as a rule, though its publisher, or that of any other periodical, can, of course, reserve the right of reproduction, and occasionally is compelled to do so.)—E. W. L. Byrne. (We are obliged, but we have little space at present for sketches of sunspots and consequent discussions on supposed connection thereof with storms.)—Irish Chairmakers. Mr. Wetherfield cannot undertake or be expected to advise on the validity of patents. Speaking off-hand, we ourselves question whether any maker could enforce proceedings of the nature mentioned.)—X. Y. Z. (It is not injurious, but its use should be limited as much as possible.)—C. J. Leaper. (You can hardly seriously expect publication of such a query, except as an advertisement!)

NOTICE TO SUBSCRIBERS

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue the Subscription.

Holloway's Ointment and Pills are never at fault in successfully disposing of skin diseases, scrofulous sores, and scorbutic affections. In all hereditary diseases these excellent remedies may be relied upon, and by their means the most delicate may become strong, and the foulest blood may be gradually changed into the purest fluid.

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Lathes. 1 3ft. 6in., with chucks, and two drawers, £7. One 4ft. back-geared, £8. Both in good order.—C. N., 15, Union-street, Reading. What in exchange?

Musical Box, new, plays six popular tunes, and 46in. Coventry Bicycle, Lamp, &c., exchange for Cottage Piano.—Saxon, 112, Packington-street, Essex-road, N.

Wanted to borrow or purchase "**The Forge and Lathe,**" containing articles by Mr. J. H. Evans. "The Journal of the Amateur Mechanical Society" and books on ornamental turning. Exchange poultry, or state wants, or cash.—Box 2, Southport.

Fishing Rod, Lines, Winch, Brass Bottle Jack, Cleaning Scratch Brushes, Daniell Batteries, Zincs for ditto, Porous Cells, Binding Screws, Herbarium, skates (wood and iron), Screw Chasers, Taps, Screw Plate, Copper Sulphate, "Design and Work," Leather Leggings, Welsh Grammar, lot of Maps, Dentist's Key. Offers.—27, High-street, Rochester.

2½ horse-power **Vertical Engine,** splendid order. Exchange for good Drilling Machine, or offers.—F. W., Wainwright's Yard, North-road, Cardiff.

Wanted immediately, a box of **Mathematical Instruments,** in exchange for a good toned Violin, with bow and case, well worth 35s.—M. H. Nurse, 6, Mackinnon-street, Rochdale.

Woodworking Planing and **Moulding Machine,** in good working order, worth £25. Will take Deal timber in exchange.—T. G., 105, Pool-street, Wolverhampton.

50in. Challenge **Bicycle,** cost £13, in thorough order. What offers? Electrical preferred.—L. Seager, Borden, Sittingbourne.

50in. **Bicycle Wheel,** bearings, good tyre, backbone and back forks, bell, oilcan. Exchange anything. Offers.—W. W., 67, Mayham-street, Camden Town, London.

"**Matthew Henry's Commentary,**" unbound, Cassell's edition, in good condition. Exchange for good Microscope.—J. Hartley, 17, Hare-street, Rochdale.

Ornamental **Flower Boxes,** for two bow windows. What offers?—Mr. Fitch, 42, Castle-street, Holborn.

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Four pint cells **Bichromate Battery,** in case, with ratchet lift, double carbons (zincs worn), for a plate Bottle battery.—Reginald Hannam, Fordingbridge.

Wanted, No. 2 or 3 Simplissimus **Printing Press,** in exchange for good double Breech-loading Gun and cash.—R. Sheppard, Witney, Oxon.

Horizontal **Engine,** 5in. bore, 7in. stroke, governors. Horizontal Boiler, 62in. by 24in., strong firebox, pump, etc., gauges. Trayser Harmonium, 11 stops, knee swell, walnut case, all nearly new. A few back volumes English Mechanic, bound. Exchange for a modern horizontal silent Gas Engine, one or two horse.—J. C., 46, Fairlane, Gorton, Manchester.

Lathe, 4ft. gap bed, 6in. centre, in exchange for a second-hand Tricycle, in good order, or a set of Tricycle Fittings (finished), or what offers?—F. Swingler, Beaconsfield Cottages, George-street, Syston, near Leicester.

I have got a new **Wringing and Mangling** Machine, cost 50s. What offers in exchange?—James Hagger, 34, Lea-road, Luton.

Offers for Parkinson's "**Organic Remains** Former World," 3 vols. half-calf and 3 vols. plates.—X., 8, Ball's Pond-road, London, N.

Lathe, 6in. geared, face-plate, chucks, tees, poppet, value, £1 10s. Slide-rest, 5in., value, £1 10s.—13, Ann-street, Linton-street, Packington-street, Islington.

"**English Mechanic,**" Vols. I. to VII.—IX. and X. bound. Also numbers. Maelzel's metronome, cost 21s. What offers?—Harvey, 8, Kinloch-street, Holloway, London.

Pair of **Telephones** (Bell's), Denny Telegraph Instrument, Electric Bell, pushes, &c. Electric Indicator, any of above exchanged for old lead or brass or tools.—Slater, Low Row, Sunderland.

Howe Treadle **Sewing Machine,** two patent Gas Fires, complete, quite new. Will exchange either or both for anything useful.—Slater, Low Row, Sunderland.

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"**Nature,**" Nos. 431 to 582 (except No. 56.), in exchange for opera or field-glass, or offers. Many numbers unsoiled.—T. H., 22, Ernest-street, Regents Park, London.

Half-plate Portrait **Lens** and Home-made Camera. Exchange for Harmonium reeds, &c.—Louis Jefferson, 3, Brownswood terrace, Green Lanes, N.

Model **Locomotive,** feed pump, check valve, water gauge, and lubricator. What offers?—Blanchard, 6, Little Church-street, Edgware-road, London.

I have a small double cylinder **Engine.** Will exchange for 50in. bicycle or good equivalent.—E. Collins, Sherborne, Dorset.

Dulcimer and 15 Music Bells, cost £3 10s. Exchange for large size magic lantern and slides.—T. Jones, 19, Pound Close, Coleham, Shrewsbury.

Three-speed **Driving,** turned and bored, for 1½in. flat strap, 3ft. 6in. Crank turned, all new, offers.—J. Mitchell, Park-street, Keighley.

4ft. planed iron **Lathe Bed** and iron Standards. What offers? All new.—J. W. Mitchell, Park-street, Keighley.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 13, 1882.

ELECTRICAL MEASUREMENTS.

By JOHN T. SPRAGUE ("SIGMA").

THE early measures of the different relations of electricity were naturally based upon the common agencies used in connection therewith, and were of necessity arbitrary and unconnected with each other; but as the study of electrical phenomena grew into a science, and its applications became of practical importance, the various measures have been systematised so as to adapt them to mathematical treatment. For this purpose they are based upon "absolute" measures—that is to say, upon measures which are common to all kinds of operations; upon the fundamental elements, time, length, mass, &c., which enter in to all physical operations. The actual measures employed or suggested have been various, but the necessity of the case limits us to some form of the "metric" system, which must inevitably supersede in time all other systems of measurement, even though these latter may be proved to have points of superiority. In science, at all events, all these are vanishing, though the foot-pound and some others will long be employed for ordinary purposes.

Before entering on the electric measures, it is necessary to understand the general system of which they are a branch. The fundamental elements of which units of measures are required are Length, Time, and Mass; of the first, two units are employed, the metre and the centimetre. The first has many advantages, but the second has been more fully worked out, and is more generally employed, and therefore, it is the one which will be used here, and we have as units—

L Length.	1 centimetre.
T Time	1 second.
M Mass.	1 gramme.

From these are derived the general mechanical units; of motion, which is length traversed in unit time; velocity, which is motion in unit time; momentum, which is mass having unit velocity; force, which is a general expression for the cause which generates velocity, but for systematic purposes is defined as the cause of "momentum"; and work, which is the energy due to the action of the force. Gravitation is the only absolute natural force, and as it is constant in its operation, it generates not only a "velocity," but also "acceleration," that is to say, the moving body, retaining at each instant its acquired velocity, adds to this the new velocity due to the force; but in dealing with the energy involved, the actual velocity only is considered; regarded as a force in the abstract, gravity, *g*, imparts a velocity of 32·2ft., or 981 centimetres per second. Regarded as a unit force, it generates this velocity in a mass of one gramme. Hence we have the following units:—

		Unit value.	Name.
V. Velocity	$\frac{L}{T}$	1 centimetre per second.	
F Force	$\frac{LM}{T^2}$	do. in 1 gramme.	Dyne.
E Energy W Work	$\frac{LM^2}{T^2}$	1 dyne in 1 centimetre.	Erg.

To understand these values it will be well to compare them with the familiar terms based on gravity. The force of gravitation (upon the earth) varies according to the distance from the centre of the "mass" of the earth; at the Equator it is 978·10, at latitude 45° it is 980·61, at the Poles 983·11, these being velocities in centimetres. Taking the value in England as 981, the force of gravity equals 981 dynes, or C.G.S. units of force. The actual force of gravity at any part of the earth is ascertained by the following formula:—$g = 980{\cdot}6056 - 2{\cdot}5028$ cosine $2\lambda - .000003h$, in which λ denotes the latitude and h the height in centimetres of the place above sea-level.

The *erg* may, therefore, be compared with the common mechanical unit of work, the foot-pound, because the ft.-lb. is the same thing as 138·25 gramme metres, or expressed in C.G.S. system as 13825 centigramme metres; then, if we take gravity g as equal to 981 dynes in this system, we find that the ordinary ft.-lb. is equal to 13,564,325 ergs. Such a figure shows at once that this system is really adapted only to minute measurements. To get rid of the numerous figures involved, a simple system of writing is adopted, and the above figures would be written as $1{\cdot}356 \times 10^7$ or 1356×10^4, and most of the calculations involved are thus reduced to the alteration of the index figures.

This system is becoming so increasingly common in electrical and scientific works generally, that it may be well to explain it. The index, as in logarithms, may be *positive*, signifying the "power"—that is, the number of tens by which the figure is to be multiplied, or *negative*, signifying the number of tens by which it is to be divided; thus the negative index written with a dash represents a *decimal fraction*. Thus we have—

1×10^6	= 1,000,000	a million
1×10^3	= 1,000	a thousand
1×10^2	= 100	a hundred
1×10^{-2}	= ·01	a hundredth
1×10^{-6}	= ·000,001	a millionth

In fact, the positive index, as in logarithms, is one less than the figures representing the number; but the negative index, unlike the logarithmic, is the number of figures representing the decimal when written out.

In speaking or naming these values, we are burdened with a barbarous nomenclature; thus, a million ergs is called an erg-six, and so on, adding the index number to the name of the unit. Furthermore, in electricity, we have the generally adopted prefixes of *mega*, signifying a million, as the mega-volt or meg-ohm; and *micro* signifying a millionth, as the micro-farad, besides the ordinary prefixes of the metric system of measures.

It is undeniable that the peculiar fancifulness of some of our leading mathematicians, which has led them to adopt the centigramme instead of the gramme as the basis of the unitary system, is a very serious inconvenience. English men of science have gradually submitted themselves to the universally-adopted metric system, and students begin to understand what is meant by a metre gramme as the unit of work, and the calory as the unit of heat, and now they are being puzzled afresh by a new system, the sole reason for which is that a gramme weight is based upon the cubic centimetre of water. But, as our writers are chiefly these mathematicians, they have it in their power to force people to submit. It would be of little consequence if (as many at first-sight suppose) it only meant the adding of 100 to all values as the result of using the centimetre (or one hundredth of metre) in place of the familiar metre itself. But this is not the case, as energy or work varies as the square of the force; therefore, unit force or velocity on the metre gramme second system means 100 times the unit-force on the centimetre-gramme second (C.G.S.) system; but unit energy is, consequently, in the metre system, 100_2, that is, 10,000-fold in value the unit energy of the C.G.S. system.

In all measurements it is necessary to have a separate starting point or "unit" for each order of things or conceptions, though these units may be derivable from the few fundamental units—thus, from the unit *length*, 1 centimetre (or metre, or foot, as may be), we derive unit *area*, the square centimetre, &c., and from this again, unit *volume*, the cubic centimetre, &c. In like manner, each separate conception or order of facts in electricity requires to have a unit of its own, and the system is similar to that of the mechanical units which have so far engaged attention. Here, also, we start from a "force" generating a velocity. We can now replace the attraction of gravitation by two distinct attractions of electricity. We have the force exerted by an electric "charge," from which is derived an electro-static system of units; and we have the attractions exerted by an electric "current" upon a magnetic pole, or upon another current: this furnishes the electro-magnetic system of units. The starting point or unit of electricity in the electro-static system is: "That quantity of electricity which will repel an equal quantity (or attract an equal opposite quantity) at the distance of one centimetre with a force of one dyne"; that is to say, would, acting for the second, generate a velocity of one centimetre per second. The unit of the magnetic system is based on the unit magnetic pole, which is one which repels a similar pole, one centimetre distant, with a force of one dyne. The unit electric current is that which, in an arc of one centimetre length of a circle of one centimetre radius, will repel a unit pole at its centre with a force of one dyne. The unit current would also, in a length of one centimetre, repel a similar current at a distance of one centimetre with a force of one dyne. Perhaps the easiest method of forming a concrete idea of these forces is to conceive a spring balance adjusted to carry a weight of 1-981 of a gramme. Any force whatever which strains the spring to that point is exerting unit force. Thus, if a magnet-pole, fixed at one centimetre from another magnet-pole, required the spring to be stretched to that point to resist motion—that is, to maintain the centimetre distance—a force of one dyne would be exerted; or, what comes to the same thing, if the balance were graduated to successive increments of that value, it would indicate the number of "dynes" exerted by any force. The ultimate idea of force is *pressure* or *tension*, attraction or repulsion really in unit degrees, but for purposes of calculation expressed in relation to mass.

The two systems of units are related to each other in ratio which is a velocity, and expressed in the formulæ as *v*. The actual value is not exactly known; but is interesting for two reasons. It has been experimentally determined by several eminent electricians by different processes.

		Per Second.
Weber and Kolrausch	make it	$3{\cdot}1074 \times 10^{10}$ c.m
Sir W. Thomson	,,	$2{\cdot}825 \times 10^{10}$ c.m.
Another mode	,,	$2{\cdot}93 \times 10^{10}$ c.m.
Clerk-Maxwell	,,	$2{\cdot}88 \times 10^{10}$ c.m.
Ayrton and Perry	,,	$2{\cdot}98 \times 10^{10}$ c.m.
Average		$2{\cdot}9445 \times 10^{10}$ c.m.

These variations, though not large, show (like the different values found for the ohm) that while mathematicians work out their formulæ to the extremest nicety, the data are by no means settled.

The other point of interest is that this ratio, which, as stated, is really a velocity, is apparently identical with the velocity of light; the various determinations of which range over much the same values as the above.

Having obtained the unit of force, which represents the different expressions—potential, difference of potential, tension, and electro-motive force, the rest are derived from considerations classed under the name of "dimensions"; derivations in fact form the unit length L, mass M, and time T; which dimensions, therefore, are alike applicable to any actual values given to those units in any system.

Magnetic units:—

Strength of magnetic pole m = $L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$
Moment of a magnet $m\,l$ = $L^{\frac{5}{2}} M^{\frac{1}{2}} T^{-1}$
Intensity of a magnetic field H = $L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$

Electric Units:—

Units.	Electrostatic System.	Electro-Magnetic System.	E. Static. / E. Magnetic.
Force	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}$	$L^{-1} T = \frac{1}{V}$
Resistance	$L^{-1} T$	$L T^{-1}$	$L^{-2} T^{2} = \frac{1}{V^{2}}$
Current ..	$L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}$	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-}$	$L T^{-1} = V$
Quantity	$L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$	$M^{\frac{1}{2}} L^{\frac{1}{2}}$	$L T^{-1} = V$
Capacity ..	L	$L^{-1} T^{2}$	$L^{-1} T = V^{2}$

V, in round numbers, closely approximating value as above is 3×10^{10} centimeters per second.

The units thus ascertained represent each its own idea, thing, or action; but the system is so related that we may actually treat them as though they were all one absolute unit, representing all forms of force and energy, cause, agency, and effect; we may multiply and divide them by each other as though they were abstract numbers merely, instead of concrete things; this is, in fact, the great advantage of the use of an absolute unit, and it results from the fundamental principle of the system—viz., that a unit force, acting in unit time and unit space, will produce a unit effect or operation, and expend and produce unit energy in some of its manifestations. Therefore, the ratios or actual values of the units themselves are fixed by this necessity. Starting from any two, the rest follow, of course, from Ohm's formula $\frac{E}{R} = C$ or $\frac{E}{C} = R$.

This relation, in fact, involves that unit current C must pass through the unit conductor (miscalled resistance) R in unit time, under the influence of unit force E; and in doing so shall expend unit energy or work, and be capable of being stored in a receiver of unit capacity, and of exerting unit force upon a unit pole or current. Hence, all being alike represented by 1, and being all inter-related, there follows the fact mentioned, that we can treat them as simple numbers without regard to their actual natures.

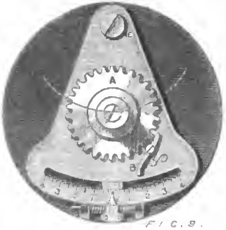
But these absolute units are inconvenient for most practical uses, and, therefore, while it was necessary to base the explanation of electric measurement on this foundation, in another paper will be explained the practical system as it is now developed and accepted by all electricians.

ON THE PRODUCTION OF LOOPED FIGURES BY GEARING.

In Fig. 8 I have represented the eccentric chuck, fitted with tangent-screw to the radial plate and click-wheel to the chuck-screw. The pointer E must be shaped like D, and admit the tangent-screw below, if it is added at all. If the tangent-screw is used, the tightening screw, C, will be less needed as an adjustable one, and may be replaced by one with mushroom head, screwed in permanently from above, and merely so tight as to prevent the upper plate from rising in the least from the base-plate. If C is used, the slot should be bevelled, so that it lies in it as a countersunk-screw. This chuck is not at all a bad one, although inferior to the modern one, and is given because so easily constructed. In effect, the line of eccentricity is dotted, being curved instead of straight. But if Fig. 9 is consulted, and A A represents the line of eccentricity produced by the slide of an ordinary eccentric chuck, and B B the curved line of eccentricity of the present one, a point, D, on the curve at a given distance from the mandrel centre, although it is a point in the curved line, is practically similar to C, a point at the same distance from the mandrel centre upon A A. Both are, in fact, lines upon a diameter: A A, in one case, and H H in the other; and this will be so in respect of any other point in the curved line, B B. If I is the mandrel centre, on which the chuck revolves, which has a straight slide; the point C in its revolution will pass through the position D. The two movements of the upper plate—rectilineal or curved according to the chuck used—are not, therefore, so different in effect as would at first be supposed. If the experiment is made, it will be found easy to cut the same pattern with either chuck if the wheel A is added, but not otherwise. With the geared rose engine so much can be done by using this chuck without such wheel that many will probaby prefer to avoid the extra difficulties incurred in so making it. These difficulties, however, are not nearly equal to those incurred in getting up the fittings of a chuck with the usual steel guide-bars and V-slides. The upper plate of this chuck may be lightened somewhat by hollowing out the edges more than here represented; but care must be taken not to run to extremes in this direction, as it should have a good bearing on the lower plate, and be very stiff and strong, because it has to bear the weight of the chuck and work, and to stand the usual shocks and strains of eccentric turning. It would be a great mistake to attempt to make this chuck of sheet brass, as castings are so cheap and so far superior for anything of the kind, and ⅜in. is the least thickness that would be likely to serve as the substance of the two plates. I did, indeed, once see a slide-rest of sheet-brass made after the old pattern devised by Maudsley, but it was only for use with a little rose engine of, I think, 2in. centre, made to turn studs, buttons, and such very light work. Such a plate as the top one may be racked for the screw by setting a tap between centres and centring the plate on the tool bed of the slide-rest by the hole at the upper end, where the screw, E, will be fitted, this being the centre from which the curve to be racked is struck. But the edge must first be divided, and the divisions sawn in by a small revolving cutter, if possible—the tap or hob being used merely to finish and correct these divisions, so that the tangent-screw may work in them satisfactorily. The rotation of the hob will carry the plate round upon its centre, E, and when it has revolved till clear of the hob, it must be drawn back by the slide-rest screw and readjusted. By these means it will soon be racked to a sufficient depth; but a segment like this is more tedious to work than the complete circle, because the latter can be allowed continuous revolution, and will not need constant readjustment, except to advance it slightly as the cut proceeds. The pin upon which the division-wheel A revolves ought to be slightly conical and stout. It is drilled at the upper end and tapped for a small screw, under which is placed a steel washer. The chuck-screw and the wheel A will be cast as one, and can be turned up on a mandrel, upon which it can be also held while the wheel is being divided and cut into cogs. Even here, however, if dividing and cutting the wheel is considered a difficulty, it would be easy to press into service one already cut, if such be at hand.

J. L.

FIG. 8.



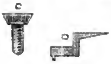


FIG. 9.

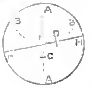
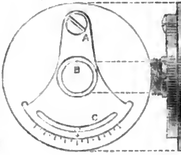


FIG. 8. FIG. 8



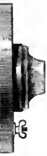


FIG. 10.

A NOVEL SENSITISING SOLUTION.

A NOVEL sensitising solution has been recently patented by Mr. R. T. Wall, of Longfleet, Poole, the active ingredient of which seems to be white pepper, but in what way the pepper acts is not stated. The patent is for improvements in photography, and, apparently, covers several processes. The improvements consist in making a new sensitising solution from white pepper and its analogues macerated with, and in, ether, turpentine, alcohol, naphtha, chloroform, &c., or by essential and volatile oils, acetic, carbolic, or other acids, or with diluted mastic, crystal, copal, sandrac, photographic, spirit, or other varnishes. A ready way is to take one pound weight of freshly-ground white pepper and macerate it in one to two pints of ether or alcohol for some days, then press the tincture through one or more filtering media: also, in using, a little mastic varnish or oil of turpentine is added to the resultant solution if ether is used, a little spirit varnish is used when alcohol is used, and the resultant solution is spread over the surface to be sensitised, and exposed in the usual way; and in the use of powdered pigments, cold or warm, brushed or dusted over the surface for the purpose of developing the image. The improvements also consist in the manufacture of transparent sheets of collodion and collodion emulsions and elastic media for printing on uneven or other surfaces. For making a clear transparent sheet of collodion a thick preparation of collodion is made consisting of acetic acid or formic acid, gun-cotton, and castor oil—canada balsam may be used also. This composition is poured upon waxed glass, edged with strips of paper by means of glue so as to form a dish, and is placed in a box, the lid being closed and then left a day or two to dry. On this layer a film of gelatine emulsion or rapid collodion emulsion is poured, and the negative or transparent picture taken thereon suitably varnished and protected, when the whole may be stripped from the glass together. If the patentee's extra rapid collodion emulsion is used, the above collodion sheet must contain gelatine or gum or indiarubber coating before the application of the emulsion. The following description will show how this emulsion is prepared. The collodion is thus made:—Ammonia bromide, 27 grains; distilled water, as little as possible; when dissolved add two or three drops of gelatined hydro-bromic acid; alcohol, 2½oz.; pyroxline, 32 grains; and ether, 2½oz. The emulsion with silver is formed by adding 120 grains of silver nitrate which has been dissolved in a little distilled water and then ½oz. of alcohol. It is poured out into a dish of sufficient capacity in order for the solvent to evaporate, and in a day and night it is ready for further treatment. This consists in breaking up the mass into pieces with a piece of glass or a bone spoon and covering it with water for some time, and pouring the whole into a calico bag which has previously been washed in carbonate of soda and then well rinsed and dried; the bag and its contents is put into an enamelled saucepan or in a stone jar covered with gelatine solution (20 grain No. 1 gelatine in one ounce of water), when the whole is boiled for 30 minutes and then taken out and put into clean warm water, twisting and washing several times till all traces of acid are removed, which can be tested by litmus-paper. When all water is wrung out the emulsion is dried on a hot-water bath or spread out in a warm room on blotting-paper. The product is mixed in 2½oz. of alcohol and 2½oz. ether.

The patentee also makes a collodion emulsion as follows:—Bromide of ammonia, 27 grains; distilled water as little as possible, and when dissolved add two or three drops of hydro-bromic acid containing gelatine, and then blend; glacial acetic acid, 3oz.; pyroxline, 32 or 35 grains. The emulsion with silver is formed by adding the silver nitrate solution prepared as before, but, instead of evaporating, pour the whole into a large jar filled with clean water and then into a calico bag and wring; then put it into gelatine solution and boil for 30 minutes, dry as before, dissolve in 4oz. of equal parts of ether and alcohol.

The patentee finds it convenient to use a box for regulating the evaporation, having both sides covered with several pieces of calico, holland, or linen, which must be soaked in alumised gelatine, whipped and then dried, or fine perforated zinc sheet, fine horsehair or fine wire gauze may be used. This box will keep down the too-rapid evaporation and prevent honeycombs and other irregular markings. An elastic medium for printing on uneven surfaces is made of gelatine, sugar, glycerine, chromealum, spirit, thymol, or boracic acid, or any preservative agent. A glass plate is prepared by gluing a strip of paper around the edge of the plate so as to form it into a dish. The mixture is poured into this dish and left to set; a negative tissue is put over it, and it is placed on a dried pepper sensitised surface, the developing being effected with the following solution:—Water 4oz., sugar 1oz., gelatine 1oz., glycerine 6oz., thymol some drops, alcohol ½oz., saturated chrome alum some drops.

Hand drawings may be utilised for the process by using the collodion sheet, coated with matted varnish, then draw any picture on the matted sheet with soft lead pencil, charcoal, or chalk, and print.

VERNON-HARCOURT'S AËRORTHOMETER.

A NOVEL apparatus to be used in ascertaining the volume which gas, measured under any ordinary conditions, would occupy under standard conditions, has been recently patented by Mr. A. G. Vernon-Harcourt, of Oxford, the object being to dispense with the use of the thermometer, barometer, and the tables, a simple arithmetical calculation being all that is necessary with the new apparatus.

In measuring gas the volume is commonly taken at the actual temperature and pressure of the surrounding air, and the measurement is then corrected to obtain the volume which the gas would have under certain standard conditions. This correction has hitherto been effected by taking readings from a barometer and thermometer, by referring (in the ordinary case of a gas measured over water) to a table giving the tension of aqueous vapour at different temperatures, and by a calculation based upon these readings and the laws of gaseous volume. The use of a table simplifies the operation, but even thus a reading of a barometer and of a thermometer and a reference to a table are needed to obtain a figure which by simple multiplication or division will convert the observed into the corrected volume. Fig. 1 is a sectional plan view of the instrument, and Fig. 2 is a vertical section.

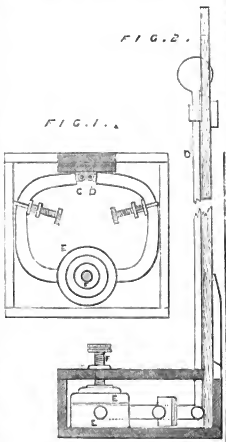


FIG. 2.

FIG. 1.

The base of the instrument consists of a box with a removable cover, and a backboard standing up from the hollow base. To the face of this backboard two tubes of glass of equal calibre, C D, are attached, the same being set vertically side by side. The tube C is open at top, and may conveniently be contracted and bent over, to prevent the admission of dust. The tube D terminates at top in a bulb whose capacity is about four and a half times that of the tube. These tubes extend into the hollow base, and are connected by means of flexible tubes, with a reservoir, E, containing mercury. This reservoir has a loose leathern top, and is intended to be contracted by the application of pressure in order that a column of mercury may be driven into the vertical tubes. F is a milled-headed screw passing through a tapped hole in the cover of the box and furnished at its inner end with a loose button which overlies the flexible portion of the mercury reservoir. By turning this screw, the button may be caused to press upon the flexible cover, thereby contracting the capacity of the reservoir. The stem of the tube D is graduated and the backboard figured to correspond therewith, so as to mark the capacity of the bulb and stem down to each line of graduation. In order that the instrument may bear accidental inversion during carriage without injury, each flexible tube is embraced by a U-shaped loop of wire, the ends of which are made fast to a plate. This plate is furnished with a threaded hole to receive a pressure screw, carrying on its inner end a pressure plate. By turning the screw the plate attached to it may be used to compress the flexible tube between itself and the loop of wire, and thus prevent the loss of any mercury except the small portion remaining in the open tube.

A convenient size for the instrument is to make the capacity of the bulb a little less than 3·1 cubic centimetres (if the standard temperature adopted is 60° Fahrenheit) and that of the graduated portion of the stem 0·7 cubic centimetres. The bulb and stem are to be charged with a volume of moist air or other permanent gas occupying under standard conditions 3·3 cubic centimetres, the stem below this level being filled with mercury. This volume is marked on the instrument as 1,000, the unit volume adopted being 1-300 cubic centimetre. The top line of the graduation may mark a capacity of 3·1 cubic centimetres, and be figured accordingly 930, this being the smallest volume to which the inclosed air is likely to be reduced by low temperature and high atmospheric pressure. The maximum volume to which the inclosed air is likely to be expanded may be taken as 3·8 cubic centimetres, and the lowest line of graduation will be marked accordingly 1,140.

To use the instrument, the pressure on the reservoir is increased or relaxed until the level of the mercury is the same in both tubes. A reading is then made on the graduated stem, and represents the volume occupied at the actual atmospheric pressure and temperature by a mass of air which, under standard conditions, occupies a volume of 1,000. Any volume of gas measured in a holder, or registered by a meter under the same conditions, may be corrected to its true volume under standard conditions by multiplying by 1,000 and dividing by the figures read upon the instrument. Thus, if the rate at which the gas is passing through an experimental meter is 4·7 cubic feet per hour, and the reading of the aërorthometer (as it is proposed to name the new instrument) is 980, the corrected rate is $\frac{4,700}{900}$, or 4·8 cubic feet per hour. If the uncorrected illuminating power of a sample of gas is 15·8 candles, the aërorthometer reading being 1,050, the corrected illuminating power (which varies inversely with the volume consumed) is 15·8 × 1·050, or 16·6 candles. Since the standard conditions commonly adopted in chemical and physical laboratories are a temperature of 0° Centigrade, and a pressure of 760 millimetres, and a gas under ordinary conditions is more expanded than under these conditions, it is convenient in an instrument to be used for correction to this standard to make the capacity of the bulb nearly 3½ cubic centimetres, so that the 1,000 graduation may come near the top of the stem. If an instrument is required for the correction of the measurement of a dry gas, the air and mercury with which it is charged must be carefully dried.

QUICK ACTING ADAPTER FOR MICROSCOPICAL OBJECTIVES.

AT the last meeting of the Quekett Microscopical Club, September 22nd ult., Mr. E. M. Nelson exhibited and described an arrangement for rapidly attaching and detaching the objectives of a microscope, in lieu of double nose-piece and similar contrivances. The method was suggested to him by that employed by the French to close the breech-pieces of their ordnance. Three equal segments (each one-sixth) of the screw-thread of the nose-piece and of the objective are filed away—the objective can then be at once inserted for the full length of the screw, and one-eighth of a turn to the right makes it perfectly secure. By a similar turn to the left, it can be detached with equal facility. The best position for insertion should be marked, as in the other two positions more than one-eighth of a turn will be required to fix or release the objective. The liability of the objective to become loose and fall out is so remote as to be practically impossible with the most ordinary care. Among the advantages of this arrangement may be mentioned the rapidity with which any number of objectives can be interchanged without the necessity of employing a contrivance, such as the double, triple, or quadrupal nose-piece, which, with the attached objectives, adds so greatly to the weight, and can very rarely be well-centred. There is no interference with any of the usual arrangements, as the altered objectives can be screwed into unaltered nose-pieces, and *vice-versâ*. The centring of the objectives is not interfered with; and it is very convenient, when using water or oil immersion objectives, as fluid can be very readily added or replaced.

Messrs. Powell and Lealand have, at Mr. Nelson's request, made a pair of standard gauges, to be kept by the Quekett Microscopical Club for reference, and copies of it will soon be obtainable.

Since Mr. Nelson made his communication, he has ascertained that the same plan was suggested by Mr. James Vogan, and communicated by him to *Science Gossip*, Jan 1, 1869, p. 18, as "A Substitute for Nose-Pieces": the only difference being the cutting away of two segments of one-fourth, instead of three of one-sixth. It is a matter of regret that so useful a suggestion should so long have remained unnoticed, and it is hoped that it will soon be generally adopted.

PRACTICAL NOTES ON PLUMBING.—XLVI.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 105.)

NOW we come to the soiling and shaving; but before we do this, I will describe another method of lining cisterns. Suppose it is required to line a cistern in three pieces, that is, the side and end in one piece, and the bottom dropped in.

Proceed as follows:—Having the right sizes, line the lead and set it up, and boss up the angle I, Fig. 259, as also illustrated at T S B, J I, K B, Figs. 258 and 260. T is the return lead for nailing, as is also A; turn the lead to stand 1in. or so on the bottom, as illustrated at E F U, Fig. 259. Having attended to the little requirements (see that no nails are standing through the wood-hole, &c, &c.), now place your knee against the side and bulge it in as at C, Figs. 258 and 260: this will shorten the lead between K J, Fig. 258, and will allow it to go easily into its place. Next place this in, as you did the first piece, and nail it there: see that it fits properly. Now fix the other side and end; do not use any nails up the angles, and fix the lead by driving it home with a chase wedge, having its point ⅜in. or so thick across the face, or to finish with a ¼in. narrower will do: well drive it home, but do not split your lead or drive the side of the cistern out. To prevent this, the cistern should always be made as illustrated. The next thing to do is to prepare the bottom, which is done as follows:—Having measured round the bottom and allowed for the substance of the lead sides, mark out the exact size of the bottom, less ⅛in. for the thickness of the turn-up lead, then with the chalk line, line out the lead; never scratch it with a scriber. Now kneel upon the quartering, and with the point of the chipping knife passed under the edge of the lead, answering as a lever, pull it up against the quartering, and with the end of the dresser knock the lead well up to the quartering, and so get it to stand up square to the bottom. Having done this all round the lead, next boss up the four corners, then bulge it in the middle. This will shorten it each way, and will allow it to drop easily into the bottom. You can now put it into its best position, and, with a piece of board laid upon the lead, jump upon it, and so cause the bulged part to go flat upon the bottom of the cistern, and the lead to expand, and the edges will jam themselves against the sides, &c. Now take a dresser and hammer, and set it in all round, after which take a chase wedge, and drive the lead well home, causing it to wedge itself tightly to the sides and ends.

FIG. 258.

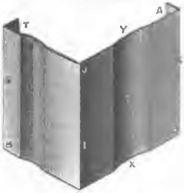


FIG. 259.

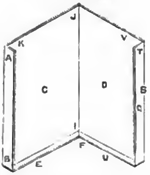
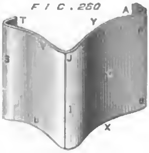


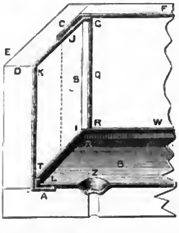
FIG. 260



Soiling.

Take the compasses, set 5in. or 6in. open, and from the angles scribe all round the sides and bottom of the cistern, as shown at H, M, G, N, S, Y, &c., Fig. 257, and with the same radius strike the quadrant J N, &c., as shown; this is most useful, for the bottom especially, when wiping upright corners, as it keeps the solder off from the naked lead, and also gives a sort of finish to the work. Next soil the parts within the marks, and dry it with shavings, hot irons, or, as best you can, or, if time will allow, let it dry gradually. Next is the cutting off of the return edge or salvage Q, Fig. 261; here you require a good straight-edge and *sharp* chipping-knife. Assuming it to be properly worked home with the sharp chase wedge, take the chipping-knife and small hammer, beginning at the top near J, and cut off the salvage edge within one-eighth of an inch, or less, of the angle; cut this straight, and from top to bottom, also round the bottom, then take the *sharp* chase wedge, and a good-sized hammer, and well drive the ⅛in. of lead into the angle, which will wedge itself as tight as is required. Some plumbers do not touch it after cutting off the salvage with the chipping-knife.

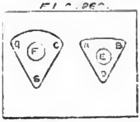
FIG. 261.



Shaving.

This is of more importance than many suppose. You cannot be too particular. In the first place, you require a small, sharp, shave-hook, the blade to be no larger than will shave the exact width you require the solder to be when finished. For my part, I like the size and shape of the blade to be nearly the same as that illustrated at S Q G, Fig. 262. This is about the right size, or, if anything, rather too large; from Q to S should be ¾in. This will shave about 1¼in. wide. Some plumbers use a triangular cistern hook, similar to that shown at A B D, Fig. 262. The circles F and E show the stem of the hook. When using these hooks, see that they are well sharpened, for a dull shave-hook makes dull work. The shave-hook being all right, and in proper order, proceed to apply the part Q into the angle of the cistern, and with the point S gauge the shaving line, by holding the back part of the hook firmly to the angle of the lead, and with a good long stroke or sweep draw the hook down, and so shave to the desired width. If too wide, the hook, of course, must be made narrower.

FIG. 262.

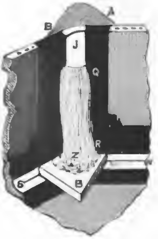


Proceed with this, and clean out the bottom corners with a *round-nosed* spoon hook. Touch it over as you go on shaving, and all will be now ready for soldering. Some plumbers, after they have shaved their work, get a punch similar to carpenter's nail punch, and so punch the cut off edge of the lead into the back lead all up the angle; this holds it in position when not properly chase-wedged up. Never use a straight-edge for shaving a cistern. Such work is only done by those who are not proficient in their trade.

Soldering.

For a cistern the size of that described at Fig. 250—namely, about 1ft. 6in. deep and 2ft. square, one large iron will do the work, and a pot of solder, say, 10lb. For large cisterns more irons will be required. I have watched my own working, and find that a large iron will comfortably do from 8 to 10ft. of flat wiping, and from 3 to 7ft. of upright wiping. I have done 9ft. of upright work with one iron, but this is a feat. For large cisterns it will be found much the best method to reckon enough: ½lb. to the foot. This allows for getting up the heat, &c., though for small ones a ¼lb. will be ample, unless the water acts upon the tin: in this last case 1 to 2lb. will be required. Having your solder-irons hot, and everything right, with warm cloth, splash-stick, &c., ready, take a piece of board B, Fig. 263, and lay it, as shown, in the bottom to catch the solder, and to prevent it getting on to the shaved part, S and W, of the bottom. Next take another piece of board about 1in. thick, cut to fit the outer angle as shown at A B, Fig. 263, and, with two nails driven into the ends and into the sides of the cistern, fix it, as shown. This will catch the metal while the top part of the joint is being made; or, if the cistern runs against the wall, push some paper, &c., between, so as to prevent waste of solder. Everything is now ready. Give the mate orders to "bring it" (the metal) and a piece of board, or, if the cistern is in a close place, a piece of lead or iron to stand the metal-pot on. Take the ladle full of solder in the left hand, and with the splash-stick in the right, commence splashing the metal on at the top

FIG. 263



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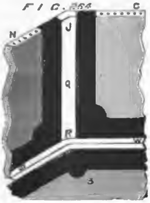
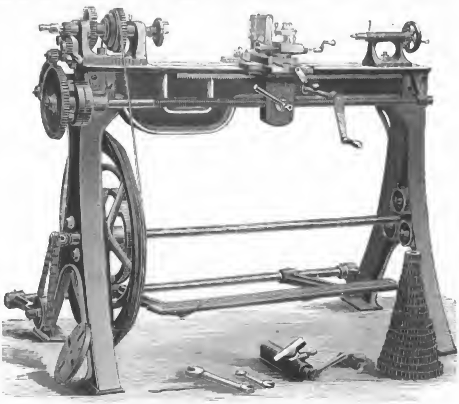
and down to J, then to Q and R. Keep at this, occasionally with the splash-stick picking and pushing up the metal from off the board B, until you can hold it like so much soft putty. Keep rubbing the splash-stick into the solder, and picking up the solder, at the same time splashing on more metal, until it is in a soft state; *quickly* put the ladle into the metal-pot, let the mate hand the iron, with felt on it, into the left hand, and let him give the warm cloth. (For the size of the cloths, &c., see cloth table, page 734, June 24th, 1881, "B.N.") Now, with the ball of the iron just touch over the top and down to about J, that is 3in. to 6in. down, and with the cloth wipe the top smooth, as shown, and down to about J; hold the cloth between the fingers as shown in Fig. 264, and wipe down to Q; now, with the ball of the iron warm up the other solder from R to Q, and when it is in almost a running state apply the cloth from where you left off, and wipe gradually down with a long, steady sweep, say 9in. to 12in. at a time. Do not attempt to wipe if the metal will not move, for it will be too cold, and if you should move it, most likely the joint, or the metal, will be broken, and perhaps too fine to be perceived; it will leak, and you will not be able to find out at what part. Having wiped the angle down to about R before the metal has time to set, push the nose of the iron into the solder at Z, and with the cloth clear the surplus metal away from the joint; then remove the board B, Fig. 263, and, by so doing, you should bring all the overplus metal with it, leaving the joint clean at the bottom, and to appear as that at J Q R, Fig. 264. After this is cold, take a strip of brown paper 3in. by 3in. well soaked in water and paste it over, and fix it over the bottom part of the solder at R, so that the solder will show only about ¼in. up the joint, and all is ready for soldering the bottom. To the unskilled it will be best to wipe these upright angles flat on their side—that is, when the cistern can be moved about. Having all the upright joints wiped out and the paper pasted round the bottom part, as at R—or, instead of pasted paper, some plumbers, especially those proficient, use chalk over this part, to prevent the solder adhering—next call for the metal, and begin splashing from I towards P, Fig. 251 (this being right-handed for wiping). When you have about two small ladles full of solder on the joint, warm it up with a large iron, and with the right hand wipe about 9in., keeping the iron close to the solder, and again warm up and wipe another 9in., and again warm up, still warming up and bringing forward the cold metal and wiping away until more metal is required to be splashed on. Keep at this until nearly the whole of your metal is gone, or cold; or, better, until the ends of the joint meet; or, if a two-handed job, until both plumbers meet. Wipe the corners out clean by applying plenty of heat round the outside and cold parts. It should appear as that shown at R, Fig. 257, and quite clean. If there should be a joint in the middle of the cistern, as at Q F, Fig. 251, this must be wiped before going round the bottom. In finishing off well warm up the cold meeting-part of the metal, and do not attempt to wipe it too cold, or it will appear scratched and rough. Nothing appears so bad as a slovenly finish, and tells a long tale about the workman. Sometimes the overplus metal will be in the way, especially when finishing; then clear it away with the cloth or shave-hook, &c.

FIG. 264



(*To be continued.*)



THE BRITANNIA COMPANY'S SCREW-CUTTING LATHES.

ON page 104, Vol. XXXIII., we illustrated and described a new self-acting screw-cutting lathe, brought out by the Britannia Company, as a serviceable machine at a low price. At that time there was nothing like it in the market, and so much success has followed its introduction, that the company now make larger lathes of the same design, which have received the attention of the Government in the shape of orders, the best of testimonials. The illustration in Vol. XXXIII. represented lathe No. 13. The present engraving serves for either No. 15 or No. 16, the difference being only in dimensions and weight. Supposing it to represent No. 15, it is a self-acting, sliding, and screw-cutting lathe, with a 4ft. gap-bed, and centres of 4, 4½, and 5in., as may be desired, at a small difference in cost. The cast-steel mandrel has conical necks running in gun-metal collars; the cone pulley has three speeds for gut band, and is fitted with reversing motion for cutting right or left-hand screws. The compound slide-rest has long bearings, the top slide swivelling to 50° each side of centre. The bed is 6½in. wide, and 4¼in. deep, with a gap of 4¼in. The lead screw is 1½in. diameter, and ¼in. pitch, and the gun-metal nut is in halves, so as to be readily detached. There is a rack and pinion for quick return. A full set of twenty-two change-wheels, to cut from one to sixty threads per inch, is supplied, and the lathe can be fitted with overhead motion for a comparatively small extra charge. The No. 15 lathe measures 2ft. 6in. between centres, swings 1ft. 4in. in gap, and 8in. over bed; but, as mentioned above, it can be had with 5in. centres. The No. 16 lathe is similar in design and fitting, but is much heavier. It is nominally a 5in. lathe, with a 5ft. gap-bed, the gap being 5½in. deep, by 6½in. wide, but it can be had, at a small extra cost, with 6ft. bed, 6in. centres, and with flat pulleys for belts. The Company make larger lathes, but Nos. 13, 15, 16 are especially adapted for the amateur's workshop, and for any purposes to which a foot-lathe is applicable. They, in fact, supply a want—a cheap sliding and screw-cutting lathe.

THE AGE OF ELECTRICITY.*

By Prof. S. P. Thompson.

IT is the fashion amongst ethnologists to classify the successive stages of development in the primitive races of mankind by reference to the kind of implement which marked the degree of civilisation to which they had attained. A chipped flint arrow, a bronze spear-head, an iron dagger are typical of the several grades of advancement in material civilisation which we familiarly name the age of stone, the age of bronze, the age of iron. To these three primitives ages you must allow me to add three others, equally well defined—the age of gunpowder, the age of coal and steam, and the age of electricity. The world is even now entering upon a new, and I am fain to believe a happier, age, wherein, whilst delivered to a large degree from the darker aspects, we shall enjoy to a degree hitherto unknown the advantages of machine-aided production. Our machinery will be driven, not by steam, but by electricity; for electricity will be our servant to do the hard work ot the world in the coming age. For a quarter of a century we have harnessed that messenger, more nimble than fleet-footed Iris, to convey our thoughts. We have but lately discovered that electricity could also convey the actual tones of our speech. It is electricity that rings our bells, that silvers our pewter and gilds our pinchbeck, that fires our torpedoes, and brings Greenwich time to our clocks. True, these are light and easy duties, but it has taken us many years to adopt in practical life these simplest applications. And, mark you, the delay is not to be imputed to science, for science has known most of these things for forty years. Mines were fired by electricity in 1749; electro-plating with silver was discovered in 1805; an electric telegraph was in actual operation in London in 1816; electric bells were invented in 1834; electric clocks were made in 1840; and speech was transmitted by an electric telephone in 1861. But, familiar as are these services to mankind, there are other services of a very important nature which electricity is perfectly competent to perform which, unless the world has grown wiser, will not, I suppose, be generally adopted for the next 40 years. Electricity can bring us a magnificent and economical light. It can smelt our most refractory metals. It can bleach our cottons and print our calicoes. It can detect base coins without cutting them, and can discover a bullet in a wound without probing it. It can stencil our circulars, grind our coffee, gather our apples and walnuts, protect us against burglars, turn our sewing machines, drive our tricycles. Nay, it can perform much heavier work. It can turn lathes, saw timber, grind scissors and knives, plane planks, propel tramcars, and, as I can personally testify, can furnish motive power of a very effective kind to an iron boat. Surely we have reason to say that the age of electricity has already begun. The success of primitive attempts to utilise electricity as a motive power was not very encouraging, for their cost was great and their power weak. The fact was that though the machinery—on a small scale at any rate—was ready, the time was not ripe for it. Compact and light in weight, these little electric motors presented, for light kinds of work, an enormous advantage over steam-engines; yet these advantages were far outweighed by the consideration that the cost of generating electric currents in the voltaic battery was so enormous as to be practically prohibitive. The great stride which has brought so many of the possible applications of electric currents into the region of practical problems is due in its origin to the genius of Faraday. With the invention and perfection of the dynamo between the years of 1862 to 1872 a new range of possibilities was opened out. Electric lighting, to which the real obstacle had been all along the extravagant expense of producing electric currents, at once began to develop, and the Jablochkoff candle, the Siemens lamp, and the Brush lamp, which sprang almost simultaneously into existence, found themselves shortly confronted by a host of brilliant rivals for fame. Then first it became clear that electric currents might be laid on from house to house in order to supply domestic electric-lights. Little lamps of the requisite compactness and brilliancy were speedily perfected by Edison and Swan, on the lines of an old invention of thirty years back, impracticable then, practicable now by reason of other advances in science. The vast possibilities opened out by the fact that a simple wire may convey electric currents to any distance now began to assume their true importance. The electric transmission of power to any distance, and the possibility thereby of utilising some of the waste forces of nature, became a burning question. The invention of the electric-accumulator by Planté, in 1860, and its improvement by Faure in 1881, suggested the further cheapening the cost of electric currents by providing a means of thus storing the intermittent energy of waves and winds. The electric-railway made its appearance in Berlin, to be followed by the electric-tramway of Paris, and various projects for electric-railways elsewhere. Electric industries of all kinds grew and multiplied; in fact, with the invention of the dynamo-machine we leaped into the age of electricity with a sudden bound. Now, as the first achievement in the age of electricity appears to be the spread of the electric-light, I will speak of that development first, though it is not, in my opinion, the most important. The blaze of the electric-arc light can be maintained by the consumption of a far smaller quantity of coal than would be required for the production of an equal amount of light by gas. So far there is economy—real and not small. But it may be said, "We don't want such overpowering displays in our houses even if we could afford them. There can be no economy in using a light far too brilliant for comfort." It is here that the incandescent lamps, such as those of Swan, Edison, and others, come in to give us exactly the brilliancy we need. Here, however, we are met by the disappointing circumstance that the very same electric consumption which will give us one blazing arc light of 1,000 and more candle-power will, when applied to light a score of incandescent lamps, only give to the latter a brightness of eight candles each; or, in total, 160 candles. It is clear, then, that the economy of small incandescent lamps is a different thing from that of arc lights. And I am quite certain that up to the present time, if any one has fixed incandescent lamps in his private house, and has erected his own dynamo and steam-engine or gas-engine to feed his lamps, he will have found no saving over his gas-bill. I say this with less hesitation, because, when the circumstances are looked at narrowly, it will be seen that for a fair discussion of the question of economy, the comparison is not a fair one. To set up little electric works of one's own in one's own house cannot possibly be as cheap a method of generating the electric current as to have it generated at central stations on a large scale by large and economical machinery. No sane man would think of saving on his gas-bill by setting up small gas-works in his cellar, and by building a private gas-meter in his back garden. The fair comparison must be made between gas as distributed from a central station on the large scale, and electricity as distributed from a central station on a large scale. That large scale distribution has, so far as I am aware, been yet only attempted in two places—New York and the Holborn Viaduct in London—and in both cases a system which is not necessarily by any means the best or most economical—I mean Edison's—is the system tried. Yet I look forward with the greatest confidence to the results of those experiments, as showing not only that electricity can be distributed on the large scale, but that it can be so done with economy and profit. This regular and systematic distribution of electric currents on a large scale, by means of conductors laid along the streets, is the first step to the further economic applications of electricity, and is becoming now a pressing necessity of the time. A century hence a supply of electricity will be just as essential as a regular supply of gas and of water has become today; a hundred years hence the town without an electric supply will be deemed as badly off as nowadays a town is which has no railway or telegraph. A general system of electric distribution is needed, not for electric lighting only, but for hundreds of other purposes of which we now dream little. Once let such a system be established, and we shall see how soon it will be found that there are many kinds of additional services which electricity can perform for us. When it is possible thus to obtain power by merely turning on a tap, there will be an enormous impetus to all kinds of small machinery. Motors to work sewing machines already exist, and would be used literally by millions if the source of electricity were but at hand, in the form of a friendly wire always ready to bring the needed power. If we have a system of electric distribution, lifts or elevators will be multiplied. An electric lift is both simpler and cheaper than a hydraulic lift, which will probably be suspended entirely at no distant date. Indeed, there are many hydraulic appliances which must at a very early date be superseded by electric machinery. Again, the establishment of a town supply of electricity will tend unquestionably to develop the industries of small workshops and home workshops, where a little power is required. The smallest electro-motors may be made just as economical as are the largest. There is, moreover, another point in their favour. They may be made far smaller, lighter, more compact, and far cheaper than steam engines of corresponding power. It is certainly possible to construct an electric-motor of two-horse power for a cost of ten pounds, and such a motor would be ample for the purposes of many small workshops. Why do we not, it may be asked, hear and see more of these little machines if they are so excellent? Why do not people adopt them? The answer is simply, they cannot be used until we have a central supply of electricity. I do not hesitate to affirm that such motors will be found to present an enormous economy in comparison with steam-engines of equal power. It is clear, then, that electricity offers an enormous future to small motor machinery. A further economy is, indeed, possible. Electricity will travel any distance along wires without sensible loss, provided those wires be thick enough. Instead, therefore, of erecting our steam-engines at a central town station, where ground is dear, and where we shall have to pay dearly for transporting coal, let us put our steam-engine and dynamos at the pit's mouth, and transmit our electricity to town through a stout copper cable. The saving of freights would much more than pay the interest on the cost of the cables required. One further step in economy is also within the range of possibility; and that is to use water-power or tide-power to drive our dynamos. If the problem of utilising the tides remains yet unsolved for want of suitable tide-mills, that of utilising the power of waterfalls by turbines is already solved, and only wants putting into effect. Niagara is not yet harnessed to the car of electricity, and is possibly too far off to supply Great Britain; but there are waterfalls enough in Scotland and in Norway to satisfy our wants for a long time to come. Of this, at least, I am convinced, that we do not yet realise the hundredth part of the future services which electricity can render to us when once it is supplied wholesale. Before the electric age is over, our knives will be polished, our shoes cleaned, our mangles driven, our coffee roasted, our potatoes pared, and our mince-meat chopped by the selfsame agency that will bring light into our dwellings. In all kinds of machinery, small first, large afterwards, we shall see a complete revolution. In a very few years we shall see electric governors replacing the rotating governor-balls for regulating the power of steam-engines. The locomotive steam-engine is irrevocably doomed. Why should we employ an enormous and expensive lumbering mass of metal, loaded with boiler and coals, and burning 4lb. of coal per horse-power per hour to draw our trains, when we might equally well draw them by electric motors of one-tenth part of the total weight, drawing their supplies of power electrically from a large and far-more economical stationary engine at one end of the line? (Hear, hear.) There is every argument in favour of this radical change—economy both in prime cost and in actual working, safety, and certainty of action. But railway directors do not yet know or realise the magnitude or certainty of the impending revolution. Having hinted, amid applause, at the prospect of electric power superseding steam on the Metropolitan Railway, Professor Thompson continued:—Setting aside all that deals with electric telegraphs and telephones, and confining ourselves only to the industries connected with electric lighting, the manufacture of dynamos, and of electric motors and their appliances, we shall find that in the electric industry today there are employed in England alone something like 5,000 persons. Practice of the actual work of the shops is of course outside the range of the operations of such a college as ours, but the work of the electrical laboratory is just as truly within our range as the work of the dissecting-room is within the range of the medical school. I look upon education in matters electrical, indeed, as a pressing necessity of the time. That nation which can earliest establish such a system of distributing power amongst its artisans will be placed in a most advantageous position for production, and such a nation will reap its reward in the rush of commerce to its doors. That city which rises to the golden opportunity in store will in like manner reap its due harvest of returns.

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* From a lecture delivered October 7, at the University College, Bristol.

ELECTRICAL ACCUMULATORS, OR SECONDARY BATTERIES.*

By Prof. Oliver Lodge, D.Sc.

(*Continued from p. 444, Vol. XXXV.*)

IN the last article I described a few typically instructive experiments that could be made with two clean lead plates immersed in dilute sulphuric acid, and connected at pleasure with a battery or a galvanometer or both. Before going on to the subject of coated plates, it may be well to draw attention to the consequences which a series of observations on plain plates will bring home to the experimenter.

If the surface of the plates are in the ordinary dull condition, he will find, on applying two Grove cells to them through a galvanometer, that the charging current at first is considerably stronger than it is after a few seconds. He will notice that oxygen rises from the + plate before any hydrogen rises from the − plate, and that as soon as both gases are freely given off the charging current is exceedingly small. In other words, the opposition electromotive force of the cell in this condition is very little below that due to two Groves; it is, I believe, about 3 volts. If the plates are brightened up just before insertion in the acid, the charging current will be weak from the beginning, and dydrogen will at once be given off. The stronger charging current observed for a few seconds in the first case was therefore due to the absorption of the first-formed hydrogen by a coat of oxide on the − plate; and if for this plate we use a purposely oxidised piece of lead, the absorption of hydrogen, and the consequent small opposition force and strong charging current, will continue for some time. The same thing would, no doubt, be observed in connection with the + plate if it ordinarily coated itself with an absorbent of oxygen; but as this is not the case, no particular effect is noticed when its surface is varied, unless, indeed, it be purposely coated with some oxidisable substance. To some extent minium and litharge act both as oxidisable and as reducible substances; and we have, therefore, the very important fact that it is much easier to send a current through two lead plates coated with litharge or minium than through two plates without any coating at all. The electromotive force of two Groves, which is almost overpowered by two clean plates, is amply sufficient to send a strong charging current through a cell with coated plates; at least, until the coatings are fully acted on, the gases no longer absorbed, and the cell full. As this state of things is approached the electromotive force of the cell gradually rises in a very decided manner.

With regard to the effect of amalgamating either or both of the lead plates with mercury, my experience leads me to conclude that amalgamation of the + plate is worse than useless. A coat of oxide of mercury is formed, which acts very fairly well as long as it adheres, or at any rate does not much obstruct the action of the peroxide of lead; but there is a certain point in the discharge when this coat falls off in a sheet, carrying with it apparently whatever peroxide of lead is present too, for the discharge current suddenly falls to zero whenever this happens. Of course the fall may be prevented mechanically, but the film still becomes electrically non-adherent, and therefore useless. Amalgamation of the − plate does, however, appear to help the occlusion of hydrogen, and is therefore so far advantageous.

The experiment of Professor Herschel, detailed in the last article, is capable of further elucidation. It consisted in observing the current produced by a piece of quite clean lead as the − plate, and a piece newly coated with peroxide as the + plate: the current is very weak, and hardly able to ring a bell. But it will be found on careful repetition that this feebleness of current is only arrived at after a second or two; the current at the first instant is quite strong. The real cause of the feeble current is a non-conducting film of sulphate or protoxide of lead, which forms on the clean lead plate the instant it is used to produce a current, and effectually screens it from the liquid. It causes, in fact, a sudden increase in the internal resistance of the cell. This can be proved in a variety of ways; such as observing that the lead plate so run down is incapable of giving a strong current when opposed to hydrogenised lead, zinc, or anything. Wiping removes the film, and restores the full power to the cell. Allowing the plate to remain in the acid for some time also removes the film to some extent, but slowly. As long as any hydrogen is present in the lead it appears to sustain oxidation alone, and the lead is unclouded; but as soon as the lead itself is attacked, the scum forms and the discharge current almost stops. By using amalgamated lead the scum is made plainly visible, and it can be seen to be wiped off when a cloth is used. The changes in the strength of the cell according to the presence or absence of this scum, are very interesting and striking. The scum never forms when the plate is merely left in the acid, it is only when it is put into electrical contact with the + plate. In the case of lead exposing a large spongy surface, no doubt this film would take longer to form, especially as a larger amount of hydrogen would be then occluded. A short connection to the charging battery speedily removes the scum, not apparently by reducing it, but by making it peel off. Violent short-circuiting of the cell forms the scum much more quickly than when only a moderate discharge current is permitted. The picking-up of the cell during standing is closely connected with the formation and removal of this non-conducting film.

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* From the *Engineer*.

It may be asked whether this insoluble film cannot be avoided by immersing the plates in nitric or acetic acid instead of in sulphuric, so that no insoluble salt need be formed when the − plate is attacked. Certainly, if plates charged in sulphuric are removed to nitric acid to be discharged, the discharge current lasts strong a much longer time; but the + plate now suffers a seriously rapid deterioration, owing to the absence of a coating which is to it protective. It is, moreover, impossible to charge up the battery properly in any such substance which forms soluble salts of lead; and the whole beauty of the secondary battery is gone if its liquid has to be changed between charge and discharge.

The reasons why lead is pre-eminent among metals for accumulator purposes are, that both its oxide and sulphate are quite insoluble in dilute H_2SO_4, that its peroxide is easily formed, and that it is conducting. The only other metal which satisfies these conditions is silver; but its sulphate is only partially insoluble, and, possibly for this reason, it does not answer. It would make a very light accumulator for some purposes, if it would work; but, for some reason or other, its power falls off with great rapidity, whether it is tried in H_2SO_4 or in HCl. The latter does rather the best, and it may be that its fall is only due to a rapidly formed scum of chloride, which speedily reduces both plates to the same condition. A chloride, moreover, not being a conductor, could never take the place of a peroxide.

A curious experiment may be tried with copper, showing the necessity for a conducting, and at the same time an insoluble, substance as a coating to the plates. Take two slips of copper, say 5centim. by 1½centim.; immerse them in dilute sulphuric acid or sulphate of copper, and send a charging current from three Groves through a dead-beat galvanometer—such as Ayrton and Perry's. It will be found that the current which at first passes easily, is gradually and rapidly weakened, until at length the needle, which was at first deflected 20° or 30°, has returned to within 1° of zero.

If the current be now stopped for a few seconds and then renewed, the needle jumps up to 10°, say, but rapidly and almost suddenly comes down to 1° again. If the current be interrupted for a longer time, it will take longer to come down again when renewed. But scarcely any discharge current can be got from the cell. The reason of the weakening of the current must be a coating of pulverulent material on one or both of the plates, which resists the passage of the current. A small amount of waiting dissolves a good deal of this off, and accordingly the charging current rapidly picks up again. Instead of a galvanometer an ordinary gas voltameter will serve for this experiment; the changes in the strength of the current are most striking. A certain *intensity* of current is, however, necessary, and nothing of the kind is observed when *large* copper plates are used.

If a cell such as a Sutton cell, where the salt of the − plate is soluble (which, considered by itself, and without reference to the + plate, is, as we have seen, an advantage), if such a cell is violently short-circuited and made to produce too strong a current, it is probable that oxide is formed on the − plate faster than it can be dissolved, and that accordingly a protecting film is formed, which temporarily stops the action. If such a cell permanently falls off, it must be owing to the deterioration of the + plate by local action, which is very difficult indeed to avoid when soluble salts, such as sulphate of copper and sulphate of zinc, are present in the cell. In fact, the requirements of the − plate are, unfortunately, somewhat in antagonism to the requirements of the + plate, and what benefits the one is usually fatal to the other.

FORMATION OF CARBONIC OXIDE IN THE BURNING OF COAL.

WITH reference to the question whether by combustion of carbon at a high temperature, the formation of carbonic acid or of carbonic acid gas is favoured, Professor Ledebur expresses himself to the following effect in *Stahl und Eisen*:

When a carbon-containing fuel is burnt, we speak of a perfect combustion, where the gases of combustion no longer contain any combustible constituents, and so consist of carbonic acid, nitrogen, and steam. This complete combustion can be reached only with an excess of oxygen, and it is promoted by a high temperature in the place of combustion; the higher the latter is, so much the smaller excess suffices, in general, to bring about the combution. This general fact has given direction to a wide-spread error—viz., that a high temperature quite generally promotes the production of carbonic acid, and a low temperature that of carbonic oxide. The first part of this conclusion is, however, only correct; where an excess of oxygen is present, the second part, regarding carbonic oxide formation, is quite false.

High temperature favours the chemical union of carbon and oxygen. From this empirical proposition the inference may evidently be made that if a sufficient quantity of both substances is present, a high temperature must favour the production of carbonic oxide.

This is no mere matter of theory, but of observation, which may be made any day. Dr. Stockman found, e.g., with a cold-working generator, 16 per cent. of CO, with 12 per cent. CO_2; with hot-working one, 22 per cent. CO, and 7 per cent. CO_2. A similar phenomenon occurs in the preparation of water-gas, as appeared from the communications of Dr. Bunte on the subject; the larger the process is carried on, and so the more the generator is cooled, the more abundant is the formation of carbonic acid. Quite similar processes occur in the iron blast-furnaces; it is observed that the higher the temperature, the more quickly and perfectly the free oxygen not only disappears, but combines with carbon to carbonic oxide. Therefore heating with the blast promotes the production of carbonic oxide in the iron blast-furnace. Were the opposite view correct, then with the strongly oxidising property of carbonic acid at a high temperature, the hot blast would not facilitate as it does the production of varieties of pig-iron rich in silicium and manganese.

The author describes some experiments of his own in this connection, in which carbon was rendered incandescent at various temperatures in an air current, and the products of combination were examined. From these he concludes, that in combustion at a low temperature, carbonic acid is formed, and at a high temperature carbonic oxide.

In these experiments, a volume of about 1 litre of atmospheric air was led from a gasometer through a combustion-tube, with glowing pieces of wood carbon at various temperatures. The combustion-tube was heated with gas. It was of glass in the case of a cherry-red glow, and porcelain in the case of yellow glow. Beyond the tube there was a potash apparatus for determination of carbonic acid; and beyond that, for direct determination of carbonic oxide, another combustion-tube with cupric oxide, and a second potash apparatus.

The proportion of carbonic acid and carbonic oxide varied for different temperatures in the following distinct manner:—

		CO_2.	CO.
1. Under zinc-melting heat, about..	350° C.	78·6 p.c.	21·4 p.c.
2. At zinc-melting heat	440 „	72·4 „	27·6 „
3. Still dark red glow	520 „	71·4 „	28·6 „
4. Commencing cherry-red glow	700 „	62·6 „	37·4 „
5. Yellow glow ..	1100 „	1·3 „	98·7 „

BELTS.*

(*Continued from page 86.*)

IN the use of belting for driving machinery, there are encountered in everyday practice innumerable difficulties and conditions not taken into account in the ordinary consideration of the belt subject. Among the small belts, say from 3in. to 6in. wide, we will find many instances wherein, by reason of slow speed or small pulleys, an excessive strain is necessary upon the belt and lacings in the endeavour to perform a desirable amount of work. The belts are laced and relaced from day to day, are worn out or mutilated so as to be replaced two or three times a year, and still the infliction goes on and comes to be considered a necessary evil. The expense incident to the placing of belting under proper conditions for economical service and long life, also to rendering it in a very great measure independent of the assistance of incompetent attendants, cuts a very small figure compared to the steady drain upon the profits, resulting from ill arranged and overloaded belts. All belting 8in. and under in width can, and should be, arranged to drive the load at a tension light enough to enable a person accustomed to machinery to throw a belt on the running pulley by hand.

Passing from the smaller to the larger belts, we are again confronted by adverse surroundings. With wide principal driving belts the conditions are apt to be more arbitrary, simply on account of the magnitude of things and the want of room. We are often forced to place a large belt in a position, already established and practically unchangeable, in which the changes are decidedly against the belt. Under restrictions of this nature, the most important factor in the transmission of power by belting is, in a majority of cases, entirely overlooked, viz., the speed of the belt.

There are many cases in practice wherein a little attention to this point at the beginning would have opened the belt-maker's eyes in time, and saved much trouble and expense.

Although seemingly unavoidable in a great many cases, on account of the lay-out of buildings already in use, I must say a word against the damaging use of idlers or tighteners placed upon the backs of main driving belts. There are some instances in which the idler simply holds the slack of the belt steady, and, aside from a slight additional wear upon the outside surface of the belt, does no harm; but there are many examples where the belt is decidedly unable to drive the load at a pressure upon the pulleys due to the steady weight of the belt alone. And as power is merely the product of force or resistance multiplied by motion, and as we must obtain a certain power at all hazards, whatever is lacking in speed of motion must be made up in weight of pressure. The production of pressure upon the pulleys by straining down upon the slack of the belt, is equivalent to an increased strain lengthwise of the belt, and when this strain is carried beyond the elastic limits of the belt substance it is a question of but a comparatively short time before the joints and the substance itself begin to give out. This point once reached, the destruction of the belt is very rapid.

Nor is this all, for the increased pressure is felt by the journals, and some of the equivalent of power becomes sensible in heat, causing the application of an increased quantity of oil. The heat indicates loss of power, while the surplus oil is not only lost, but is mostly thrown upon the belt, and hastens its already assured destruction.

It seems as though it would be a good plan for belt manufacturers to take a trip around to numerous factories, indicate the engine for power, and observe the conditions and probable pressure under which the large belts are operated. They would soon discover that engines reputed to be driving enormous loads were having quite an easy time of it, and consequently the work being done by the belt had been wildly guessed at. They would probably find instances like one I noticed, where a certain width of belt was driving a certain load at a speed of about 4,500ft. per minute; while another belt of the same width and weight was struggling along at 3,000ft., with a greatly increased pressure and doing less work. A few such lessons would put a stop to their puzzling over the question, "Why does one belt run steadily along for years, while another one just like it goes all to pieces in a comparatively short time?"

In conclusion, I would remark that in the practical operation of belting there is quite a distinction between light narrow belts and wide heavy ones. As will be seen by inspecting the table in the previous article, a higher resistance is given per square inch of contact for the narrower belts, which was in part explained, but the following may set the matter in a still clearer light: It may be possible to strain the large belts nearly up to the unit of pressure of the small ones, but when a large belt stretches a little and becomes slack it would fall short of the driving power calculated on, and unless the belt was tightened it would slip, and in a very short time work a great deal of damage. To throw off and relace a small or medium-sized belt is not much of a job, but to shorten up a wide heavy one, especially if made endless, is quite another thing, and should be avoided as much as possible; therefore, it is cheaper to give the large belt sufficient capacity to drive when quite slack as compared with a small one.

TONING FOR YOUNG AMATEURS *

ONE difficulty the young amateur frequently encounters in his photographic manipulations is that of toning. To give any definite rule for the accomplishment of this in a satisfactory manner is not easy. Toning can only be learned by practice. It is necessary that the student proceed in a systematic manner to work it out, and the following plan is suggested by which a vast amount of information on toning will be obtained. Select a strong, vigorous negative, and from it make a proof on sensitised paper, printing deeper than the finished print should be. Cut this proof into four equal parts, and on the back of each put a number, as 1, 2, 3, 4. Make a toning bath according to the formula in use; four pieces are washed in several changes of water, and then placed in the toning bath. Watch the prints closely, and as soon as No. 1 assumes a very slight approach to the purple, remove it and place in a dish of clean water. Allow No. 2 to show more of the purple; No. 3 should be carried further; and No. 4 will receive the longest immersion in the toning solution. Wash well the four pieces in several changes of water, and fix in hyposulphite of soda (say four ounces soda to pint of water). After fixing, wash in five or six changes of water, and then transfer to a solution of acetate of lead. Again wash and dry the prints; then study each well.

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* By Chas. A. Hague in the *American Machinist*.

* By Henry Clay Price, in the *Photographic Times*.

SCIENTIFIC SOCIETIES.

MICROSCOPICAL SOCIETY OF LIVERPOOL.

THE seventh meeting of the 14th session of this society was held at the Royal Institution, Colquitt-street, on Friday last, when Mr. F. T. Paul, F.R.C.S., was elected president for the year 1883. The paper of the evening was read by Mr. F. T. Paul, F.R.C.S., the president-elect, entitled "On Hair and Allied Structures." He said that as the subject was a very wide one, he would limit his remarks to a consideration of the morphological relations of the various tegumentary appendages which must be regarded as allied to hair. The structures which were included in this general association were of the most opposite character, but were uniform in the possession of certain common qualities of a protective or attractive nature. After a few general remarks upon the adaptation of the external covering to the requirement of the individual, showing the combination of as much attractive beauty as was consistent with the welfare of the species, the development of the skin in vertebrate animals was described. Special attention was called to the history of the two layers of which it is composed, showing their separate origin and their different character throughout life—that the epithelial layer may be modified to form horny or calcified tissues, and the connective tissue layer to form bone, ivory, cartilage, muscle, nerve, &c., so that where complicated structures like teeth, spines, feathers, and so forth were produced, they always knew what share each layer had taken in their formation, because they knew to begin with what modification each layer was capable of undergoing. The appendages were divided into two classes — those developed from comparatively large areas of skin tissue, such as nails, claws, hoofs, horns, scutes, and beaks, and those developed from a small bud or germ from the epithelial layer, such as hair, feathers, scales, spines, teeth, and glands. The developmental relations of the first class were then considered, and special reference was made to the fossil remains of birds that have recently been discovered and described by Prof. Marsh, of America, in which there is a full set of reptilian teeth in the beak or jaw, which, together with the abortive germs in some existing species, and the serrated beaks of fossils and recent birds, show a gradual change from the reptilian jaw to the present beak. Taking the second class, fish scales are omitted as too large a subject to be compressed into one paper; but the development of the hair, the various phases of its life history, its decay and reproduction, were fully considered; and the microscopical characters of the most striking varieties of hair were illustrated. Attention was called to the character of the papillæ, and the effect of its modifications in size, shape, and position in producing special kinds of hair—size, shape, curling, &c.; but more particular allusion was made to the extremely complex nature of the papillæ which inspire the extraordinary combination of cells resulting in the production of a perfect spine or feather. A short account was given of the glands of the skin, especially in such animals as the naked amphibians, in which they act as weapons of defence by pouring out an acrid secretion which is obnoxious to the palate of some of those animals that are naturally disposed to prey upon them. The paper concluded with some suggestions for preparing these tissues for the microscope.

PRACTICAL RECIPES.

To Bleach Straw.—About 9oz. of permanganate of potash are dissolved in 1 gal. of warm water. This is done in an earthenware vessel, and cold water is then added until the liquid takes a dark red colour. The straw is left for about six hours in a tepid and weak solution of soda crystals. It is then washed carefully and introduced into the permanganate solution, in which it is continually agitated. As soon as it has taken a light brown colour, it is dipped in cold water, then in a bath of bisulphite of soda, strong enough to be smelled. In this bath the straw is left for fifteen minutes, and when taken out it is perfectly white.

Glass Coating on Metals.—The following method has been suggested for coating metal surfaces with glass. Take about 125 parts (by weight) of ordinary flint-glass fragments, 20 parts of carbonate of soda, and 12 parts of boracic acid, and melt. Pour the fused mass out on some cold surface, as of stone or metal, and pulverise when cooled off. Make a mixture of this powder with silicate of soda (water-glass) of 50° B. With this coat the metal to be glazed, and heat in a muffle or other furnace until it has fused. This coating is said to adhere very firmly to steel or iron.

To Clean Brass.—The method prescribed for cleaning brass, and in use at all the United States arsenals, is claimed to be the best in the world. The plan is to make a mixture of one part common nitric acid and one-half part sulphuric acid, in a stone jar, having also ready a pail of fresh water and a box of sawdust. The articles to be treated are dipped into the acid, then removed into the water, and finally rubbed with sawdust. This immediately changes them to a brilliant colour. If the brass has become greasy, it is first dipped in a strong solution of potash and soda in warm water; this cuts the grease, so that the acid has free power to act.

Cement for Glass and Metal.—Brass letters may be securely fastened on glass windows by the following receipt:—

Litharge	2 parts.
White lead	1 ,,
Boiled linseed oil	3 ,,
Gum copal	1 ,,

Mixed just before using, this forms a quick drying and secure cement.

Glacialine.—According to Dr. Besana, this substance, which has met with so much favour in England and elsewhere as an antiseptic, especially for the preservation of milk, meat, and other articles of food, has the following composition:—

Boracic acid	18 parts.
Borax..................	9 ,,
Sugar..................	9 ,,
Glycerine	6 ,,

A Roman composition of a similar kind was found to be nothing but pure boracic acid. It is called salt of glacialine, and sells at five francs per kilogram (about 45 cents a pound), the market price of boracic acid being exactly half that rate.

FACTS AND FIGURES.

The Railway Mileage of the United States.—The *Railway Age* compiles the following table, showing the railway mileage of each State on Jan. 1, 1882, with the numerical rank of the several States in railway enterprise.

1	Illinois	8,326	25	South Carolina	1,484
2	Pennsylvania..	6,690	26	Mississippi	1,232
3	Ohio..........	6,664	27	Maryland&D.C	1,048
4	New York	6,279	28	Arkansas	1,042
5	Iowa	6,113	29	Nw Hampshire	1,026
6	Texas	5,344	30	Maine	1,022
7	Indiana	4,765	31	Louisiana	999
8	Michigan	4,284	32	NewMexicoTer	975
9	Missouri	4,211	33	Connecticut ..	959
10	Kansas	3,718	34	Vermont......	916
11	Wisconsin	3,442	35	Utah Ter.	908
12	Minnesota	3,391	36	Nevada	890
13	Georgia	2,581	37	Florida	794
14	Nebraska	2,310	38	West Virginia	712
15	Colorado......	2,275	39	Oregon	689
16	California	2,261	40	Arizona Ter. ..	557
17	Virginia	2,194	41	Wyoming Ter.	533
18	Tennessee	1,974	42	WashingtonTer	480
19	Massachusetts	1,935	43	Delaware	278
20	Alabama......	1,804	44	Indian Ter....	275
21	New Jersey ..	1,753	45	Idaho Ter.	265
22	Kentucky	1,715	46	Montana Ter..	232
23	Dakota Ter. ..	1,639	47	Rhode Island..	211
24	North Carolina	1,619			
				Total Miles	104,813

Area of Yacht Sails.—No yacht in the New York yacht fleet is more completely fitted in racing and cruising canvas than the *Montauk*. The following table gives points of interest:—

Sail.	Yards.	Width in Inches.	Square Feet.
Jib topsail (large)	360	28	2,343
Flying jib	290	11	846
Jib	445	14	1,292
Lug foresail	665	14	1,675
Mainsail	925	14	2,636
Foretopsail............	170	14	442
Maintopsail	180	14	500
Topmast staysail	170	28	884
Balloon topmast staysail	620	28	3,827
Balloon club topsail....	135	28	840
Balloon jib............	390	28	2,700
Spinnaker	380	28	2,640
CRUISING SAILS.			
Boom foresail..........	550	14	1,408
Fore staysail	280	14	780
Jib	225	14	650
Awnings,covers,traps&c	700	22	3,675
Totals	6,580		26,736

Digestibility of Food.—Drs. Stutzer, Fassbender, and Klinkenberg have been examining the digestibility of various kinds of food. The method employed is that of Stutzer, who extracts the ferment from the digestive organs of slaughtered animals, the membranes of the stomach and the pancreas, and allows a solution of it to act upon a weighed quantity of the food at the temperature of the blood. The amount of albumen left undigested is compared with the total amount previously present as found by special analysis. Indigestible albuminoids were found in blood, yolk of egg, meat, &c., but could not be detected in milk or in egg albumen. From the extended series of results in the *Chemiker Zeitung*, the following examples, in tabular form, are taken:—

	Digestible Albumen.	Fat.	Carbo-Hydrates.	Phosphoric acid.
Nestle's children's food.	9·9	5·1	79·3	0·4
Wahl's ,, ,, ..	1·8	1·2	86·3	0·1
Fresh white bread	7·2	0·3	60·7	0·2
Fresh black bread	4·2	1·1	52·1	0·5
Du Barry's Revalesciere	19	1·5	65·6	0·9
Link's malt extract....	2·5	—	63·0	0·3
Hoff's ,, (alcohol 1·2)	0·3	—	71·0	0·1
Lean beef (extract 2·6).	18·5	3·4	—	0·5
Beef soap (,, 2·3).	1·5	0·5	—	0·3
Fowl (,, 2·8).	16·5	2·8	—	0·4
Extract of meat (extract 53·8)	3·4	—	—	8·6
Smoked ham (extract 5·4)	18·9	36·0	—	0·5
Cow's milk	4	3·5	—	—
Condensed milk, Cham.	8·8	10·4	—	0·5
Caviare (extract 2·0) ..	25·8	15·4	—	1·1
Oysters (,, 8·6) ..	5·7	1·2	—	0·3

A dozen oysters weighed 86 grammes, or about 3oz., so that 14 oysters contain as much digestible albumen as one hen's egg. Meat that had been used for soup still retained 17 per cent. of albumen, but only 0·3 per cent. of extractive matter.

USEFUL AND SCIENTIFIC NOTES.

Bills of Sale.—The new Act relating to bills of sale will considerably alter the nature and value of such instruments—in some respects we hope for the better. Our legal contributor, Mr. F. Wetherfield, has drawn up a little treatise on the subject, which should be read by all who are likely to use such documents, or to do business with others who use them. Bills of sale in the past have been equally instruments of shameful oppression in the hands of rapacious creditors, such as bogus loan societies and the like, on the one hand, and the means of evading their just liabilities by rascally debtors on the other. The new law will probably neither make all men honest nor wise, but it may help those who are so to guard a little against knaves and fools.

Electro-Generative Fuel.—At the recent meeting of the French Association for the Advancement of Science, Dr. Brard, of La Rochelle, read a paper before the Physical Section, in which he described a new method of generating electricity by the combustion of a peculiar kind of fire-slab. This slab consists of a brick of carbonaceous matter and a brick of nitrate of soda or nitrate of potash, placed together, but separated by a thin sheet of asbestos paper, and both enveloped in a wrapper of abestos. The carbon brick is formed of about 100 grammes of coaldust kneaded into a paste with tar or molasses, and shaped in a mould by heat. The mould gives the brick a pitted surface above, and perforates it with holes through and through from the upper to the under side. Strips of brass or copper are also imbedded in the under side of the brick to serve as an electrode for the carbon pole of the electro-generative element. The other brick consists of a mixture of three-parts ashes and one part nitrate of potash or soda, melted together and poured upon the pitted surface of the carbon, which, however, is first covered with a layer of asbestos paper. Strips of brass are also imbedded in this compound, to serve as an electrode. The slab thus formed constitutes a generator of electricity when wrapped in asbestos and placed in a furnace or fierce fire. In such an element the carbon forms the negative plate, and is oxidised just as zinc is oxidised in the ordinary voltaic cell; the nitrate of potash being the oxidising substance. The slab becomes a thermo-chemical battery, and Dr. Brard states that an electric current is obtained strong enough to actuate an ordinary electric bell. By connecting up several of these elementary slabs after the manner of a voltaic battery, a more powerful current is the result, three or four cells being sufficient to decompose water.

SCIENTIFIC NEWS.

THE great comet seems to be puzzling astronomers. There is not much doubt that it is the same as that found by M. Cruls on Sept. 12, and, as it now appears, by Mr. Finlay at the Cape Observatory on the morning of Sept. 8; but as to when it appeared before, or when it will return, there is a great conflict of opinion. Dun Echt Circular No. 61 publishes elements computed by Prof. Weiss, of Vienna, as follows:—T = 1882, Sept. 17·42 G.M.T.; $\pi - \Omega$ 87° 58′; Ω 350° 44′; i 143° 42′ (mean equinox 1882·0); log. q 8·52634. Prof. Weiss considers the comet to be identical with that of 1668. Dun Echt Circular No. 62 contains the following remarkable elements, computed by Messrs. S. C. Chandler, jun., and O. C. Wendell, of Harvard College:—T = 1882, Sept. 17·18 G.M.T.; $\pi - \Omega$ 71° 40′; Ω 346° 52′; i 142° 35′; log. q 7·94448; eccentricity, 0·9981; period, 3,116 days. Dr. Oppenheim, however, still makes the orbit parabolic with log. q 7·88036. Dun Echt Circular No. 63 contains the elements computed by Dr. Oppenheim; and a position observed by Prof. E. Millosevich on Oct. 1 at Rome.

We have received the *Science Observer* special circular, No. 26, giving the elements already telegraphed to Lord Crawford, and issued in the Dun Echt Circular No. 59 (see p. 109); but the elements above given, computed by Messrs. Chandler and Wendell, being later, are presumably more accurate.

MM. Thollon and Gouy, of the Nice Observatory, have observed the comet with the spectroscope, and have noted the displacement of the sodium lines D_1 and D in a manner indicating a retrograde movement. The spectrum of the comet presents much similarity to that of comet Wells, which is the more remarkable as no previous comet (i.e., to Wells) had ever shown the sodium bands. According to Messrs. Chandler and Wendell, the comet passed its perihelion on Sept. 17, at the small distance from the Sun's centre of 0·0033 in terms of the Earth's mean distance, which, if true, would show that the comet actually passed within and through the Sun's surface.

We have received many notes from observers, for which we are unable to find room; but the following gist of a letter from Mr. C. E. Peek, B.A., who is *en route* to Australia to observe the Transit of Venus, may be of interest. The letter is dated Simon's Bay, s.s. *Liguria*, Sept. 18:—My attention, says Mr. Peek, was drawn to it on the 14th, by the officer of the watch, at about 5.15 (local time) in the approximate latitude of 20° S., when it appeared as a brilliant object in the heavens. Owing to clouds, however, I was unable to observe it for any length of time. On the 15th we had a clear view; the nucleus was intensely brilliant, of about the same brightness as Jupiter, which was up at the same hour. After the sun had risen some considerable time the tail was still visible, and about as long as the semi-diameter of the sun. When rising through the haze the nucleus appeared as a disc almost as large as the moon.

Most of the Transit of Venus observers are now on their way, the last parties to start being those who will be located in the West Indies. Capt. Mackinlay, a member of the Jamaica party, gave an interesting lecture on the Transit last week at the Royal Artillery Institution. In addition to the official observers, whose names will be found on p. 49, many volunteers are going out, some of them attached to the parties, e.g., Mr. Peek, above mentioned, and Dr. Pearson, of Emmanuel College, Cambridge, who goes to Jamaica. The American observers, going to the Cape and elsewhere, left Plymouth last week.

Mr. J. A. Westwood Oliver has in the press a brochure on the great comet of 1880, and the effects which may be expected to follow its absorption by the sun.

Dr. Traill, T.C.D., delivered an interesting lecture last week, in Belfast, on electricity as a motive power, with especial reference to railway work. An electric tramway between Portrush and Bushmills is nearly completed. It is the first of the kind in the United Kingdom, and is six miles in length. Besides the well-known advantages claimed for the electric propulsion of the cars, Dr. Traill mentioned that the cars could run up any reasonable incline; the dynamo itself acts as a powerful brake when the primary current is cut off; and whenever a car meets with extra resistance, such as an incline or a sharp curve, the dynamo puts forth the exact amount of extra power required, and no more.

We have received the sixth edition of Mr. C. E. Stretton's pamphlet on "Railway Accidents," and are pleased to think that the success which has attended its issue is some evidence that the public is being educated to appreciate the question at issue. If the members of the House of Lords who effectually prevented Earl De la Warr's Bill from becoming an Act had read Mr. Stretton's pamphlet, they would not have been misled. The sixth edition contains additional matter, and a plate illustrating Tweedy's system of interlocking, besides the plates found in previous editions. The continuous brakes' return is given in tabular form, so that the public can see at a glance the progress made by the respective companies; and with the author's notes and description of the plates they will understand what is needed, and what can be done to render railway travelling safer than it is.

The Amalgamated Society of Railway Servants, at the conference held in Darlington, passed resolutions declaring that it is desirable the compulsory adoption of continuous brakes for all passenger trains should be the object of legislation; that it is possible to avert a great many of the accidents now happening to the employés, in consequence of the old-fashioned methods of coupling; and that a more numerous staff of Government inspectors is demanded.

Miss Ormerod, the entomologist to the Royal Agricultural Society, is preparing her annual report, and solicits information from farmers and other observers upon the habits of injurious insects, and methods found serviceable in checking their ravages.

The *Anisoplia austriaca* is a species of beetle which has recently made sad havoc in the wheat fields of Russia. The entomologists are seeking for means of destruction, as the insect, when once established, proves a veritable scourge.

At Owens College, Manchester, a practical class in electricity will be held, under the care of Prof. A. Schuster, assisted by Mr. W. Haldane Gee, on Thursday evenings. The class will have the assistance of a Wilde dynamo, worked by the college engine, Ayrton and Perry's ammeter, Sir W. Thomson's volt-meter, and the Siemens' electric dynamo-meter.

An exceptionally interesting excavation for geological purposes was conducted in the New Forest during the last fortnight of September by Mr. J. W. Elwes, of Otterbourn, and Mr. J. W. Shore, of Southampton, who obtained special permission for the purpose. A considerable area of the Brockenhurst bed was exposed by the removal of about 12ft. of overlying strata near the railway cutting, which yielded some very interesting specimens forty years ago. More than a thousand good specimens were obtained, comprising seventy species of molluscs and other corals.

Our contemporary, *Nature*, with a too-sanguine estimate, we fear, of the linguistic powers of Englishmen, printed last week, *in Italian*, an interesting item regarding the comet, of which the following is the gist:—Prof. Cacciatore, of Palermo Observatory, issued a circular, stating that while all Italy was moved by the disaster that had befallen the Venetian and Lombard provinces, and committees of succour were being formed throughout the country, the Observatory, with a view to furthering the compassionate design, would open its halls on the morning of the 26th, at 5 o'clock, to those generous visitors who should make a contribution of 200 lire (say, £8), and who might wish to enjoy a sight of the surprising spectacle (of the comet) with the Observatory's large and magnificent refractor. "In this way, the apparition of this comet, which in other times would have been regarded as a precursor of Divine wrath, and a cause of present miseries, will be recorded as a blessing to humanity."

The pronunciation of geographical names often presents difficulties, especially where the local pronunciation differs from what would elsewhere be expected from the spelling. The Society of Commercial Geography of Bordeaux appointed a committee to study the question with a view to discussion at the Congress of French Societies of Geography, which recently met in Bordeaux. The Congress adopted the principle that *geographical names should be pronounced in the local way*, account being taken, however, of some exceptional cases. The committee was instructed to continue its labours, some idea of which may be had from the following examples (given in *La Nature*) from a table distributed to members:—In France, the name Aiguillon is pronounced *Aig-uillon* (ll soft); Aix (Ile d'), *Ile Dé*; Aix (Bouches-du-Rhône), *Ex*; Arveyres, *Arvei-ire*; Aunis, *Auni*; Auxerre, *Ausserre*; Auxerrois, *Auc-cerrois*; Auxonne, *Aussone*; Aveyron, *Avéron*; Ay-Champagne, *Aï*., &c., &c. The foreign names, Anvers, *Anversse*; Bruxelles, *Brusselles*, &c.

Experiments have been recently made by Herr Craner on the nutrition of a man in his sixty-fourth year, who had practised vegetarianism since he was eleven. The author arrives at these conclusions (given in a German physiological serial): The régime of vegetarians affords food which is, both in absolute amount of nutritive matter, adequate to maintenance of bodily and mental functions, and in relative ratio of mixture sufficient. It suffices, however, for prolongation of life, only because it depresses the quantity of vegetables by introduction of animal albumen in the form of milk and eggs. Yet this régime, where too great loading of the digestive system is to be avoided, is too dear to be recommended for sustenance of large bodies of men, as in poorhouses, barracks, and prisons; and, on the other hand, it is an eminently unpractical method of feeding man, since for the same price may be provided a much larger quantity of mixed, and therefore more utilisable food.

With regard to the priority claimed for M. Berliner, in the matter of the microphone (see recent note), Count Du Moncel remarks in his paper that M. Berliner's apparatuses are only telephonic transmitters, and not *microphones*, as they are not arranged for amplification of vibrations. What constitutes the novelty of Prof. Hughes' apparatus is the arrangement of contacts which allows of rendering them as sensible as desired by a position more or less near that of unstable equilibrium. Prof. Hughes (in the Count's opinion) remains the inventor of the microphone; but M. Berliner may have the priority for telephonic carbon transmitters.

An electro-magnetic indicator of temperature at a distance has been recently patented in Austria by Herr Bing, of Vienna. It requires only one conducting-wire, and consists of a V-shaped vessel, whose wider branch, of metal, and closed above, is filled with commercial naphtha, alcohol, oil, or the like. The narrower branch is of glass, is open above, and contains mercury, the position of which varies regularly with varying temperature (which causes expansion or contraction of both liquids). A float on the top of the mercury is connected with a cord held tense by a counterpoise, or with a toothed wheel chain, which turns a roller, serving as contact-arrangement in one direction or the other. The electro-magnetic transmission of this motion to the empirically graduated indicating apparatus at a distance, takes place on the principle of Siemens and Halske's water-level indicator. The apparatus is simple and cheap, and is said to work reliably. It can be adapted as a maximum and minimum thermometer.

It is known that Dr. W. Siemens has been seeking the establishment of chairs for "Electrotechnik" at all technical schools in Germany, and he has had very encouraging success. Prof. Dietrich has lectured on the subject at the Stuttgart technical high school since April. Prof. Wüllner has just begun a course at Aix-la-Chapelle; Prof. Meidinger has been similarly engaged about a year at Karlsruhe, and the telegraph director, Merling, since 1880, in Hanover. In Berlin, this winter, Dr. Slavy is appointed to give electrotechnical lectures at the technical high school, beginning with electrical power-engines.

Belgium now possesses the densest railway system, relatively to the surface of the country. Comparing the extent of railway with the population, she is surpassed only by four States—viz., Switzerland, the United States, Bavaria, and England. The Belgian railway system had, at the end of 1880, a total extent of 4326·4km. To about 7 square km. there is 1km. of railway.

A recent law in France has authorised the application of electric lighting in forty-two of the principal lighthouses on the French coast. The cost of the enterprise is estimated at 8 million francs. The transformation will be slow, and will take eight or ten years. The light has been already applied at Cape Grisnez and elsewhere.

At the Californian town of San José (which has rapidly grown in recent years), a method of electric lighting has been adopted, which consists in the erection of lofty quadrangular pyramidal frameworks of metal, with several light-centres at the top, surmounted by a reflector. The first of these towers, which has been tried, with very satisfactory results, is at the base about 25 metres a side, while at the top of the truncated pyramid, the side is only 1·25m. The uprights are tubular, diminishing in section upwards. The total height is about 60 metres (say, 200ft.). There are six light-centres at the top, each with a luminous power of 400 candles. They are fed by a Brush machine requiring an initial force of nine horse-power. The effect obtained is like that of bright moonlight, and is of large extent. It has been resolved to raise five other towers, and the illumination will benefit the suburbs where formerly there was no gaslight. A picture of the arrangement appears in *La Lumière Electrique*, 16th September.

USEFUL AND SCIENTIFIC NOTES.

Obtaining Oxygen from the Air.—A method of obtaining oxygen from air for technical purposes has been recently devised and patented by M. Margis, of Paris. The principle is that of dialysis, or diffusion under pressure. Atmospheric air being forced against a first caoutchouc membrane by suction, a mixture of about 40 per cent. oxygen and 60 per cent. nitrogen is obtained on the other side. A second membrane increases the proportion of oxygen to 60 per cent., that of the nitrogen being reduced to 40. A third gives 80 per cent. oxygen; a fourth, 95 per cent. M. Margis prepares his membranes by immersing taffeta in a solution containing sulphide of carbon (or light petroleum-ether), spirit of wine, ether, and caoutchouc. After drying, the taffeta has a fine layer of caoutchouc on it. A bag of the membrane, with framework of rings of galvanised iron wire, is placed in a cylindrical iron vessel admitting air. It is connected by means of strengthened caoutchouc tube with the suction apparatus, which is (preferably) formed of a cylinder containing a series of conical cups with small spaces between; steam is forced through these, and draws in the gas obtained from the first diffusion, passing on with it through a cooler, where the steam is condensed and the gas separated for its second diffusion. This latter occurs through a similar apparatus, except that the space round the bag is provided with a tube passing down into water; thus the pressure can be regulated and the superfluous gas let off. Four apparatus are generally used (as already indicated), and the final gas with 95 per cent. oxygen is collected in a gasometer.

A Massive Safe Deposit Vault.—The safe deposit vault for the Nassau Bank, corner of Beekman and Nassau-streets, New York, is said to be the largest steel vault ever constructed. It is made of welded chrome steel, iron, and Franklinite, and is to all appearances, thoroughly fire and burglar proof. Entrance to the vault is effected through the bank proper. A staircase of marble and iron leads down into a well-lighted and ventilated basement, about 12ft. high. The floor is paved with tile mosaics and marble. The vault, which is 35ft. long, 22ft. wide, and 9ft. high, is built clear of the walls of the building, and rests upon a thick foundation of concrete and granite. The sides, bottom, and top of the structure are very thick, and comprise inner and outer walls of welded iron, chrome steel, and Franklinite, between which is a solid layer of fire-proof cement, 9in. thick. There are two massive iron doors at each end of the vault, and the outer ones are the largest single doors ever made for this purpose. The doors are built of the same material used in the construction of the vault. The inner doors are about 6in. thick, and the outer are of the same thickness, but larger, and hung on central hinges. Their locks are double-dial time locks of the very best make. It will require two persons to get into the vault, for one will have the combination of the inner doors, and the other the combination of the outer doors. Outside of the heavy steel doors are electric burglar alarm doors, which cannot be tampered with without sounding a loud alarm. There are now nearly 1,400 safes in the vault, but that number is to be increased to 4,000. These safes are 24in. deep, of various sizes, and are made of half-inch chrome steel. The door of each is provided with a double-key lock, and some of them have combination locks. No customer can unlock his own without the help of the attendant, who has a key with which he sets each lock. Neither the customer nor the attendant can get in singly. The vault is lighted by the electric light.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE SIMPLEST WAY OF USING AN EQUATORIAL TELESCOPE.

[20609.]—I cannot claim to be even the fifteenth part of a Wrangler, but I think I can, nevertheless, point out a still simpler way to use an equatorial telescope than that given by Mr. Pearson on p. 88 of the current volume.

No clock or watch is necessary, neither need we care about the aberration of mean time, or clock error, or anything but the right ascension and declination of the required star, as compared with those of some known and easily-observed star.

The stand should preferably have both the hour and declination inches loose on their axis, but so made as to be easily and quickly clamped to them.

We then proceed as follows:—Select any convenient known star, and turn the telescope on it. Make the circle read the right ascension and declination of such star, and then clamp them to their respective axes. Next turn the telescope till the circles read the R.A. and declination of the required star, and the latter will be found in the field of the finder. In practice, a slight allowance can be made in the first setting to give time for the second setting; but if quickly done, this is scarcely necessary.

A friend who has made an equatorial stand from the sketches I gave him, and who works on this system, finds it very easy and perfectly successful. In a letter now before me, he says he has thus picked up as many as 72 double and triple stars in the course of 2½ hours, and can do more in an hour than he formerly could in a week, when using his altazimuth stand.
A. S. L.

THE SPOTS ON JUPITER.

[20610.]—The following recent observations of the white spot have been made here:—

White spot on C.M.

	h.	m.	
September 13....	13	27	v. bright.
„ 15....	14	36	v. bright and large.
„ 27....	11	52	faint.
„ 29....	13	2	v. v. faint.*
October 1....	14	11	v. v. faint.†
„ 7....	17	42	v. v. bright.‡

* The spot seemed utterly obliterated at first; but after close attention a very faint indication of it was seen.

† The only sign of the spot is a feeble whitish glimmering, only glimpsed in moments of best definition, from the equatorial region of the great south belt now on C.M.

‡ The spot is very brilliant and conspicuous, indenting the S. belt.

The above observations will show the remarkable variations of brilliancy to which this marking is subject. It shone with conspicuous lustre at the middle of September, but at the end of that month had become so faint that it was glimpsed with great difficulty in my 10in. Browning reflector. At the epoch of the last observation, Oct. 7, the spot had, however, regained its former brilliancy, and was one of the most striking objects visible on the surface of the planet.

On Sept. 17, Miss Ashley, at Bath, observed the spot with a 4in. Wray o.g. It came to the central meridian at 15h. 53·6m., and was noted as bright and conspicuous. But on Oct. 1 and 3 the spot could not be distinguished at all, though definition was good.

As to the red spot on Jupiter, it is becoming very faint, and transits are observed with difficulty in small instruments. The early disappearance of this curious object seems imminent, unless there occurs a fresh outbreak of dark matter to reintensify it. The middle of the spot was observed to be on the C.M. at 15h. 52·6m. on Sept. 17, and at 13h. 55·6m. on Sept. 27, by Miss Ashley, who notes that it appeared very much fainter than formerly. "On Sept. 17 the spot could only be seen when in the middle of the disc; on Sept. 27 it had become so much fainter that it was with great difficulty it could be seen at all." My own recent observations have also shown the rapidly-increasing faintness of this object; in order to get satisfactory transits of the ends of the spot, I have to give it very close attention. The following are a few results obtained here recently:—

	p. end.	middle.	*f.* end.
	h. m.	h. m.	h. m.
Sept. 13	12 0	12 28	12 52
„ 15	13 42	14 6	14 32
„ 29	—	15 31	—
Oct. 1	16 46	17 13	—

The middle of the spot follows Marth's assumed first meridian (see *Monthly Notices*, June, 1882, p. 391) in slightly less than an hour.
W. F. Denning.

Ashleydown, Bristol, Oct. 8.

THE EQUATORIAL TELESCOPE—ITS MOUNTING AND USE.

[20611.]—In making use of an equatorial telescope, there are certain problems which frequently occur which are worked out by the following calculations, and which it will give pleasure to the amateur occasionally to verify on his instrument. They are here given as devised by myself.

The following expressions are thus abbreviated:—

R.A. = Right Ascension.
N.P.D. = North Polar Distance.
M.T. = Mean Time.
G. = Greenwich.
N.A. = *Nautical Almanac.*

In the *Nautical Almanac*, "Sidereal Time" or Right Ascension of Mean Sun, indicates the Right Ascension of the Meridian of Greenwich at Greenwich Mean Noon.

I. To find the R.A. of the Meridian of Fleetwood. Long. 12m. 1·3s. West, on Oct. 8, 1882, at 7h. 8m. 13s. Greenwich Mean Time.

	h.	m.	s.
G.M.T. of Observation	7	8	13
Accel. of Sid. on Mean Time (N.A. page 478)..............		1	10
R.A. of Mer. of Greenwich at Greenwich Mean Noon........	13	8	4
R.A. of Mer. of Greenwich at 7h. 8m. 13s.....................	20	17	27
Long. W., sub.		12	1
R.A. of Mer. of Fleetwood at 7h. 8m. 13s.....................	20	5	26

In words, to find R.A. of Mer., add Greenwich time of observation, the acceleration, and the sid. time at Mean Noon at Greenwich, and subtract the longitude if W., add if E. Note.—The R.A. of the Mer. is the sum of the R.A. of a heavenly body, and its hour angle West of the Mer.

II. To find at what Greenwich Mean Time the R.A. of the Meridian of Fleetwood on Oct. 8, 1882, is 20h. 5m. 26s.

	h.	m.	s.
R.A. of Mer. of Fleetwood	20	5	26
Long., W., add		12	1
R.A. of Mer. of Greenwich at required time	20	17	27
R.A. of Mer. of Greenwich at Greenwich Mean Noon, sub. ..	13	8	4
Interval from G'wich Mean Noon to time of obs. in sidereal time	7	9	23
Retard. of Mean in sid. time (N. A., p. 480)		1	10
G. Mean Time required	7	8	13

Or in words, to find the Greenwich time of observation from the hour-angle of a star or planet, add the R.A. and longitude if W. (subtract if E.), to the given hour-angle, and subtract the sid. time of G. Mean Noon, and also the retardation of the remainder.

III. Given the hour-angle of the sun at any instant, to find the G.M.T. at that instant.

To the observed hour-angle apply the equation of time from apparent time, and add the longitude if W., subtract if E.

IV. To find the Greenwich Mean Time of transit of Altair at Fleetwood on Oct. 11, 1882.

	h.	m.	s.
Star's R.A....................	19	44	36·83
Long., W., add..............		12	1·30
R.A. of Mer. of Greenwich at required time..............	19	56	38·13
R.A. of Mer. of Greenwich at G. Mean Noon, sub.	13	19	53·46
Sid. time elapsed from Greenwich Mean Noon	6	36	44·67
Retardation, sub.............		1	5·00
G. Mean Time of Transit	6	35	39·67

V. To find the Greenwich Mean Time when the bour-angle of τ Leonis is 23h. 8m. 18s. W. on Oct. 11, 1882, at Rio Janeiro.

	h. m. s.
Star's R.A.	11 20 6
Star's hour-angle, W., add	23 8 18
R.A. of Mer. of Rio at required time	10 28 24
Long., W., add	2 52 36
R.A. of Mer. of Greenwich at required time	13 21 0
R.A of Mer. of Greenwich at G. Mean Noon, add	13 19 53
Sid. Time elapsed from G. Mean Noon	2 40 53
Retardation	26
G. Mean Time required	2 40 27

VI. To find the Greenwich Mean Time of Transit of the Moon's light limb at Fleetwood on Oct. 11, 1882.

	b. m. s.
Moon's R.A. at G., Transit of limb (N.A., p. 389) ..	13 15 27·80
Var. of ☽ R.A. in passing 12m. 1s. of longitude (120·03s. × ·2)	24·01
Moon's R.A. at Fleetwood Transit of limb	13 15 51·81
Longitude, W., add	12 1·30
R.A. of Mer. of Greenwich at required time	13 27 53·11
R.A. of Mer. of Greenwich at G. Mean Noon, sub.	13 19 53·46
Sid. Time elapsed from G. Mean Noon	0 7 59·65
Retardation, sub.	1·31
G. Mean Time of Transit to 1-100th of a second	0 7 58·34

The factor by which to multiply the Moon's Var. in an Hour of Longitude (V) is V . (l^h / 1^h) where l = longitude in hours.

VII. Table showing the effect of the Moon's parallax (Mean) on North or South Polar distance.

NOTE.—This interesting table will show the observer at once that he does not see the Moon in the same position as if he were stationed at the Earth's centre, and the ever-varying correction to be applied will cause much gratification :—

MOON'S HOUR ANGLE.

N.P.D.	h. m. 0 0	h. m. 0 40	h. m. 1 20	h. m. 2 0	h. m. 2 40	h. m. 3 20	h. m. 4 0	h. m. 4 40	h. m. 5 20	h. m. 6 0	h. m. 6 40	h. m. 7 20	h. m. 8 0
60°	23′	21′	24′	25′	26′	27′	31′	34′	37′	39′	42′	45′	48′
65	27	28	28	27	30	32	34	37	39	42	44	46	48
70	32	32	33	33	34	36	37	39	41	43	45	47	
75	35	35	36	37	37	39	40	41	43	44	46		
80	39	39	40	40	41	41	42	43	44	45			
85	43	43	43	43	43	43	44	45	45	46	N.P.D.		
90	46	46	46	46	46	46	46	46	46	46	Additive.		
S.P.D.													
85°	49	49	48	48	48	47	47	47	46				
80	51	51	51	50	50	49	48	47			S.P.D.		
75	53	53	52	51	51	50	49	47			Subtractive.		
70	55	54	54	53	52	51	49						
65	56	56	55	54	53	51							
60	56	56	55	54	53								

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Oct. 2.

THE VARIABILITY OF ALPHA CASSIOPEIÆ AND EPSILON DRACONIS.

[20612.]—I AM sorry that it has been out of my power to respond to the desire expressed by "F.R.A.S." that I should examine γ Virginis. I have only seen γ Virginis *twice* this year, and on both occasions with the naked eye. I hope, therefore, that "F.R.A.S." will not consider me discourteous.

α Cassiopeiæ.—As is well known, a serious difference of opinion obtains as to the existence of variability in the light of this star. A discovery of Mr. Birt's, it is entered as variable by Proctor, Heis, and Argelander. The latter, however, says :—"This star is very difficult to observe: the difference between maximum and minimum only amounts to a few gradations, and is, moreover, as variable as is the length of the period." On the other hand, according to Mr. G. F. Chambers, "J. F. Schmidt says he cannot detect the least trace of variability, though he has kept watch on the star for many years." For my own part, I believe the star to be really variable; but must remark, that I spoke too decidedly when, in letter 19457, I said it was "certainly" so. My reason for just now drawing attention to the variability of α Cassiopeiæ is, that I believe the present to be an epoch of minimum. The following is a selection from my own observations :—

1878.	Aug.	22.	Equal to γ.
,,	,,	28.	Fainter than γ.
,,	Sept.	26.	Almost equal to γ; same as β.
,,	Oct.	26.	Fainter than β.
1879.	July	22.	*Perhaps* brighter than γ.
,,	,,	27.	Rather fainter than γ.
,,	Sept.	23.	Almost as bright as γ.
1880.	March	18.	Nearly equal γ.
,,	April	1.	Looked brighter than γ.
,,	Aug.	8.	Equal to γ.
1881.	Nov.	19.	2·5.
,,	,,	28.	2·35. Just brighter than γ.
,,	Dec.	10.	2·6.

From Dec. 27 to March 4, '82, the star remained of the same brightness—2·5—with the exception of Jan. 7, when it was distinctly brighter.

1882.	March	27.	2·6	
,,	April	23.	2·6.	
,,	,,	29.	2·7.	Less than β.
,,	May	10.	2·7.	
,,	Aug.	2.	2·7.	γ 2·4. "Difference most decided."
,,	Sept.	20.	2·7.	
,,	Oct.	1.	2·9.	
,,	,,	4.	2·9.	γ 2·4.

The golden colour of α Cassiopeiæ has been more obvious since its brightness diminished. It will thus be seen that the variability is irregular and capricious.

ι Draconis.—Since reading Mr. Johnston's letter in the "E. M." for Jan. 20 (19631), I have kept a watch upon this star.

1882.	Feb.	2.	3·8.	
,,	April	22.	4·0.	
,,	,,	26.	4·0.	
,,	,,	28.	4·2.	
,,	May	9.	4·2.	
,,	,,	11.	4·3.	
,,	,,	13.	4·35.	
,,	,,	18.	4.45.	
,,	,,	21.	4·3.	
,,	Aug.	7.	4·15.	
,,	,,	24.		"Bright."
,,	Sept.	3.	4·3.	
,,	,,	6.	4·3.	
,,	,,	8.		"Fainter."
,,	,,	10.	4·45.	
,,	,,	17.	4·5.	
,,	,,	18.	4·3.	
,,	Oct.	1.	4·8.	
,,	,,	4.	4·6.	

With the exception of that of Sept. 18, these observations show a continuous increase or decrease in brightness.

The series is too much broken—a circumstance due to the bad weather, of which we have had so much here this year, to admit of the determination of a trustworthy period; but one of 68 ± days will, I think, satisfy the observations.

S. Maitland Baird Gemmill.

Glasgow.

TO M. C. GAUDIBERT.

[20613.]—THE beautiful close double star mentioned by your correspondent, letter 20591, p. 111, is doubtless Otto Struve's No. 410 of the Poulkova Catalogue, where it is thus entered:—R.A. 20h. 33m. 41s.; Dec. + 40° 3′; mags. 6, 6. Estimated distance 0·5″.

The R.A. and Dec. are for the year 1840, and the precession being applied would bring up the R.A. nearly to M. Gaudibert's.

May I take this opportunity of pointing out an error of the press in my last letter, No. 20564, p. 88? Towards the close, μ (mu) Coronæ should have been η (eta) Coronæ.

George Hunt.

Hopefield, West Dulwich, Oct. 9.

λ AND τ OPHIUCHI.

[20614.]—IT may be of service to some of your readers, and to Mr. E. S. Beaven, to state, in response to his inquiries (letter 20461), that I clearly resolved, July 28 last, at 10.30 p.m. (power of 250); also on July 20, 9 p.m., both λ and τ Ophiuchi. Both were well and distinctly seen on each occasion, and the colours of the former, as given by Webb, verified—*white* and *smalt blue.* In my opinion, the range of discretion in small instruments will be determined by the comparative equality of the components, as well as by the formula 4·56 / aperture. This empiric formula, as no doubt it is, serves excellently well to place a limit upon one's expectations concerning a fairly good instrument. It is evident, from the testimony of many of your correspondents, that it is of no service in determining the limits of discretion, where an exceptionally fine eye and instrument are concerned. My o.g. is by Bardou, mounted equatorially.

John Bone.

St. Thomas's Vicarage, Lancaster, Oct. 7.

DOUBLE STARS.

[20615.]—THE double star Mr. Gaudibert alludes to (letter 20591, p. 111) is not new. The star itself is a naked-eye one of the 6th mag., and is 226 B Cygni; its place for the beginning of the present year is 20h. 35m. 14s. + 40° 9′. It is OΣ 410, and might be called a triple star, there being, according to OΣ's measures, a golden 7·7 mag. at 69·8° : 68·99″. OΣ rates the two close stars at 6·4 mag., 6·7 mag., yellowish. The following are the only measures I know of :—

Mä 23·1° : 0·52″ : 1843·4
,, 28·9 : 0·43 : 1846·9
OΣ 23·3 : 0·63 : 1850·6
Da. 207·7 : 0·53 : 1853·8
Se. 204·7 : 0·40 : 1857·5
De. 24·1 : 0·5 : 1867·3

I see that it *is* in Gledhill's book, p. 379.

With regard to ε Arietis, I may say that I watched its occultation on the evening of January 20th, 1880, with the R.A.S. Sheepshanks equatorial of 3·2in. aperture, power 150. The night was very misty, Saturn just being visible to the naked eye, but the definition was very good. ε was not divided, but very deeply notched indeed; I estimated the distance at about 1·3″; the disappearance was instantaneous, but the conditions were unfavourable to a gradual extinction or a disappearance by two stages. I see that Mr. Downing observed the disappearance with the 6·7in. Cauchoix equatoreal, power 140, at Greenwich, and he notes, "the star seemed to disappear gradually," but there is no intimation of its having been seen double; at Stonyhurst the disappearance was instantaneous. Perhaps "F.R.A.S." may have observed this occultation.

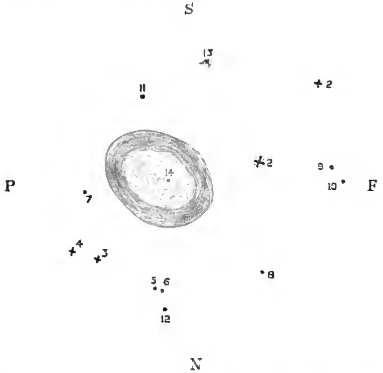
October 6th. **H. S.**

DOUBLE STARS—M 57 LYRÆ.

[20616.]—MR. GAUDIBERT's first, fourth, and fifth pairs (letter 20490, p. 37) are new, if his declinations are fairly correct; the second and third are undoubtedly Σ 2320 and Σ 2401; there has been no change in either since Σ.

With regard to some of the stars in Mr. Perry's valuable communication (letter 20540, p. 65), I would remark that in the cases of β 68, 69, 74, 75, 379, and 381 no change can really be inferred, as the figures quoted as *measures* are merely Mr. Burnham's *estimations* at the time of finding the objects. The measures of β 476 and 477 are De's, not β's, the correct results being 93·1° : 2·62″ : 1876·8 in the case of β 476, and in that of 477, 45·9° : 6·42″ : 1876·8.

The annexed rough copy of the best drawing extant of the minute stars round the annular nebula in Lyra, made by the late Mr. Lassell with his 4ft. speculum, power 474, will, I hope, be of use to "F.R.C.S." (letter 20542, p. 66). I have, of course, omitted all detail in the nebula itself. The stars were numbered by Lassell in their order of brightness in September, 1860, but some certainly seem variable. Schröter discovered No. 1, von Hahn (who really does not seem to have been so bad an observer as has been thought) discovered No. 14 about the year 1800 (I believe this most difficult object has only been seen by von Hahn, Se, Schultz, Lassell, and the Washington observers). Smyth saw none, and his drawing is as eccentric as most of those in his book, H one (No. 1), with his 20ft. reflector—this he calls 11m., but it is, as d'Arrest remarks, really 14m. (Auwers calls it 11·6 Arg.); this I have seen with a 3in. refractor. D'Arrest with the 11in. at Copenhagen in 1860-63 saw 1 and 3, and once glimpsed two or three others; but Lamont, with a telescope of the same aperture, in 1837-39 drew and measured 1, 2, 3, 4, 7, and 12. Lord Rosse saw 1, 2, 3, 4, 5, 6, 7, 11, and 12 with the 3ft. mirror; he remarks of 5 and 6, "near [12] are two very minute stars, seen with great difficulty." I repeatedly saw in 1876 with my 6½in. Calver 1, 2, 3, 4, and 12, and once 11. The following are the magnitudes in Σ's scale assigned by Hall to the stars forming a ring, as it were, around the nebula; he remarks they are probably too bright:—No. 1 = 10m., No. 3 = 12m. (this d'Arrest calls 18-19 H's scale), No. 4 = 12-13m., Nos. 5 and 6 are 13-14m., No. 7 = 13-14m., No. 8 = 13m., No. 11 = 14m., and No. 12 = 14-15m. The distance between 5 and 6 is 3·96". No. 1 is nearly 30" *f.* the edge of the nebula.



Oct. 3rd. **H. S.**

IMPROVED BICYCLE HEAD.

[20617.]—Surmising that Mr. E. Martin (letter 20570) invites a fair and unprejudiced criticism on his design for bicycle head, as a practical man I take the liberty to offer a few remarks, and also to submit an additional sketch, which I consider remedies the defects which I point out in Mr. Martin's design, and I trust that my attempts will prove acceptable to our readers, and call forth a good sound critical argument from interested parties.

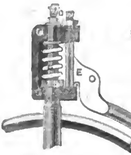


FIG. 1.

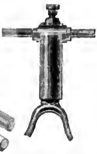


FIG. 2.

Referring to his sketch, p. 89, Sept. 29, and presuming that Mr. Martin makes use of the top bridge for attaching his handle bar, I consider that the forks being shouldered down to ⅝in. diam. at this point, would allow a great deal of twist when pressure was put on the handles, and if an attachment were made to the tubes for fixing the handle-bar into, I still consider the arrangement anything but satisfactory, and most assuredly shaky, at the best.

Mr. Martin has hit upon the right principle, which is to obtain rigidity vertically, but a springy tendency horizontally, and the idea is one to which I have myself given a good deal of attention. I will now explain my sketch. Fig. 1 is a section through the sliding head or socket, and shows the fork with a 1¼in. square vertical spindle, A, fitting the socket G at the bottom. This spindle A is reduced to 1⅛in. square above the loose collar B, so as to form a shoulder for B to butt against, when taking the thrust of the coil spring C. The top part of A (1⅛in. square) fits the socket G also.

D is a combination of nut and lubricator, screwed fast to spindle A, to prevent it falling out.

F is the hole for handle-bar.

The backbone E has the usual fixings of the cone type.

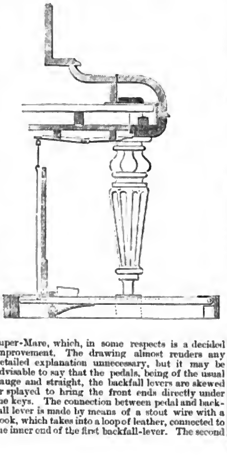
Fig. 2 is a front elevation of the head, which I think altogether presents a neat and compact appearance.

I cannot answer for the efficiency of this arrangement, as it is only on paper at present, but I hope anyone seeing some defect in it will be kind enough to say so, as I beg to invite argument.

C. F. Archer.

PEDALS FOR PIANOFORTE.

[20618.]—I have seen so many inquiries for methods of applying pedals to pianofortes, that I have thought it would interest your readers to see the plan patented by Mr. W. C. Dyer, of Weston-super-Mare, which, in some respects is a decided improvement. The drawing almost renders any detailed explanation unnecessary, but it may be advisable to say that the pedals, being of the usual gauge and straight, the backfall levers are skewed or splayed to bring the front ends directly under the keys. The connection between pedal and backfall lever is made by means of a stout wire with a hook, which takes into a loop of leather, connected to the inner end of the first backfall-lever. The second backfall is connected in a similar manner to the under side of the keys, the wire being adjustable by means of a screw-button. The leather strip here leaves the key perfect freedom of action when touched by the finger. The two backfalls are connected by a pin, which is screwed into one and works in a slot cut in the other. The backfalls work in notches on pin fulcra, being held down to position by a screw-button, but a spindle fulcrum may also be used if preferred. **J. M. S.**



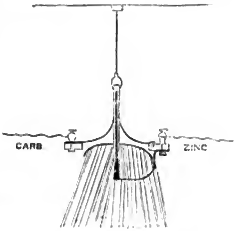
SEMI-INCANDESCENT LAMP.

[20619.]—This lamp depends on the principle that a point of carbon resting on a point of metal or carbon offers a very high resistance to the electric current, and so when the electric current is passed through it becomes intensely hot, and emits a pure white light of considerable quantity, and is, therefore, suitable as an economical means of lighting, provided a cheap source of electricity is available.

The lighter the contact between the two points, the whiter the light and the more economical of electric energy.

This lamp is designed to meet this requirement, and so depends wholly on the weight of the carbon to feed itself as it burns.

The sketch almost explains itself. A is a piece of brass tube, 6in. long, to be ¼in. internal diameter, and bored out perfectly true. To the two sides of this must be brazed (not soldered) two arms of $\frac{1}{16}$in. sheet-brass one 1½in. longer than the other; these must be screwed on to two little oblong pieces of wood; one binding screw should pass through the longest arm, and be fastened with a nut underneath. The end of the rod is tapped, and a silvered reflector screwed on; the other binding screw passes through the other arm of wood and a nut on its bottom secures the longest end of an arm of brass, which has screwed into it a piece of ¼in. brass rod, in the top of which is a platinum point. The ¼in. carbon rods should be coppered, and then amalgamated. One end should be brought up to a fine long point, which should rest on the platinum point beneath.



If, after working some time, the battery fizzes unpleasantly, couple the cells so as to get the quantity of two, and the E.M.F. of six; if this does not give you enough light, make another battery, and couple the two together, so as to get quantity two, E.M.F. twelve. **H. T. B.**

LEGAL REPLIES.

[20620.]—Equitable Mortgage:—Foreclosure. (48120).—The only way in which the querist can enforce the mortgage is by bringing an action against the mortgagor for foreclosure. There will be no need for him to obtain a legal mortgage before proceeding; the deposit of the deeds being of itself sufficient. The action can be brought in the Chancery Division, or if the mortgage debt does not exceed £500, it can be brought in the County-court of the district in which the property is situated. But the querist had better consult a solicitor, as he can hardly take the necessary legal proceedings himself.

Settlement — Trustees (48146.) — The legal arguments of this querist, though ingenious, are again fallacious. I do not think it would be either just or proper, and it certainly would not be legal, to treat the rents mentioned as income, so as to keep them out of the settlement; for they are, in fact, part of the property settled. As to the other point, the clause in the deed would not protect any trustee from such a breach of trust as is suggested; and which is, nothing more nor less than throwing over the settlement altogether. To say that it exists only as between husband and wife, is to leave out the unborn children, for whose sake the settlement was doubtless made, and over whose interests the Court of Chancery will always watch. If the trustee were to allow of the proposed arrangement, he would certainly be accountable to the children and the Court.

Income-Tax—Exemption (48166.)—No; income below £50 is, of course, exempt from the payment of Income-tax. Where it has been deducted from money invested, the proper plan is to apply for its return. To do this, a proper form of certificate must be filled up and signed by the persons who have so charged the applicant, who will also have to fill up other forms setting out the facts and claiming exemption. Three years is the limit of time for which the tax can be recovered; and the querist had better ask the collector of his district for the proper forms.

Intestate—Next of Kin (48167.)—In the division of the personal property of an intestate (which includes leaseholds but not freeholds), brothers and sisters of the half-blood share equally with those of the whole blood. Presuming personal property only to be left by the deceased intestate, it would, therefore, be equally divided between her sister and her half-brothers and sisters, who are the children of her father by his second marriage. But her father's widow, being only her stepmother, is no legal relation at all, and would take nothing.

Wife's Separate Estate—Bill of Exchange (48168.)—A married woman can bind her separate estate by signing a bill of exchange, even with her husband. The creditor can, therefore, sue her upon the bill after demand made; but in his action he must ask for a declaration against her separate estate, and he must join her husband with her as a defendant. The law will be simpler next year, but at present suing a married woman so as to bind her separate estate is better done by a solicitor than by the party himself, who may easily go astray.

New Married Women's Property Act (48171).—The new Act does not in any way alter the law of descent as to a married woman's property. If, therefore, she does not exercise the power given her upon or after the 1st of January next, of making a will, her real property will go to her husband as tenant for life by the courtesy, where this applies, and afterwards to her legal heirs, while her personal property will wholly pass to her husband under his marital right, if it be in possession, or to him as administrator, if it be in reversion, and in either case he will be entitled to take out letters of administration to his wife's estate, and take all after paying her debts and funeral expenses.

Servant.—Notice (48175).—As the wages are payable monthly, then, in the absence of any other facts, the hiring is monthly, and a month's notice from one pay-day to another must be given on either side before the contract can be legally terminated. If the assistant leaves before his time expires, he acts wrongly, and will forfeit whatever wages may be due, besides being liable to an action at the suit of his master for damages, or breach of contract; or, if he came within the definition of a workman, he could be summoned by his employer to the Police-court, for so leaving his service.

Intestate—Partnership—Next of Kin (48181).—There can be a partnership without any deed or writing, and the question is, Had the son a share in the business in fact? If he had, then he was a partner, and to that extent his share survives to him. As to the rest of the business, it descends for equal division amongst the children of the intestate, presuming, of course, that there is no widow. Each one is entitled to take out administration; but the Court will prefer the eldest son, who should at once obtain letters of administration to his father's estate. The father's share in the business should then be valued, and it might be bought by the son and the money divided between himself and the others; or, by agreement between them, the business could be carried on by the eldest son as before, for the benefit, to the extent of their shares, of his brothers and sisters.

Master and Servant—Salary (48200).—As the first year's salary was £10, so, if nothing further has been agreed, it will be presumed that the hiring was continued upon the same terms, and certainly a master cannot fix his own rate of wages, simply because he pays irregularly. If the master become bankrupt, the workman can claim as a preferential payment the wages due to him at the date of the adjudication to the extent of two months' wages; but the master's having given a bill of sale can have nothing whatever to do with the workman's position.

New Married Women's Property Act (48201).—This statute comes into operation upon the 1st of January next, and not before.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

BOOT AND SHOEMAKING.—II.

[20621.]—Now we will proceed with the cutting out of the uppers. So, in the first place, we will get the measurement for them. Having fitted up your last with the leathers the size of foot, take the end of the paper that is pointed off and place as near the centre of joint as possible, pass down towards the sole of the last, allowing ¼in. beyond, fold your measure and cut a notch. Take from the centre of instep and down to waist, and allowing ¼in. as before, take from centre at top again to heel, and notch again, and ankle and do the same; thus you half measurements. (See sketch of upper.) These notches are made by folding at the place and snipping a piece out. Now take a piece of stiff paper 5½in. deep and 1ft. long, A. Next sweep the back out with the knife to the shape wanted; then measure off C, and mark it the same with D, the same with E and F. Now mark the sweep from top to toe with the back of your knife, and see how it looks, and if it wants any alteration make it before cutting it; in this way you have the whole side of boot in one. Now, mark upon this your golosh or vamp 1, see dotted line—as you would like it. Do not cut this, but keep it for reference when wanted again, and for that purpose should be cut out of stiff cartridge paper. If for a goloshed boot the quarters K should be extended to dotted line J; if for half-boots, lace-ups, or shooting-boots, keep the vamps well back to the joint of heel, and in any instance keep them well up at E, so that the seam or stitching may not come in contact with the joint of toes. Now, to transfer this to and cut out the real working pattern, place this upon another piece of paper, mark the outlines with the back of knife, outside and over the lines you want, and cut out quarter; now fold a piece of paper, and place the folded part in a line with H, and mark with back of knife, and take your diagram off, and cut out; now open it, and there you have a vamp or a golosh, that will only want closing up at the back; again double a piece of paper, about 2in. by 8in. long, and place in a line at back of heel L, and cut out for a counter if the shoes are unlined, or a stiffening if lined with linen lining; and M struck off in the same way for lace-hole linings, and N for a back strap of leather outside, or a stout strap of linen webbing inside if lined. The counter is felled in; if not it is stitched as far as the heel junction, and felled the rest, in which instance the counter should be 2in. longer. You can put side linings in along the toe if you like; but if the leather is of good quality I never use them, because, put them in how you will, the perspiration makes them curl, and they interfere with pet corns and bunions; and, therefore, I cut all that come to my share out as soon as I get them, and find the shoes none the worse. You will understand I am only giving you a plain boot or shoe—you can put as much fancy work as you like about them, if you are fond of it. You can slash them, scollop them, tag them, Vandyke them, and punch and cap them, to all intents and purposes, and as many rows of buttons as you like, with fancy welts or pipings (see Fig. 8). The same pattern that was illustrated for an Oxonian shoe will do for goloshes to a certain extent. Fig. 9 is a watertight shooting or fishing-boot, lace-up. I should have said upper for one complete. As I have to make a sketch to illustrate, I shall not confine myself to one species of boot or shoe, but as far as it goes, shall diversify it, as the giving the one idea carried out this way will give the general idea and manipulation in all, and carry more general information. In Fig. 10 is the pattern for same, A vamp, B quarter, C tongue, which is first stitched upon the vamp at E outside the crease line in a line with the crease line of vamp. Fig. 11 is the vamp doubled through centre; the dots are made through with the stabbing-awl. When the quarter is placed on these marks form a gauge to put the tongue to, and afterwards the quarters over them. With three small tacks fasten the quarter on for stitching, and the first row should be as close to the edge without breaking out, say within a full 1-16in., and the next row 3-16 from it. The thread for stitching should be 5-cord of ordinary closing flax, 1d. per ball, or 8-cord of the diamond flax, which make the best thread for felling or fine stitching, three of the former to five of the latter. When the first is stitched on, tack the other on and do the same, but be sure to place the quarters a good ¼in. over the crease of vamp; that is, that they may lap one another a quarter of an inch, or when folded they will not come right. See how the upper sets at the junction of golosh in Fig. 8, where they seem to be crowded together; it is as it seems, but when lasted it comes right. After stitching the other quarter on, tack the edge of tongue to the dotted line near the lace-holes, and stitch through, then the other side; then fold your upper inside out. And it will be of no use telling you to close a flat or round seam, or a seam with a welt, without giving you an idea of what it is like. But a seam with a welt is to place the two backs together, and insert a piece of tight light calf, and stitch through the three within a sixteenth of an inch full of the edge; then place over a last, and wet and rub down on the top of it, pulling the welt first on one side and then on the other (see Fig. 12); 1 is the stitching, 2, 2 is the quarters, 3 the welt. When you have rubbed it down with the long-stick that you may lay the welt over either side close, you may, with a sharp knife, cut it off at 4; that is, within a sixteenth of an inch, and wet it, and rub down on the right side with the hammer-face. But do not hammer or rub too hard to break it or fire it. This seam will answer all general purposes; the flat or round seam is rarely spoken of now, much less seen. If required, I will illustrate. When the counter and stiffening is stitched in, &c., as seen at Fig. 9, it will be ready for lasting. The best way is to just tack them with a thread by the edge, and with a bit of paste well rubbed between them. Pull it over the last (see Fig. 13) and let it remain until set, when you may stitch the counter around as far as the quarters stitching go, and fell the rest along the vamp; for the which, see just above, Fig. 11, where 1 is the path of the closing awl, 2 is with the stitch upright as it should be, but not as at 3, which is not good work. Fig. 13: A is the heel-pin spoken of; B the heel of last; C instep leathers for building up, of which I will say a little more by-and-by. The heel-pin consists of a piece of tight leather, about ¼in. thick, chamfered, or in Crispin's craft, skived down on both sides, put round the heel, and tied with a piece of string or wax-end through the hole, and pegged down as shown.

Jack of All Trades.

FIG. 8.

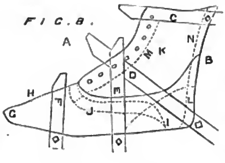
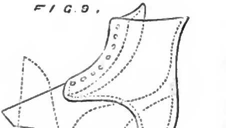


FIG. 9.



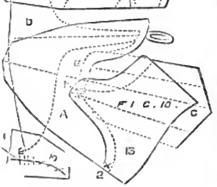


FIG. 10.

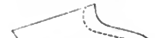


FIG. 11.

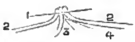
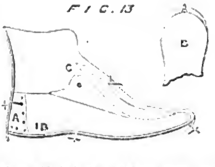


FIG. 12.

FIG. 13



GRINDING AND POLISHING GLASS SPECULA.

[20622.]—I must now return to the polisher and ring and the parts above these. The ring has a space of about ¼in. between it and the polisher (which is the grinding-tool covered with pitch and facetted, and must be for all sizes of specula ½in. larger than the speculum, for reasons I shall explain hereafter); the space between the polisher and ring is made up by four rollers, set in brackets, which are screwed to the under-side of the ring; the holes through the brackets are slotted, to allow of the rollers to be adjusted to the size of the polisher, so as to allow as little shake as possible in the straight stroke; the side-rollers by their adjustment give the amount of turn required for the polisher, for one revolution of the speculum. I must explain this a little more fully, for this is one of the important details that we are coming to and which the amateur must carefully attend to. The brackets and rollers are represented in Fig. 4 half size, on page 113, and will, when once made, do for any size speculum, being simply screwed on to the under side of the ring. Fig. 4 is a kind of plan of the bracket and roller. Fig. 5 is a front view. I made a wooden pattern for the bracket and cast it in zinc; the roller is of brass ⅝in. diameter and ⅜in. long, with 3-16 of the face left, and shaped at each end as shown. The pin on which it revolves is a bit of a thick knitting-needle, this is smooth and hard, and so allows of a smaller size being used than soft wire, without the fear of bending, which would add much to the friction; this would frustrate one of the objects of the rollers, which is to allow the polisher as free and unhindered motion as possible. Another advantage is that the push is always in a line with the curve of the speculum, although the motion of the rollers is in a straight line. This is very important for deep curves; all this will be understood from Fig. 6, which, of course, is exaggerated to make the principle plain to the eye. Let A be the centre of the curve, B C the line of motion of the rollers—i.e., parallel to the top of the guide bars; A D and A E are radial lines representing the edge of the polisher, which should be always radial. Now, it will be seen that the roller must push in a line from its centre to the point of contact with the pushed surface, and, therefore, at a right angle to it, since the radius is always at right angles to its tangent; therefore, if the side of the polisher is practically radial, the push from the roller being at right angles to it, must be practically parallel to the curve of the face of the speculum immediately under the side of the polisher where the motion is imparted, which is the thing required; so that even with straight guide bars we get a tangential push to the radius of curvature. In a previous machine I had used to curve my guide bars, but found this awkward, and was glad to discover the above useful property in the rollers, which do not at the same time tend to lift up or down the edge of the polisher, which the friction would cause the unrolling surface of the bare ring to do, however slight the deviation of even curved guide-bars may be from the exact curvature of the speculum, or if the guide-bars were not exactly parallel to that curvature. Not only ought the polisher to be moved by rollers to secure the above advantages, but another advantage, or rather two, may be derived from the way they are arranged on the ring, and from the fact that they afford four points of contact between the ring and polisher, that may be varied at pleasure; everyone knows who has worked specula by machinery, the importance of getting the polisher to move round at a regular rate; now this can be aided (I may almost say secured) by the arrangement of the two pushing rollers, and controlled by the side rollers. The laws that govern this will be understood by studying Fig. 7, the one to the right of Figs. 4 and 5, where the outer circle represents the inside of the ring, with its four rollers projecting inwards; the two inner circles represent the polisher in two of its positions. Everything is exaggerated, of course, to make the laws understood through the eye. The line E F is the centre line of the ring; the dotted straight line parallel to this is the centre line of the polisher in one position, the plain straight line on the other side of E F is the centre line of the polisher in another position. Now it is evident that if there be no play between the side rollers C D and the speculum, and that the pushing rollers A B be on the centre line E F, then the only condition that would tend to make the polisher move round would be the circular motion of the speculum through the friction between it and the face of the polisher; but this tendency of the speculum to move the polisher would be hindered by the friction between the pushing rollers A B and the sides of the polisher, and would be only free to act at the end of each stroke, just as the polisher was free for a moment as the push was changed from one roller to the other. This then would only allow a very slow motion, which is actually the case when the rollers are close up to the polisher. Now, it is evident that, if we put the pushing roller on that side of the centre line of the polisher that is leaving the centre line, we shall push it on, and thus help the rotation, while if the pushing roller were on the other side we should tend to push back the advancing side, and thus retard the revolution of the polisher; all this I have proved by actual experiment. Now, the cut of the polisher is not always the same in every part of its surface; therefore it follows that if an accidentally greater cutting part be on the side of the centre line of the polisher nearest D, then the push of the roller A (supposing it to be on the centre line of the polisher) would tend to turn the polisher on this greater cutting part as a centre, since the lesser cutting part on the other side would yield first, and so the polisher would turn the opposite way to the speculum; the push of the roller B (supposing it to be on the centre line of the polisher) would tend to turn the polisher the same way as the speculum, i.e., of the arrow; in fact, help the action of the speculum to turn the polisher. Thus a see-saw motion would be given to the polisher which no amateur likes to see, and which shows that something is wrong, with no tendency to set it right, by a regular circular motion of the polisher. Now, it is evident that, by putting the pushing rollers, A B, in advance of the centre line of the ring, which is practically the centre line of the polisher, we can always have the tendency to push in one direction, i.e., to help the polisher round. This I do by simply putting the pushing rollers A B about 1in., or a little more, in advance of the centre line of the ring, as shown at A and B; that would be for any other size of speculum one-sixth its diameter. This tends, and actually does give, a most pleasing regularity to the motion of the polisher in the right direction, and thus a constant tendency to equalise any irregularities on the face of the polisher is obtained by very simple means. But I have said nothing about the rate of the motion, and how it can be controlled and regulated to any required amount that we might think best. Well, fortunately, this can be done by the side-rollers, by simply allowing little or much play between them and the polisher. This will be understood from Fig. 7. Suppose the polisher to be in the position of the dotted circle, as the roller A is about to push it, this roller, pushing on the D side of the centre line (the dotted line) of the polisher, will have a tendency to push the polisher round against the opposite roller C; and according to the distance between the polisher and the roller C, will be the time A will have to act in pushing the polisher round, and therefore the amount of turn imparted by the push of A. Now we will suppose that A is at the end of its stroke, with the polisher resting against it and the roller C, when the roller B begins to act; this is represented by the plain inner circle. It will now be seen that B will push on the C side of the centre line of the polisher, and so have a tendency to push it round and over to the roller D; and upon the same principle as before, the distance between the polisher and the roller D will regulate the time the roller B will have to act on the polisher, and therefore the amount of turn imparted by the push of the roller B. So much for the theory; and we are never master of any process till we know the true theory or explanation of every step of the process. Now for the actual experience. I find that with about 1-100in. play between the side-rollers C and D and the polisher, the polisher will turn completely round in from 12 to 14 revolutions of the speculum. This I consider too slow, for reasons I hope to give further on; but with about 1-16in. play the polisher will turn completely round in from 5 to 6 revolutions of the speculum. This I consider a much better rate, and is the one I now keep to, being, as far as my experience goes, the best. The play between the pushing-rollers A and B should be as little as possible, so as to avoid jamming in every part of the stroke.

In Fig. 1 a watch will be seen to hang on the left hand upright *d*, a thermometer on the right hand upright.

I must leave till my next the explanation of the lever on the top of the polisher and the balancing.

The amateur had better add what the engraver has omitted—viz., a G at the right-hand end of the guide bars in Fig. 3. This omission confuses the meaning of the two first lines of page 114, for it is these two omitted G's that I refer to there.

H. A. Wassell.

Addenbrook Villa, Stourbridge.

SPECULA.

[20623.]—I have read with great pleasure and profit the valuable letters of "O. V.," "Prismatique," and Mr. Wassell on lenses, specula, and flats, and as there have been several incidental queries addressed to me, I will endeavour to reply in a general way, at the same time contributing a mite to the subject of our common interest. I confess I was somewhat surprised at the contents of letter 20482, in which our good friend "Prismatique" rather calls into question the accuracy of the colour test, and still more so when he calls it a mechanical one. What? the reading of the beautiful phenomena of Newton's colours a mechanical manipulation? I hope he will pardon me when I say that I consider it one of the most refined of all our *optical* tests. And I say so from the fact that I am well acquainted with the test he mentions in his letter, and had the pleasure of testing the surface of a 4in. prism with Alvan Clark himself, in his own testing-room, by that method. I have tested objectives with flat surfaces, as is the practice of the Clarks, and I have tested flats with objectives, and if there was a possible error seen with the objective it was readily and quickly detected by the colour-test. But here's the rub. How many have a first-class objective, perfectly *free* from aberration, to use in such work? It is well known that an indifferent objective is perfectly useless for this work. Now, as to the accuracy of the colour-test, I shall not use my own words, or my own calculations, but give the words of Dr. Hastings, whose optical knowledge, both practical and theoretical, is considered of the highest authority among the learned of our country. He says in one of his letters to me—"I can hardly imagine a more accurate method of testing a plane surface than the one you are accustomed to use. By combined experiment and calculation, I found the limiting error in white light 1-50,000,000th part of an inch, in sodium light 60 times as great, or about 1-800,000th of an inch." Now, is it possible for the human hand to work to anything so close as either of the above fractions? Hence, what use would be a still more *refined* test? I confess that the method given by our good friend of working a single flat, cutting it in two, and testing it, is very crude and *mechanical*, "for, if it is bad, throw it away, and try again." How can we tell when we have only *two* surfaces to test—whether either of them is flat? If we are to carry out this method as it is intended for perfect work, *three* surfaces are a *necessity*. *Once* you have a good *test-plate*, you are fixed for all future work. I can highly commend "Prismatique's" idea of placing the two surfaces in contact, as I soon found it was the only way to avoid scratching. Let me say, in passing, that some time since a rock-salt prism was needed at the Allegheny Observatory of great accuracy. One of your best London opticians said *no rock-salt prism could be worked that would show the leading Fraunhofer lines.* Alvan Clark was applied to. A prism was made that showed over 200 lines. The success was brought about by *perfect flatness* of the sides of the prism. I should be sorry, indeed, if our amateurs could not produce better flats than can possibly be selected from plate-glass. I have never but once found any approach to accuracy, having tested hundreds of pieces. Mr. Holmes will find an error of convexity or concavity produces distortion of the image, greater or less, as the curve digresses from flatness, owing to the angle at which the "flat" is placed in the Newtonian. He has only to make an exaggerated sketch, arranging the angles of incidence and reflection in their proper relations, to readily comprehend the whole matter. I will now give, for the benefit and criticism of your readers, a method of making flats I have recently used with great success. I stated in my first article on the subject that the iron discs mentioned in Mr. Calver's work on the telescope were not a necessity, yet I have found where a number of flats are to be made, the method of *polishing*, as used by Dr. Hastings, is rather too slow and tedious, and I now proceed as follows: I first cut out three or more flats of any size I want them, and of any shape—preferably circular or octagonal; I then grind them on one another, using washed emeries up to the "60 minute" grade, until I have a fine semipolish. The pressure of the hand should be gentle, and the discs should be alternated regularly. I prefer not to use the iron discs to grind the glass on, as they would get out of shape. On one of the iron discs I make the polisher thus: the disc being warmed, the melted pitch is poured over it so as to get a fairly even coating. One of the other discs is now taken, wetted with rouge and water and pressed on the pitch bed; the edge of a steel straight edge is now gently pressed down in the pitch at intervals of half an inch or more, and then a series of grooves are made the same way, at a right-angle to the first set. Before the pitch cools, the iron disc is again pressed down and turned around on the pitch bed, and then it is cooled at once, before the pitch has time to change. As many as twenty flats have been worked on one bed by keeping it scrupulously clean. The flats are not cemented to anything to aid in holding them; but they are moved over the pitch-bed with the hands, in strokes suitable to cure any existing error. The iron disc is used frequently to keep the bed flat, and when the polisher has not been used for a day the pitch should be invariably warmed on its surface. The test-plate is frequently applied; and here is the beauty of the colour test, as I find in this way of working the heat of the hands nearly counterbalances the heat of the friction of the lower surface, and a few minutes is sufficient to wait before testing the plate. We have here from time to time a guide for our work, and no guessing. If the surface is working convex, I increase the strokes, and run the glass over the edge of the polisher, turning the glass gently all the time.

The strokes used are generally straight and tangential. If the disc is working concave, the strokes are shortened so that they go only to the edge of the polisher, and are usually diametrical. The polisher is placed on the head of a heavy barrel, and the person polishing walks round it. Of course, the polisher could be rotated if necessary. In making flats of any size, I would not recommend that two or more be worked in one piece, as they frequently spring when cut. We have worked flats in this way 5in. in diameter that showed exquisite *broad parallel* bands of colour up to the extreme edge, showing conclusively that flats can be worked good to the edge as well as specula. The process is quite rapid, too, if the glass has been well fined in the first place. The pitch-bed need not be so hard, as with the iron disc we have a ready means to correct it; and, indeed, with some experience, the glass disc that is being polished can be so manipulated as to assist in keeping the pitch-bed flat. The method is essentially that used by the Clarks for working prisms. I trust our friend "Prismatique" will not take my remarks as an unkind criticism of his letter. The word "mechanical" made the *rub*, and it is only in vindication of what I consider a beautiful and *accurate* method that I write. I have seen the marvellous beauty of these colours so changed by a few seconds of careless work, as to make the surface almost unrecognisable from what it previously was. I am much pleased with his method of edging "flats," and if desirable will give a sketch of a simple machine I use for the same purpose. I must now close this already long letter, but, friends, I am so far away from you that I prefer to finish up anything of this nature at one writing, though the subject is worthy of more than one communication. In concluding this note, I wish to mention a grand work compiled by Prof. Edw. Holden, and issued by the Government. It is a "Monograph on the Central Parts of the Nebulæ in Orion." The work is a quarto, of 230 pages. The famous drawing of the Bonds occupies the place of honour, while the grand photograph by Dr. Henry Draper is placed at the close of the book. There are 38 find woodcuts to illustrate the subject, and a drawing of Dr. Hastings' Nebulæ Photometer. The work is one of absorbing interest to the lover of this branch of astronomical research, and Prof. Holden has given us almost every observation of worth from the time of Huyghens down to the latest observations obtainable. It is a fitting companion volume to the monograph on the Trapezium by the same author. I think it would be an excellent idea if some of our publishers would reproduce the index chart given in the work for the benefit of nebula workers. No doubt our esteemed correspondent, "F.R.A.S.," will give your readers an outline of the contents of this valuable work. Our friend and contributor, Barnard, of Nashville, has picked up another comet, of which I have had some good observations. The naked-eye comet discovered near the sun has given Dr. Swift abundance of work, for many have claimed its discovery. There seems to be plenty of work left for all of us to do; so let us do our part, do it well, then it can be said of us, "He hath done what he could."

Pittsburg, Pa., Sept. 20. **J. A. Brashear.**

THE RECENT ACCIDENT AT THE CENTRAL STATION, LIVERPOOL.

[20624.]—In reply to numerous letters relating to the recent very serious accident at Liverpool, which is now receiving such attention at the present time, I give the following details.

On Friday, the 22nd September, the Midland Company's 10.5 a.m. express from London to Liverpool, was drawn by an engine fitted with a steam brake, and the Pullman car and other vehicles fitted with the "*two minute modification of the Sanders vacuum brake.*"

The driver applied the brake as usual; but from some cause it leaked away, and failed to act, thus allowing the train to dash into a meat-van standing against the buffer-stops. The Midland Company's officials know well that the brake failed again in the same way as it has done upon so many occasions; therefore, I very much regret that to save the reputation of this very dangerous brake, the company has committed the great injustice of suspending from duty an innocent engine-driver.

Leicester, Oct. 3. **Clement E. Stretton.**

THE BRAKE QUESTION IN HOLLAND AND GERMANY.

[20625.]—For several years the Dutch Government has appreciated the value of, and paid considerable attention to, the subject of railway brakes, and many of the most important trains in that country have for a long time been fitted with the Westinghouse brake. I have just received a copy of the Royal Decree which has been issued, and which will come into operation in May next, the purport of which is—

"That article 84 of the General Regulations for Railways is thereby superseded by the following order:—

"For express trains running at a greater speed than 60 kilometres per hour (37¼ English miles) the engines, tenders, carriages, and vans must be provided with automatic continuous brakes, of a system prescribed or approved of by the Minister of Public Works.

"Similarly, automatic brakes of such prescribed or approved system will have to be fitted to the engines, tenders, carriages, and vans of such passenger trains which do not run at a higher speed than 60 kilometres (equal 37¼ miles) per hour, as the Minister of Public Works may order."

For many years it has been pointed out in your columns that nothing will tend so much to the safety of railway passengers and servants as the adoption of an automatic continuous brake. The Board of Trade has long ago laid down "Conditions" which efficient brakes should fulfil, but unfortunately the companies have not complied with them to any large extent.

The Dutch Government having watched for some time the action of England, has now come to the conclusion that permissive legislation is practically useless: it has therefore caused the new order to be made absolute in the form of a Royal Decree.

In Germany, the Hugstetten disaster has called serious attention to the brake question. The commission appointed to test and report upon the various systems of brakes has not yet made its final statement; but it has already come to the conclusion that *automatic* action is most essential, and that *air pressure* is the best principle which can be adopted.

From these data it will, no doubt, be an easy matter for the German Government to finally decide upon an efficient brake, and avoid in future disasters similar to the one at Hugstetten.

Clement E. Stretton.

RAILWAY SIGNALS.

[20626.]—I should be happy to express an opinion upon the recent discussion upon railway signals, as desired by Mr. Stooke and Mr. Manock, but from the letters which I have received from some of your other correspondents, it would appear that they wish to give further information or details upon the subject before the controversy is closed.

Clement E. Stretton.

Saxe Coburg-street, Leicester, October 7.

THE ELECTRIC LAUNCH.

[20627.]—I see in your "Scientific News," p. 109, you mention the statements made by Prof. S. P. Thompson about the launch, *Electricity*, and as that gentleman doubtless reads your paper, he will, perhaps, give a little further information. I see that in another place he gives the length of the boat at 25ft. (not 26ft., as you have it), and also some other particulars—notably the fact that the storage batteries weighed 1¼ ton. The batteries supplied two Siemens machines of the D_3 type, provided with two pairs of brushes at the commutators to facilitate the reversing of the motion of the screw. The belts from the machines are carried up to a counter-shaft with a friction clutch, so that one dynamo can be thrown in or out of gear, while a third belt passes down to a pulley on the screw-shaft. There is, consequently, a good deal of belting, and one would think a considerable amount of friction. The screw is calculated to run at 350 revolutions, the motors running at 950 per minute. It is impossible to arrive at any definite conclusion as to what the launch did on the recent trip, for although the time of reaching London Bridge is given at 4.37, the time of starting is not mentioned. We are, however, informed that the launch ran along the southern shore at about 8 knots an hour against the tide. We will take that "about" to mean that the speed was nearer 8 than 7, and 8 knots is 9·2 miles. Now, that is a very creditable performance, especially as I find it was done against a 2 hours' ebb. At London Bridge the launch was put about, and swinging down with the strong ebb, reached Millwall in 24 minutes. At first sight that is definite enough; but the distance and time are so small that a few hundred yards make a wonderful difference in calculating the speed, and it is necessary to know what part of Millwall is meant. Millwall pier is, I believe, less than four miles from London Bridge; but supposing the distance to be four miles, we find that the *Electricity*, with a swinging tide under her, went at the rate of 10 miles an hour, whereas against tide she made "about eight knots." For the want of some more definite information, doubt will be thrown on Prof. Thompson's statements—which is really a pity, as we know from experience in the modern history of electric lighting. On one other point, further information is desirable. The storage batteries were capable of yielding four horse-power for six hours, and the power actually utilised was $3\frac{1}{11}$ h.p. Prof. Thompson says that it is premature to speak of economy; but such machinery may be lighter and more compact than that of steam-engines of corresponding power. I should like to hear what Mr. Moy has to say to that. I do not know the weight of a Siemens D_3 machine; but a couple of them added to the 1¼ ton of the storage batteries, and the countershaft and belting, would, I imagine, make rather more than the steam-engine, boiler, and coals necessary to drive such a launch at the same speed—coals for six hours firing only to be allowed, as that is the duration of the battery power. The question of economy is not yet ripe for settlement; but it would be interesting to learn definitely that the electric propelling machinery is lighter than the steam-engines now employed, even if more costly and less durable. **E. F. N.**

THE ELECTRO-DYNAMIC UNIT OF POWER.

[20628.]—Mr. Moberly, in his reply to letter 20573, p. 114, is, no doubt, right in the explanation he has given, which amounts to this: that the unit of weight is expressed dynamically.

Thus the gramme = gM, where g is the accelerating force of gravity, and M the mass of matter in the gramme.

The kilogramme would then be $g \times 10^3$M, which becomes $9{\cdot}81 \times 10^2 \times 10^3$ M $= 9{\cdot}81 \times 10^5$ M when g is expressed in centimeters. Multiplying this by the metre (= 10^2 centimetres) gives the kilogrammetre = $9{\cdot}81 \times 10^7$ M per second, and the horse-power = 736×10^7 M per second; where M is the mass of the gramme, and not the gramme itself. Of course, assuming the mass of the gramme as the unit of mass.

The horse-power = 736×10^7 per second. Now, with all due deference, I think that the unit in this should not be called C.G.S.

The gramme is a statical unit, and by introducing its dynamical equivalent in the above process, we have entirely changed its character.

The ordinary idea of a foot-pound is one pound raised one foot, and that of a kilogrammetre is one kilogramme raised one metre; and, if I do not mistake, C.G. means one gramme raised one centimetre.

But the unit in the above value of the horse-power has not the meaning of one gramme raised one centimetre in one second.

To illustrate the argument, let us use English units and express the horse-power in inch-pounds per second.

In the first place, the foot-pound = 12 inch-pounds. By Watt the horse-power was taken to be 33,000 foot-pounds per minute, or 550 foot-pounds per second. Therefore, the horse-power = 6,600 inch-pounds per second.

In the next place, let us express the horse-power, using the dynamical expression for the pound. Thus the pound = gm, where g, as before, is the accelerating force; only in English it is 32·2ft. per second, instead of 9·81 metres, and M is the mass of matter in the pound.

The pound would, therefore, be = $32{\cdot}2m$ per second, or, expressing the accelerating force in inches, = $386{\cdot}4m$ per second. The foot-pound would be = $4636{\cdot}8m$ per second, and the horse-pound = $2550240m$ per second. Taking the mass of the pound as the unit of mass. The horse-power = 2550240 per second. Now we want to give a name to the unit in this. It is not the inch-pound per second, for we have seen that the horse-power is 6,600 such units.

In the same way, defining C.G.S. as meaning one gramme raised one centimetre in one second, the kilogrammetre = 10^5 C.G.S. and the horse-power = 75×10^5 C.G.S. **Milverton.**

[20629.]—"Milverton" (letter 20573) is in error in assuming that the unit of work in C.G.S. units is one gramme raised one centimetre, the unit being an erg, that is, a force of one dyne acting through a distance of one centimetre. The gramme is the unit of mass in C.G.S. units, but the weight of a gramme is not the unit of force.

The h.-p. is as stated, 746 Watts, and a Watt is 107 ergs.

The French estimate of 75 kilogrammetres per second is approximate; this, as "Milverton" says, equals 750 by 10^4 grammes raised one centimetre in one second; to convert this to ergs. per second we must multiply by the value of g at the particular place, that is about 980; this gives 735 by 107, instead of 746 by 107 ergs.

I hope this clears up "Milverton's" difficulty.

Ll. B. A.

NEW METHOD OF FASHIONING A VIOLIN-BELLY.

[20630.]—As many amateurs are desiring to make their own fiddles, and prefer the old form, and as I heartily wish them to come to a conclusion of some sort concerning the best and easiest way to produce an instrument worth hearing, and also that they may not waste their time over the unsatisfactory, because difficult, fashioning of the belly or soundboard, I give this better way. First, get the lightest (in weight) pine-wood, without knots, but as near to a knot as possible, with the grain growing wider towards the edge, pick out a board to cut 15in. plates from, 5in. wide, ¾in. thick, when planed.

Cut out two plates, and shoot the thick edges to be afterwards glued together, which will be the middle line of belly. Don't glue yet, only prepare; take off a shaving or two from both sides of plates towards the ends of middle line, making them slightly tapering. Now we are ready for the bending business. Take two foundation plates 1¾in. thick, 1in. longer than the belly plates, to cramp them down to. Place a block or wedge of wood with rounded edges on top side, in the middle of thick plate; this block to be 1in. high, tapering off to nothing, and as long as the plate is wide. Thus, then, we have a thick plate with a wedge block placed on its middle, and a sound plate on the top of all; if we press down the ends of thin plate we have a rise in the middle. Now, this must be a gradual process, or the wood breaks; so get a cramp for each end, and put a piece of wood between it and the thin plate to prevent a dent or mark; let this protector be as wide as the plate, and screw down. Novelty shops sell cramps 3d. each. Don't drop them, or they will break; otherwise, they are the very thing. Our people will charge 1s. 4d. for steel that won't break, and so on. Gradually screw down to half the distance, let rest for five minutes, then put the lot into the kitchen oven, leaving the door open—a dying-out fire is the best; leave it half an hour, then screw down the plates close up. Give it another half-hour's bake, and it is finished. The soundboard plates are now bent, and never will be straight again; the wood is perfectly dry; glue the middle edges together, clamp on a board with sidepieces and wedges, and you have made a soundboard with a good curve and finish with a minimum of time and care.

Now, I have given thick proportions, ¼in. in the middle, because I want the natural spring to that extent in fashioning. This will have to be scraped with sharp edge down to $\frac{3}{16}$ in the middle, and ⅛ in a valley all round the edge, or rather 1in. from the edge; the actual edge can be done with a wood-file; to obviate the trouble of scraping towards the edges, most of this can be planed off at first before bending, making a feather-edged plate, but don't take off too much; mark out position of *f* holes, and cut half-way through with a very thin pointed lancet kind of knife, not quite through yet. Remember these *f* holes are the lips of utterance; endeavour, then, to shape them, like lips, thicker in the middle and thinner at the round holes, with a projecting twist in and out through the whole shape; scrape the soundboard so that the middle part shall be a lip to overlook the under or opposite edge towards the rib. This is the thing that bothers makers, and is something like making or voicing an organ-pipe. You may do it right; but I won't discourage you. It appears, however, that Strad. made very few good instruments, and they can't be had for 30s., as per advertisement. The higher you make the belly, the better chance you have with the *f* holes, because the transversal vibrations have a greater hold on them, irrespective of the soundpost. It is just at this point that our new departure takes place, and it is open to all to simplify the violin in the direction of lifting the middle of the soundboard higher and higher, bringing the *f* holes nearer the strings, so as to make them act together, and the same way and time controlling each other. I admit that the soundpost stands in the way; but, Nil desperandum, we are going on. **Fiddler.**

DYNAMICAL PROBLEM—"A. S. L.'s" PARADOX (20593).

[20631.]—"A. S. L." says "the descending weight can't do the work of lifting the companion weight and at the same time balancing the weight at the opposite end of the lever"; but we can eliminate any question of balancing while the bellows at E is filling itself (see p. 112), by pressing a finger against one of the arms so as to stop the revolution of the machine. When the bellows at E has filled itself, withdraw the finger, and the machine will revolve through a quarter of the circle; again stop the revolution, and the process of filling will be repeated, and again the machine will revolve as before after being allowed to do so.

Some self-acting arrangement could be applied to stop the revolution at the proper time instead of the finger, so here we have perpetual motion without any dynamical complications! This, as "A. S. L." says, is absurd; but where is the fallacy? **M.I.C.E.**

ON THE POSSIBILITY OF RENDERING VISIBLE THE ORIGINAL COLOURS OF PHOTOGRAPHED OBJECTS.

[20632.]—An accumulation of minor facts often makes possible the accomplishment of more important results, and under this impression the following idea is submitted to the experimenter and the physicist.

We know that if a pencil of polarised light traverses a thin film of a double-refracting crystal, certain colours appear which are different according to the thickness of the film. We also know that certain soluble substances can be washed away partially, after having been exposed to coloured light, and I have found that when, for instance, exposing a sensitive gelatine plate to several glass plates of different colours, each colour-strip after washing is distinguished by a certain thickness of remaining gelatine.

Under the above facts the problem would be to compound or produce a substance which combines the power of a strongly refracting crystal with the sensitiveness of a chrome gelatine-plate. By exposing such a plate to coloured light, and afterwards washing it, the remainder, when viewed through a Nicol's prism or other polariser, should show certain colours which stand in certain relations to the original colours which acted on the plate.

Boston, Mass. Sept. 26. **E. Berliner.**

LOBSTER-TINS AND RHEUMATISM.

[20633.]—It may interest some of my fellow-readers to know that lobster and other tins may be utilised by cutting them up into socks to fit the in-sole of boots, shoes, &c., and that they are of great advantage to those who suffer from cold feet or rheumatism in the feet. I do not need them myself, but have made many for others, and some of them say they are worth their weight in gold. New tin may be used, if preferred.

Lockstitch.

MINNESOTA AND THE NORTH-WEST.

[20634.]—Two days ago I left Minneapolis for a journey into Dakota Territory. I met a young Irishman who had just landed from the old country. A year ago he asked a question (in the columns of the English Mechanic, to which I replied) concerning the chances for emigrants. He then entered into a personal correspondence with me, and when I was in England a few months ago he met me there. His mission out in the great North-west is farming, and he realises that it will be his own fault if, in the course of a few years, he is not a comparatively rich man. I have seen so much during the six weeks I have lived in Minnesota, and am seeing so much now I am in Dakota, that I venture to state some facts concerning this wonderful country for the benefit of the readers of the English Mechanic. Before going further, allow me to say that I have no purpose to serve by exaggeration, and I shall not exaggerate. Every word I write may be implicitly believed. So much is published in England by railway agents and speculators concerning certain sections of this country which is false, that scepticism on the part of my readers might be pardoned did they not have my assurance that from me they will get no district puffs or over-colouring. All the interest I have in the North-west lies in a couple of building plots in Minneapolis, and I fear that the utmost I might say about the city in English newspapers would not add to their value.

Minnesota is best known for its fine flour and wheat. St. Paul, the State capital, is the city concerning which the most is heard in England. It has a population of 75,000 people, and is one of the liveliest cities on the continent. Minneapolis, which is 12 miles further west, has a population of 80,000, and is growing more rapidly than its sister city. Minneapolis is the greatest manufacturing centre of the two, and has grown up in half the time St. Paul has. The Mississippi river has a fall of 80ft. at Minneapolis, and the volume of water is immense. Flour-mills (one of which turns out 5,000 barrels of flour per day) abound, as do sawing-mills, all turned by water power. The city is lighted by electric light, which is also produced by water power. And yet, notwithstanding that hundreds of thousands of horse-power are being used, there is apparently as much water going to waste as before any mills were erected. Seeing that steam is expensive, owing to the high price of coal, a great future may be said to lie before Minneapolis. Common labourers have no difficulty in getting work at wages ranging from 6s. to 8s. per day. Of course, board and the general necessaries of life are correspondingly high; but they are sufficiently reasonable in price to allow a labourer who has the faculty of saving, coupled with experience in management of household matters, to save money. If he has a careful wife, he is more likely to save than if he is single.

What shall be said of the chances which prevail out here for mechanics? Simply this—if a man has any ordinary skill, he can earn wages which, if named, will seem almost fabulous to an Englishman. If he is exceptionally skilful, he will have no difficulty in making rapid progress towards prosperity. Men of value find their own level very quickly in this country. A man gets where he belongs. If his knowledge and capacities should secure him a place at the top, he will assuredly get there. For two or three years past I have, when writing occasionally to the "E. M.," urged my readers who have thought of coming to this country to come out West. I did this before I had travelled 500 miles west of New York City. Now that I am 1,700 miles away from the Atlantic Coast I repeat the advice, only with much more emphasis.

What would my reader say if he were to see on his travels a hill of water? He would gaze on it and wonder why it did not disperse and run down hill. The same when I look at the thousands of men and women in the east of this country—in New York, Philadelphia, Brooklyn, Boston, and all through the New England States—needing remunerative employment. But when I go to England, the sight is all the more aggravated, while here, if a man can work, no matter at what, he can find it to do. It is almost as difficult to go without work here as to get it in England. Every man seems to be full of the working spirit. He is full of a pasionate earnestness to do something—anything to make money.

I am writing this in Fargo, Dakota. It is a city of 8,000 people. Everything is dear because of the great cost of labour. The hotel at which I am staying charges 12s. 6d. a day for food and room—this latter I am sharing with a friend. Electric lights are flaring in every street; telephone bells are to be heard in nearly every office; tramways run all over the city; two daily papers are telling the people the news of the day; everybody makes money; Hotels are all full; and, speaking roughly, there is hotel accommodation for 2,000 people; two railroads run into the place; servant girls can earn from 16s. to 30s. a week, besides, of course, board and lodging.

And why all this? Is this state of things peculiar to Fargo, or is it to be seen in other cities? Let me answer the first question first. All around this city is a country, with soil so fertile, that if I were to repeat facts concerning it, I should be put down as a hatchet-thrower. The yield of wheat and other grains is so enormous, and the cost of producing them so small, that every farmer gets rich and spends money freely. When a kernel of wheat is sown it acts in an amazing fashion. Only to-day, I saw 85 stalks of wheat, an ear on each stalk, that had grown from one kernel. That is a stupendous fact. The soil is so rich and so deep that wheat may be grown upon it, year after year, without manure. Its good qualities are, apparently, exhaustless. That is why we have so much prosperity here. Farmers have plenty of money, and they spend it freely.

Now for the second question. My reply to it is that there are hundreds of such places as Fargo scattered over the North-west. Further along on the Northern Pacific Railroad are Bismarck, Manden, Jamestown, Miles City, and Billings—all growing places, surrounded with just such conditons of prosperity. I cannot but grieve that to-day there are millions of pounds sterling lying in England at 3 per cent. interest, whereas, they might as well and safely realise 10 per cent. up here. If you have any money, you can get 8 to 10 per cent. on mortgages as safe as are ever offered anywhere. On the other hand, if you go into real estate investment, there is no reason why you should not make from 50 to 200 per cent. per annum.

In the English Mechanic I have attempted at different times to dissuade intending emigrants from going to Texas. My last article on the subject found its way to the office of the *Houston* (Texas) *Weekly Post*, and in a fiery article I got such a dressing down as rarely falls to the lot of mortals. I was called "a damnable liar," and other choice titles were given me, the editor winding up in this fashion:—"If this humbug ever comes to Texas we shall be glad to head a party to wash his dirty carcase in the Buffalo bayou." This article of abuse was written at the instigation of a "Doctor" of London—a man who has an interest in Texas—at least, so the editor assured his readers. Texas has an enormous capacity for raising cotton, and for grazing; but it is partly because such scapegraces and revolver-users as the Houston editor infest the State that I advise my friends to keep clear of it. Then, too, its unbearable heat in the summer time, and its generally unhealthy climate are murderous. Kansas and Missouri are not as lawless, and are not so hot. In Minnesota and Dakota I have seen no sign of lawlessness. A drunken man will not be seen from one week's end to another.

But what about the winters in the North-west? It is true they are cold judged by the thermometer, but 30 degrees below zero is easier to bear here than 10 degrees above zero in England. Whereas one person in every 42 die annually in Europe; one in every 80 in the United States; one in every 65 in the Southern States (of which Texas is one); in the North-Western States one in every 120 die annually. That is a remarkable showing.

I feel I have drawn out this letter to an inordinate length, but I wanted my fellow-countrymen to have the facts concerning this country from some one authorised to speak. My three years' residence in the United States, coupled with extensive reading, travelling, and observation in my capacity as a journalist, have taught me much. If any readers of the English Mechanic desire to write me privately, I will endeavour to answer their questions. The shorter and more practical the questions the better. My address is P. O. Box, 206, Minneapolis, Minn., U.S.A. **R. M. Tuttle.**

Fargo, Dakota Territory, U.S.A.,
Sept. 19th, 1882.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[29864.]—**Caledonian Engines (U.Q.)**—As I promised some time ago to send dimensions of the above railway's bogie express engines (125-129 class) I now proceed to fulfil my promise. These engines were built by Neilson and Co. in 1877, to run between Perth and Glasgow. They have occasionally come as far south as Carlisle, leaving at 7.45 p.m. and returning north by the down limited mail. They are now stationed at Dundee, and run between that place and Glasgow (Buchanan-street). They have some rather fast running to do between Dundee and Perth. The other North main line traffic is worked by 30-41 and 117-122 classes. The following are some of the dimensions of the bogies. Cylinders, 18in. diameter, 24in. stroke; coupled wheels, 7ft. 1in.; No. of tubes, 186; length of do., 10ft. 9in.; diameter (outs), 1¾in.; weight 41⅝ tons, distributed as follows:

	Tons	cwt.	qr.
On bogie wheels	12	17	2
Driving "	15	1	2
Trailing "	13	13	2
Total weight	41	12	2

The 30-41 class have 17in. cylinders, 24in. stroke, and 7ft. wheels; and same applies to 117 class. This letter also replies to 30246 (U.Q.)—Carstairs.

[46814.]—**Caledonian Engines.**—To "R. N. H."—No. The arrangement of the wheels was not the same. The old 122 class had its trailing-wheels behind the firebox, and the modern 631 class before the firebox, thus reducing the distance between extreme centres to a minimum. The wheel base of the old class was 13ft. I cannot better describe the modern six-coupled engine than by adding that it is almost an exact copy (though, of course, much heavier) of the old "Sphynx" class on the M.S.L. Ry., and with whose outlines "R. N. H." is no doubt familiar. The "Sphynx," however, I will venture to say, had a greater distance between the leading and driving wheels than in the case of the Caledonian engine.—Carstairs.

[47239.]—**Vegetarianism.**—I do not know whether there is any special reason for making statements which are not facts under the head of vegetarianism; but it is unfortunate that those who pose as its prophets are given to that failing. I may say something of the big guns soon; but at present I want to knock down something that appeared on p. 69. The sea-captain who "proved" that tinned vegetables were "not of the least use as ship-stores" must, unquestionably, have been a chip of the old junk, and his opinion may be allowed to pass as rather too-too; but when "H. O'B." says that green peas served in London eating-houses are really "tinned," and, *therefore*, not nourishing, one is compelled to ask what next? I suppose every one knows that peas from the greengrocer's are nicer than those in the tins, just as those fresh gathered are better than the market-sweated peas; but really one must ask what has become of their nutritious properties that they are condemned in this style? If tinned peas are not nourishing, I suppose split peas are worse than useless. The brewer in Lancashire probably spoke of his own product, and was just as wise as those who "stand aghast at the waste of valuable food at Billingsgate." "H. O'B." would do well to start to prove the "waste," which may be possible, but certainly it will be impossible for anyone to substantiate that peculiar dictum about white fish supplying nutriment specially to the brain and nervous system. What, in the name of common sense, does white fish contain that is not found in other fish? and whatever it is, by what means does it specially supply the "brain and nervous system"? I suppose we have here a resuscitation of the exploded nonsense about phosphorus, which, if true, would involve the eating of mackerel and salmon in preference to white fish, and salmon roe in preference to either. The real reason why white fish are recommended is, that they are more digestible as a rule than the oily fish; but eels are white, and yet remarkably oily. Why not recommend sheep's brains as "just the very, very nutriment for toiling and over-worked men and women"? I suppose because that would be outside the pale of vegetarianism, while eggs, milk, and fish (white fish, mark you!), are akin to vegetables. One other argument I note—that about a man's teeth. How long-lived these errors are! What does it matter about a man's teeth not being capable of tearing flesh, when the fact is that they are quite capable of masticating it, and his stomach digests it as easily as it does anything else? Can't these vegetarians see that man is capable of living on either kind of food, and: e at least by so much superior to any other animal?—Nux. Dor.

[47684.]—**Tin-Plate Working.**—As a tinman, I should require, to make canisters, a pair of stock shears, pair of rollers, folding machine, a jinny, and large mandrel. I X charcoal is the best stuff to use, but coke is the cheapest. I would advise you to learn to take up bottoms with the bottoming-stake before using the jinny. For prices, get a list from some shop.—T. P. W.

[47728.]—**Tin-Plate Working.**—To make a water-can spout we turn a piece of tin about the size required, and then pare it to fit the body with a pair of circular snips. If this is not sufficient for "Tiro Tironum," if he publishes his address and the size he requires, I will send him the pattern he requires on paper.—A Tin-Plate Worker.

[47732.]—**Coil for Lighting Gas by Electricity.**—To "Sigma."—I am much obliged to Mr. Sprague for his kindness, but fear he misapprehends my query. If he will look at the query again (No. 908, p. 557), I think he will agree with me that an ordinary induction coil could not be used. The system I mentioned has been a long time in use in this country (U.S.) for dwelling-houses, as well as hotels and large buildings generally, and was introduced to allow the use of open-circuit batteries like the Leclanché, which rapidly ran down on a closed circuit. I am entirely familiar with the theory of the old method, where a powerful closed circuit battery (Bunsen or gravity) is used, its current turned into the "primary" of an induction coil, and the "secondary" opened and shut by hand at the battery, causing a series of sparks to leap over the gas-jets, many of which may be lighted in the same moment. What I mean is totally different. We have in the new system:—1. An open-circuit battery, used also for bells and burglar-alarms, and running for years (perhaps) without attention. 2. A helix of wire, not always very fine, length and method of winding at present unknown to me, and which I desire to find out. 3. One terminal of battery goes to gas-pipe, the other terminal to one end of the coil wire, whose other end is joined to insulated wires that divide and subdivide till a branch runs up the side of each gas-burner, but carefully insulated therefrom. A metal point, usually a brass wire, projects from the gas-burner, being in electrical contact with the gas-pipe. 4. Each has its own cock, which, when turned on, causes the two electric terminals at the burner to come into contact and then to separate, a small spark passing on making circuit, and a much larger one on breaking it, which latter lights the gas. As Mr. Sprague will now see, there is no current in coil till gas is turned on at burner, the current ceasing as soon as gas is turned on; hence, the possibility of using such a battery as the Leclanché. Mr. S. will also see that an ordinary induction coil could not be used without putting primary and secondary into one circuit, in which case I doubt its efficiency. Can Mr. Sprague suggest a suitable helix to do the work, and will Mr. Lancaster also attack the problem? Allow me to say that this method is valuable, in that it lessens fire-risks, as no matches are needed out of the kitchen, and hence our large hotels favour it. At the celebrated "Hotel Brighton," at the famous watering place, Coney Island, the system is used, there being about 1,700 gas jets lighted, each separately as needed.—Roi ne Puis, Souza je Suis.

[47735.]—**Cataract.—Eating Salt, and the Effect of so doing on Man and the Lower Animals.**—Whoever judged by the effect on dogs of what would be the effect of salt on human beings must have been a very unreasoning being. There is not the least reason to suppose that the effect would be the same in the two cases. I do not fancy a diet of thistles with lumps of rock-salt would be beneficial to man, but donkeys certainly thrive on both. It is a well-known fact that to experiment on animals with drugs for the purpose of ascertaining their effect is futile and utterly useless; the action being different on nearly all. Tobacco is harmless to a goat, lachesis (rattlesnake) to a pig, strychnine to the toucan, and belladonna (deadly nightshade) to a rabbit; but all these are deadly poisons to man. I do not know whether salt (chloride of sodium) be good or bad; but, as a fact, I do not eat more than a teaspoonful in a year, and am very healthy. I have often noticed that persons who are fond of salt are generally unhealthy or half-developed, but I do not know whether that is the cause or the effect.—Murano.

[47771.]—**Dead Black for Brass.**—AgCyKCy is cyanide of silver and potash. The articles would have to be plated, though it would not cost much, because they only require a "blush" of silver. But, since writing your first query, you say the articles are soft soldered, so, if you follow this process, you must either copper them (see answer 48118) or use an intense current. But, perhaps, this will give too much trouble, or cost too much; however, if the articles, are worth the trouble, I am confident this will give a satisfactory result.—Girdlestone Wright.

[47803.]—**Third Grade Art.**—To "L."—You cannot get a third-grade prize unless you are a student of some school of art; but you can get the first part of the "Art Teacher's Certificate," which includes several third-grade subjects. The work for the certificate can be done at home. You ought to buy two casts, viz., "Madeleine" and "Egg Plant," as the first is required to be drawn in pencil, the second shaded in chalk, neither of them easy, although they sound simple. A group of models shaded in sepia is also required, imperial size. The casts are not expensive. If you want to know anything more I can assist you in, write again.—C. J. R., Ventnor.

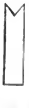
[47808.]—**Telephone.**—To Mr. Lancaster.—Having waited for your reply to my query, I have since taken my telephone to pieces and tried the magnets which are made out of ⅝in. round cast steel, and they will only lift half an ounce of iron each; and I have turned two hard wood reels, and wound them with half an ounce of 36 silk-covered wire, and tried them again, and still they will not speak. The discs seem all right, and the connections are clean; the magnets are driven tight into the wood, and the wires are brought out to brass posts, fastened with iron screws. Will you please to say if I have got enough wire on the reels, and if I wound the two half-ounces on one reel, and brought the four wires to the binding screws, would it make them any better? and on the other wind three-quarters of an ounce, and would one 6in. Leclanché cell work them? Sorry that I am giving you so much trouble with my query, but I want to conquer the mystery.—W. H., Liverpool.

[47856.]—**Preserving Meat.**—The process has been frequently described. The meat is packed in tins in any size joints they will hold, and the lids soldered on. The lids have a small hole left in the centre, under which is a little flap to prevent solder falling through. The tins are placed in a bath of chloride of calcium or a strong brine, which is raised to the boiling point (some degrees above that of water), and when the meat has been sufficiently cooked a drop of solder is placed over the hole, which hermetically seals the tins. On cooling the heads of the tins bulge inwards, which is proof that the operation has been properly performed.—T. P.

[47871.]—**Power for Churning.**—If "Yokel" has a tower of sufficient height, he can, of course, get power by winding up a weight; but if it is wanted for more than a few minutes, the weight must be suspended from blocks with several sheaves, and connected to the machine by gearing, which would introduce so much friction that it would have to be very heavy indeed to yield even a half man-power for an hour.—Essar.

[47872.]—**Boiler.**—If the tube-plate is properly bored and the tubes properly expanded, they would not leak. Solder is an abomination in steam-boilers.—Essar.

[47879.]—**Silversmith's Work.**—First of all the articles are either stamped up, rolled, or have solid half-beads put on them; they are then finished in the ordinary way, either scratchbrushed or polished bright, and then faceted. According to the size of your facet you want your tools made. Take a piece of iron wire, square and file at one end with a "three-square," or square with one edge downwards till you have a slot thus; after which



it must be polished with emery, hardened, then polished in the slot with finer emery, and finished on the lathe (leather buff); the articles are then placed on a piece of hardwood, the tool held on one of the beads and hit hard with a hammer, that puts two facets on, turn it half-round, and hammer again, and so on. We generally put 8 facets on the large beads and 4 on the smaller ones; however, that is a matter of taste. As for its being "the new style of ornamentation," I must differ. It was in great vogue eight years ago.—Girdlestone Wright.

[47899.]—**Ladder.**—To prevent the ladder from twisting, "Steeple Jack" can take off the one side and put it on the reverse way—*i.e.*, so that if cut from a round pole the two round sides will face the same way, D—D. A pole which is twisted in growing will continue to twist in seasoning, but by reversing the one half, the twist of one half counteracts that of the other. This is sometimes done in making ladders from home-grown poles.—Mon.

[47916.]—**Midland Engines.**—A few errors have crept into the interesting lists of engines furnished by your correspondents "Meteor" and "Camomile," which require correction. Engines Nos. 165 and 166 *are* of the 800 class, both being built at Derby in 1870; they should, therefore, be added to the list given. "Camomile," in his letter, p. 95, omits to mention Nos. 78, 132, 151, and 152, which are all of the 890 class; on the other hand, he includes No. 122, which does not belong to it. With regard to the question of "brakes," the Midland Company has 37 bogie tank engines, fitted with steam-brakes upon the coupled wheels, and also with the necessary ejectors and pipes for working Smith's vacuum upon the 115 carriages, which are fitted to work trains over the Metropolitan and London, Chatham and Dover Railways to and from Kentish Town, &c. A difference of opinion appears to exist as to the size of cylinders of the 800 class. The whole of the 800 design have been ordered to be "rebuilt," and with two or three exceptions the work is complete. The new cylinders are all 18in. diameter, but there is a difference in the length of stroke. Those rebuilt during the year 1877 had the stroke lengthened to 26in., and their numbers are as follows:—800, 804, 805, 807, 811, 813, 814, 816, 818, 819; all the others, which were "rebuilt" either before or since, have the stroke still of the original length, namely, 24in. Of course, the above ten engines which have the "26in. stroke" are much more powerful, and have a great advantage when ascending an incline with a heavy train; but the trouble and expense of lengthening the "stroke" was considered to be such a serious item that the locomotive officials decided nearly five years ago that the "advantage was not worth the cost." The engines now numbered 101 to 110 were built at Derby in 1877, and originally numbered from 1,347 to 1,356.—Clement E. Stretton.

[47921.]—**Magic-Lantern.**—To Mr. Lancaster.—Thanks for reply. Will you please give particulars for a good achromatic front? I want a large field with good definition.—Poor Amateur Glassgrinder.

[47935.]—**Ventilation of Room.**—I do not know if my answer will be in time to be of any use to you, but the plan we have adopted, after trying many methods, is as follows:—First provide sufficient outlet, or, in other words, see that your perforated ornament has communication with the outside; next, in most convenient part of room, cut a hole through the wall to the outside, the bottom of hole to be level with top of floor, all the better if it dips towards the outside; build a grating in flush with outer side of wall—it should be about 12in. square; then fix a wood tube against the wall on inside, having a capacity of 12in. wide by 6in. deep; carry it up the wall about 5ft. from floor, and insert near the top a piece of perforated zinc, and your ventilation will be complete. Of course it can be made as ornamental as you like, and a cover fitted to top to shut if required. We have them in both day and bedrooms, containing from thirty to eighty people, and find them a perfect success.—On Guard.

[47972.]—**Metal Work.**—Errata.—For the word "making" read "matting;" for "circular, and triangular," read "circular, triangular, or star-shaped"; for "burnished" read "finished"; for "speaking" read "operating."—A. Francois.

[48014.]—**Lantern-Slides.**—The best colour for bright yellow is Italian pink; for orange, first a wash of Italian pink, and after allowing to dry, lightly wash over with crimson lake. For bright scarlet use a strong wash of crimson lake. Where a density of colour is required, use a coat of copal varnish first. I would recommend painting of slides entirely in oil. If using water-colours it would be necessary to coat with transparent varnish after the first colour, as you would not be able to use your second colour without washing up the first. To moisten water-colours when gone hard, use water and just a suspicion of honey. I think as brilliant an effect may be produced with water-colour as oil; but water is not so satisfactory, having a tendency to crack. One method used as a means to prevent cracking is, after drawing your outline on the glass with Indian ink, to coat the plate with transparent varnish in the same manner as a photographer coats his plates: work on the varnish, and having finished, coat again, so that four colours are between two coats of varnish. Messrs. Barnard and Son publish a handy little book upon slide painting (price 1s., I think). They also supply for 22s. a case containing ten moist water-colours, and requisites for slide-painting. In skilful hands, all the colours required are Italian pink, raw sienna, burnt sienna, crimson lake, burnt umber, Chinese blue, and burnt lamp black.—A. Francois.

[48021.]—**Electro-plating.**—Is "B. A. J." sure he has no grease on the parts named. Try scratch-brushing all over, and then give a preparatory in a solution of pearlash (potassium carbonate) before putting in copper solution. See answer to 48118.—Girdlestone Wright.

[48022.]—**Concrete.**—After H. Stephenson has removed board-floors, he may now take out, if necessary, the soil or rubbish to the depth of 6in., and make up with broken bricks and stones 3in., and beat them well down so as to prevent sinking; he may now mix five parts of gravel and one of cement for blinding—this prevents shrinkage and cracks when finished. The simplest way now is to lay two narrow screeds along the floor, which will be divided into three equal parts. After they are hard enough, but not set; he may now make up two and a half parts of fine gravel, to one part of cement, and rule across both screeds, which are, of course, levelled when laid down; he may take down the two sides first and finish before filling in the centre, by polishing with trowel when firm enough, without making holes. Brickdust, fine gravel, or ground granite, will do for finishing coat.—Auld Reikie.

[48025.]—**To Mr. Parkinson.**—The grooving for dark slide will do, as described by me in "Amateur Work." If the camera is required for outdoor work, of course the object is to get rid of all bulk and weight not absolutely necessary. The same width will do, but make it ⅜in. thick; follow my articles as they appear, and you will have no difficulty, if you can use a few tools. The next will appear in November issue. If you should find any difficulty in any part, I shall be pleased to help you.—James Parkinson.

[48032.]—**Zinc Cylinders.**—In reply to "Adda," if the cylinders are in good condition—*i.e.*, smooth and not eaten into by the acid, scour them with sand and water until the metal is quite clear, then dip into acid, and the Hg will adhere quite easily. If they are eaten into holes you will never amalgamate them properly, and will always give you trouble. The best time to amalgamate plates or cylinders, when they require it, is after you are done working the battery.—Thos. J. O'Connor.

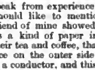
[48057.]—**Registering Bell-Gong.**—"P. M. G." is advised to test a patent money till that sounds a gong. The money (say 1d.) must be paid to make the signal. No signal can be made unless the coin first enters a locked-up till. The signal is made in the till, and it may be transmitted to 60ft. distance, and made to register in either or both places. As each person entering the room may place the 1d. in the till which makes the signal, there seems no need to register the takings. Unlocking the till, and counting the money, may give sufficient security. The maker of these money tills is Mr. Symons, 2, George-street, Blackfriars-road, London, S.E. Some tills he has which give the change automatically; requiring, for example, 1s. to be put in to permit 6d. to be taken out from the locked-up till. Others exhibit the takings displayed in the order of entry. No signal can be made except by the coin itself, whether it be in the act of entering or leaving the till. The whole is interesting to mechanics, apart from its value in preventing mistakes or fraud in places where money is taken.—H. C. S.

[48070.]—**Prospects in Western Australia.**—The chief products of the country are wheat, barley, oats, hay, potatoes, and wine, though the corn is sometimes destroyed by "red rust." The average yield of oats and barley is 10 to 20 bushels per acre. Gold has been found in many parts of the country, but not in very payable quantities. Lead and copper exist in large quantities in the northern districts. The pearl fishery is also engaged in. The export in pearls and pearl-shells in 1875 was £65,000. In the same year, horses to the value of £3,000 were exported to the Mauritius. Considerable quantities of gum, resin, sandalwood, and tortoise-shell are also exported. "The finest and most salubrious in the world" are the terms in which the climate is spoken of in the book I quote from. The annual mortality of the province since its occupation (1826) has not averaged more than 1 per cent. of the population. From the northern to the southern extremity the climate varies considerably. The southern temperature is somewhat similar to England, but higher. The northern is higher still, but free from the moisture of tropical climates generally. Snow is never seen, and ice only early in the morning, and in the depth of winter. Emigrants paying the full passage money, who are artisans, miners, &c., receive a grant of land of the value of £20, under conditions as to cultivation and staying in the colony a certain number of years. Don't know whether it refers to this colony, but it does to South Australia, Victoria, and Queensland. Abridged from the "Australian Handbook," Gordon and Gotch, London.—Girdlestone Wright.

[48072.]—**Induction Coils, &c.**—I do not think that the primary wire is long enough; I should have put on four layers at least. The secondary wire is not properly insulated, and I should think that you have too many layers. If I were you, I should make another bobbin, and put on three layers of 18 wire; pour over it some good shellac, varnish, when dry, give a coat of paraffin wax, into which some resin has been added; when set, wind on a layer of thin twine, well varnish, and put on one side to get hard; then wind the secondary very even, keeping a sharp look-out for cracks in the silk insulation; separate every layer with the paraffin wax and resin. When you have on about twelve layers, you had better try the effect. You must not forget that after a certain number of layers the spark will not increase in length, so that all the wire you put on above that number will be wasted. Let me know how you succeed.—W. T. W.

[48079.]—**The Voss Electrical Machine.**—The stationary plate should be 2in. larger than the one that rotates—the latter may be 12in. in diam. The two plates should be close together, ⅛in. to $\frac{1}{16}$in. apart. Ordinary window-glass, thin and quite flat, is very suitable; more so, I think, than vulcanite, for these machines generally require warming in damp weather, and vulcanite would not stand the heat without warping; and besides, glass is much cheaper; the two plates may be had for a couple of shillings of any glass-dealer. The pair of discs on the stationary plate are best put on the back of the plate, under the paper shields, instead of on the front next the rotating-plate. The conductors should be supported on two glass or vulcanite pillars, instead of on the condensers, as shown in the illustration. The condensers can then be placed alongside, and connected in a way mentioned in a former letter of mine. Unless "J. W." is used to tools and work of this kind, I would not recommend him to begin to make one, for they require a good deal of careful labour. I made mine, and therefore can speak from experience. Now that I am writing, I should like to mention a beautiful experiment a friend of mine showed me the other day. There is a kind of paper in which some grocers wrap their tea and coffee, that has a bright lead-like surface on the outer side; but it is not lead, for that is a conductor, and this is not. If a piece of this paper, after being warmed, is held under the knobs of this machine when 2in. or 3in. apart, a splendid spark will rush along its surface accompanied by numerous ramifications. I have pasted a piece of this paper on to a rectangular piece of glass, 10in. by 5in. When this is warmed and placed on that part of the conductors which connect the sliding balls with the horizontal combs, bridging over, as it were, the intervening space behind the knobs, which in my machine is 8½in., vivid, decrepitating sparks, 8in. to 10in. long, rush along the plate in a beautiful zig-zag form, attended by numerous ramifications in all directions. It is really the most beautiful experiment I have yet seen with these machines, and will well repay any-one the trouble he may have in trying it. I strongly recommend it to your correspondent "H. B. T. S.," who occasionally writes on matters electrical.—John C. Frank.

[48080.]—**Compensation Balance-Wheel.**—This piece of mechanism, which is used in watches as a guard against variation of temperature, is composed of brass and steel welded together (brass being outermost), and connected with the opposite ends of the spoke of the wheel (see Fig.). Little brass screws are placed at intervals on the rim for the purpose of "timing" it. On a rise of temperature the steel spoke expands, causing the half-rims to become more curved, and thus compelling the small weights to approach the axis. If, now, the centre of oscillation is as much moved in as it is moved out, it will remain in exactly the same position, and the elasticity of the hair-spring will have the same amount of resistance to overcome.—John Bull.



[48085.]—**Rosin for Violin Bows.**—Otto, in his "Treatise on the Violin," in the edition published 1828, says: "Put a pound of Venetian turpentine into a new earthen pot; add some water to it, and let it boil for two or three hours over a slow fire. As the turpentine rises to the surface, cold water must be kept ready to pour in whenever it threatens to run over. And even if no such tendency appears, water must be added from time to time; otherwise the turpentine will be boiled too much and become burnt. The sign that it has boiled sufficiently is when a drop, which has been allowed to cool on a plate, rubs clear between the fingers without sticking. When it is so far ready, pour it into cold water, and work it well through the hands, so as to express the water which it has taken up in boiling. When quite cold, break it into little pieces; and in the summer let the sun extract the remaining moisture, until it becomes perfectly transparent. In the winter, it must be put into a porcelain vessel in the oven—not so hot as to fry it, but only so warm that the water contained in it may be gently evaporated. In this manner beautiful and clear rosin is obtained.

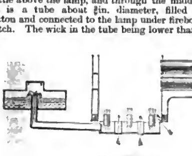
Mangin, in his "Manuel da Luthier," page 138, says: "Behold the secret, which is aothing. Melt some common rosin in a new-glazed earthen pot over a moderate coal fire, and as it dissolves filter it through a rather coarse new linen cloth into a second pot of the same kind as the other, taking care to keep it near the fire; afterwards pour the rosin into little rolls of paper, or make it up into tablets for use."—War.

[48091.]—**L. B. & S. C. Engines.**—No. 28, Isfield, is four-wheeled conpled wing-tank, used for passenger traffic.—Alaric.

[48091.]—**L. B. & S. C. Engines.**—The names and numbers of the engines asked for, are as follows:—Mayfield, 23; Brambletye, 24; Rotherfield, 25; Hartfield, 26; Uckfield, 27; and Isfield, 28. They are four-coupled tank-engines, stand at Brighton, and are used for local passenger traffic.—Spike.

[48092.]—**The Properties of the Number Nine.**—Any number may be represented by $a_0 + 10a_1 + 10^2a_2 + 10^3a_3 +$ etc. $+ 10^na_n$, where $a_0, a_1, a_2, a_3 \ldots a_n$ are the digits beginning at the units place. The sum of the digits is, therefore, $a_0 + a_1 + a_2 + a_3 +$ etc. $+ a_n$. Subtracting this from the number, we have: $9a_1 + 99a_2 + 999a_3 +$ etc. $+ (10^n - 1)a_n$, which is clearly divisible by 9. Thus, in the example proposed by "Tiro Tironum," $653442 = 2 + 40 \cdot 4 + 10^2 \cdot 4 + 10 \cdot 3^3 + 10^4 \cdot 5 + 10^5 \cdot 6$. The sum of the digits $= 2 + 4 + 4 + 3 + 5 + 6$ ∴ Subtracting we have—$9 \cdot 4 + 99 \cdot 4 + 999 \cdot 3 + 9999 \cdot 4 + 99999 \cdot 6$, which is, of course, a multiple of 9. Generally in any scale of notation, if the radix of the scale is r, the difference between any number and the sum of its digits is divisible by $r - 1$.—Hemisus.

[48099.]—**Model Locomotive Boilers.**—Your firebox and tubes are too small. The inside box should not be less than 3in. long and 2in. broad, and the tubes not less than ¼in. diameter, and five or six of them, or three ⅜in. tubes. The lamp should have five or six wicks, ⅜in. diameter, placed in a flat box, about 3in. by 2in. and ½in. deep, which would represent the ash-pan, the air being admitted round the sides and through two ¼in. tubes, which pass through the middle of the wick-holder. The supply of spirits should be carried in a reservoir placed a little above the lamp, and through the middle of this is a tube about ⅜in. diameter, filled with cottton and connected to the lamp under firebox, as sketch. The wick in the tube being lower than the spirits, it causes a continual flow to the lamp. The cause of failure in these small model boilers is insufficient draught and heating surface. The best way to get these necessary qualities is to use a few large tubes, leaving about ¼in. betweea each. The draught will be improved if the exhaust steam is turned up the chimney. If the gauge of your driving wheels will allow a boiler more than 2½in. diameter, and you intend to make a new one, leave as little space as possible between the boiler and wheels.—E. L. P.



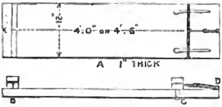
[48101.] — **Westinghouse Brake.**—If your correspondent "Mc. K." will refer to Vol. XXXII., p. 118, he will find that two years ago I gave an illustration and description of Stroudley's air brake regulator, as in use on the Brighton Company's engines.—Clement E. Stretton.

[48105.]—**M.R. Engines.**—I cannot tell you how many engines the M.R. Company have got over 2,000; but there are not more than 25. They are all small four-wheeled saddle-tanks. They are numbered any way; they don't follow each other. The M.R. Company lets them out on hire to colliery companies. 201—203 are built by Sharp, Stewart, and Co., Manchester. They are side-tank six-coupled engines; I cannot give you dimensioas. 1322 is a four-wheeled saddle-tank, outside cylinders; 1326 is a six-coupled saddle-tank, inside cylinders; both of them are built by Manning and Wardle, of Leeds. Perhaps some other kind reader of the "E.M." will give us more particulars of this class of engines, and oblige—Camomile.

[48108.]— **Spongy Iron Filters.** — Spongy iron is described by Professor Bischoff as metallic iron which has been reduced from the oxide without fusion. I bought a spongy-iron filter some years since; but finding it impossible to keep it in order, I gave it to a scientific friend, who found it as utterly useless as I had done. The filtering material is as course as gravel, but the rapidity with which the water passes into the lower chamber is regulated by a small glass tube. The Grand Junction Water Company tried a bed of spongy iron; but, I believe, the constant clogging up soon caused them to discontinue its use. Silicated carbon filters have all the advantages of spongy iron without the drawback of clogging. I like them for many reasons better, the water being perfectly aërated when passed through silicated carbon, while the filtrate through spongy iron has always a flat, metallic taste.—M. F. G.

[48109.]—**Zinc.**—In reply to "Ignoramus," use soft solder, and Baker's preparation for the flux. Rosin does not work well with zinc. If the above flux cannot be procured, get some spirits of salts (mur. acid), and dissolve in it as much zinc as it will take up. Dilute with water before using.—Thos. J. O'Connor.

[48113.]—**Knees of Trousers.**—A, plain yellow pine or mahogany deal; B, a piece of 1in. lath screwed securely to A, with another piece hinged to it, and secured at the other end by a thumbscrew; C, the same as B, but only left loose, and is intended to slide in a hole at each side of the board; D is a strap by means of which C is drawn tight, and thus it makes the trousers quite tight.—W. P. Dixon.



[48118.]—**Electro-plating.**—The proper way is to have, say, 10 quart Bunsens, or equivalent strength of current; it should be plated direct, without mercury or anything else; it must be covered all over with a film of metal the instant it is placed in solution. Otherwise it must first be coppered in a solution of the cyanide of copper and potash (CuCyKCy); the sulphate of copper solution attacks the metals lead, zinc, &c. To deepen the colour of gilding, use your solution hotter, and have more current; don't use copper.—Girdlestone Wright.

[48119.]—**Legal.**—The minority of women ceases at the beginning of the day preceding the 21st anniversary of their birth, but they may consent to their marriage at 12, and, with the sanction of the Court, make a valid marriage settlement at 17 years of age (40 and 41 Vict., c. 18, s. 49).—Jos. P. Thompson.

[48123.] — **Reed Organ.** — If you are really *building* a 3½ row instrument without first deciding what reeds to use, and how to use them, you are surely very unwise, to say the least. As it is to be exhaust bellows, no plan you are likely to arrange will beat the ordinary tubeboard and reeds of the American organ; as one or more of the best French makers have tried and abandoned the harmonium reed on suction. 3½ or 4 rows are easily arranged on the American organ style, and can be procured complete, as far as the pan is concerned; but all are prepared to act *under* the keyboard, although the pan can be reversed and placed on top if so preferred, but with doubtful advantage and the certainty of extra work. The channel in the harmonium is a most important part; but if you mount harmonium reeds on suction, you alter the condition of things altogether, and voicing the reeds becomes a necessity, if you wish to make a musical instrument. If you decide on harmonium reeds you had better adopt the pipe-organ style of soundboard, i.e., with channels running the full length of your arrangemeat (back to front) over which the reeds could be screwed, in separate registers; each channel having a pallet-hole about 6in. long; and as you want your pan above the keys, each pallet to have a pull-down, so you would want no stickers. I do not think this arrangement would equal either the ordinary harmonium style or American organ—at least not in the hands of an amateur. However, if you have not begun, I should be pleased to send a sketch, if you state precisely what you want.—Joiner.

[48123.]—**Reed Organ.**—If "E. J. L." has not yet started on his reed organ it is to be hoped that he will wait until he clearly sees his way. There is no reason why he should not work harmonium reeds by means of suction; but there is no advantage whatever in doing it: and, considering what harmonium reeds are, some difficulty in achieving a satisfactory result. Let him reflect that with suction he can never, when actually playing, get more than atmospheric pressure on his harmonium reeds, while they are made to stand much higher pressures; in fact, to have wind forced past them. To get good results, then, it will be necessary to thin them down; and if he does not want a mere copy of the old seraphine with the wind-course reversed, it will still be necessary to put each reed on its own channel, or else put them in tubes like the American organ. If I recollect, I have already answered similar questions to this; and now for brevity I will repeat that those who wish to make reed organs should determine which style they will adopt. There is the harmonium with its channels and pressure wind; and the American organ with its tubes and exhaust wind. I don't pretend to know whether any of your readers can or cannot improve on those arrangements; but you will perhaps allow me to advise them to stick to one or the other. The man who can really produce a successful result by a "cross" between the two will not need to ask questions. I would recommend "E. J. L." to read what has appeared before—even in recent volumes. I am not quite clear how he would work pallets above the keys when the wind is exhausted (I mean with harmonium reeds); but no doubt he has it all drawn out and measured off.—Organon.

[48123.]—**Reed Organ.**—In the answer to this query I notice a mistake in one word. Instead of "two stops to subdue the power of the diapason and principal in the 'base'" it should be "bass."—G. Fryer.

[48124.]—**G.N. Engines.**—No. 8 is an 8ft. single cylinders, 18 by 28; Nos. 26 and 31 are 5ft. 6in., coupled in front, cylinders 17 by 24; 212 has driving and trailing-wheels 6ft. 6in., cylinders, 17½ by 26; 251 driving and trailing-wheels 6ft. 4in., cylinders, 17 by 24; 284, driving and trailing-wheels 6ft. 6in., cylinders, 17 by 24; 625 is a trailing bogie-tank engine, leading and driving-wheels 5ft. 6in., cylinders, 17 by 24.—Alaric.

[48124.]—**G.N. Engines.**—I will give you a few of the principal dimensions, &c., of the following engines: Nos. 8, 562, and 284. No. 8 is an 8ft. 1in. single wheel, outside cylinder, express engine, cylinders 18in. by 28in., designed by Mr. Stirling, and in collision at Arlsey on the 23rd of December, 1876. No. 562 is 5ft. 6in., four coupled engine, and designed by Mr. Stirling. No. 284 is a 6ft. 6in. four-coupled express engine, and also designed by Mr. Stirling.—Phaeton.

[48124.]—**G. N. Engines.**—No. 8 is an 8-footer, cylinders 18 by 26. It was built, I think, in 1871. Nos. 212 and 284 are 4-coupled express passenger engines, cylinders 17½ by 26, driving and trailing-wheels 6ft. 7in. The former was built at Doncaster in 1881, the latter by the Avonside Co., in 1868. No. 562 is a mixed traffic-engine, built by Sharp, Stewart and Co, in 1876, leading and driving-wheels (coupled) 5ft. 6in., cylinders 17½ by 24. No. 625 is a bogie tank-engine, built in 1878, cylinders 17½ by 24, leading and driving-wheels 5ft. 6in. dia. No. 385 is a 6-coupled goods-engine. The wheels are 5ft. in dia. Sketches of the 8 and 284 classes have appeared in the "E. M.," but I cannot give the exact volume, as I have not got them to hand at present; but it is between Vols. XXVII.—IX.—Meteor.

[48125.]—**Electric Bell.**—The end of the wire of the upper bobbin should be connected with the screw which supports the armature, and the end of the wire of the lower bobbin should be connected with one of the binding-screws, the other binding-screw being connected with the stud which holds the contact-breaker. Care, however, should be taken that the armature is properly adjusted. The bell should be firmly fixed, and the hammer pressed against it. Whilst in this position, adjust the bobbins to about the thickness of a card from the armature; allow the hammer to fall back again into its place, and carefully adjust the contact-screw until it presses gently against the contact-breaker. I think if you follow these directions you will succeed; for, although your wires may be properly connected up, it is necessary that the working parts should be adjusted to a nicety.—E. A. Longstaff.

[48126.]—**Electro-Deposition.**—"Os's" reply came rather inopportune, as I have already gone to some little expense in obtaining guttapercha and Grove's cells. I was not aware that guttapercha was soluble in cold cyanide, but had followed the directions found on p. 213 of "Spon's Workshop Receipts," which said that "Cold electro-silvering baths . . . are contained in large rectangular wooden trough lined with guttapercha." Of course, I did not intend to use a hot solution in my trough, which would speedily loosen my guttapercha; besides, isn't guttapercha used as moulds in electrotyping? Would aot the cyanide dissolve exposed parts and spoil the mould, besides polluting the bath? However, if guttapercha positively will not do, will "Os" tell me what will? Shall I pitch it with asphalte? If so, what is the process, or is asphalte soluble in hydrocyanic acid? I don't understand why a Grove's battery will not do. Isn't it as constant, and much stronger than a Bunsen's which is often used? If not, could not I use one cell for a certain time and then put on the other, or else strengthen the acid solution, when it requires renovating. Of course, if necessary, I can make a Daniell cell, but should like to utilise my Grove's cells if possible. With regard to the brass rods, I had intended (in following out Spon's directions) to have two brass rods running round the sides of the vessel one above the other, one for positive and one for negative, the brass bars for supporting, with room between for the brass stair-rod to lie across on the lower one, without touching the higher, on which were suspended the articles to be plated, the anodes being supported on a brass rod lying across the trough, and resting on the upper wire. If, however, two simple rods lying across the trough from end to end, and joined to the battery, will do so much the better, though I could only have a few things in at a time. I have read the letters you referred to, but could find nothing touching the present question, save the construction of a Daniell cell with which I was already acquainted.—BYSTANDER.

[48129.]—**Steam-Boiler Manhole-Doors.**—At the works where I am employed we use indiarubber joints for manhole doors, putting a strip of brown paper, same size and shape as rubber, between it and the boiler. The joint adheres to the door, and when door is loosened leaves boiler quite freely, without injuring the rubber. When putting door on again just pick off old paper and put on a new strip. The rubber lasts a long time; wet paper to make it lie flat on joint. We use the paper with all joints which have to be disjointed occasionally, such as cylinder covers, &c.—SCOTCH WORKING MECHANIC.

[48129.]—**Steam-Boilers.**—"Steam User's" query is too indefinite to give information upon. He states the boilers are at two pits, but fed with the same water. Is it water from the mine? Is water for both boilers drawn from the same source at the same point? Is feed-water at one or both boilers heated; if so, how is it heated? Sometimes water from a hot well, or from a heater in which exhaust steam from engine mixes with the water will cause corrosion, and sometimes foreign matter will mysteriously find its way into a boiler, cause corrosion, which, although inactive after the corrosive matter has expended itself, would lead an unwary steam-user to think it was bad water. To hold the corrosion in check, be sure no grease, or mineral oils in particular, be allowed to enter the boiler, and try about 2lb. of common washing soda, daily dissolved and passed into boiler with feed-water. If "Steam User" will state full working conditions, I may be in a better position to advise. —BOSWELL.

[48130.]—**Steam-Boiler Manhole-Doors.**—"Steam User" does not say what kind of joint it is. Is it a rough joint (inside door), or is it a faced joint? My experience goes to show that it is not worth while or risk to find out what will stand twice, as the joint failing would necessitate blowing the boiler down, and cost more than several times making. The only material I know of used twice with safety is lead wire or lead rings, and these are only used for good faced joints, and even this will not always stand.—BOSWELL.

[48131.]—**Colouring of Engines.**—On the L. B. and S. C. R. passenger engines, the boilers and wheels are painted yellow, and the tires black, the tenders are the same. The frames are chocolate colour. The lines on the boiler, tender, &c., are broad stripes of green, lined with red and white. The frames have black lines. On the goods engines, the boilers, wheels, tender, and frames are green, and are picked out with black and red.—SPIKE.

[48132.]—**Bacteria in Beer.**—To MR. W. A. THOMS.—My own observations of "stout" confirm those of "Observer," that this beverage is always unusually rich in the various bacterial forms, much more so than ales. But free as "Bass" (to which I am very partial) is of bacteria, I have never examined a sample without finding them more or less numerous. It is the same with all waters exposed to the atmosphere, particularly so just now from decaying vegetation flying about. But to see bacteria in perfection, and to learn how little pathological significance they have, unless in special mediums, and stout and ales as usually dispensed by the publican are not these mediums, try fermented milk, or milk-beer, and especially the richer cheeses while ripening. The cheese ferments belong to the bacteria family. As to the spherical forms "Observer" alludes to, they are probably the young spores of torulæ or yeast. The reproduction of these organisms by "bud" in a fluid medium containing all the necessary elements for healthy development, is only one phase of their increase. They do not bud indefinitely; but after this form of reproduction has reached a certain stage it stops, and the protoplasm resolves into spores, rarely less than four, and there may be more than can be counted. The spores develop in the parent sac till the sac is burst, and they are free. At this stage they are very minute, and more round than oval. An hour's observation of any of the foreign pressed yeasts in a fresh state, in pure water, under a high power and fine light, will show in parts what I mean. Where the brewer carries attenuation too far there is not enough food for the cells to reproduce by this form of free cell formation, and the protoplasm, instead of developing into healthy spores, is disaggregated, and escapes from the sac as bacteria. A fine instance of this sort of bacteria, from fungoid cells arrested in development, will be seen in the zoosporangia of the salmon fungus, Saprolegnia, if a bit of dead fish from where the fungus is seen is put in water for a day or so. Zoospores are not formed in the sporangia after the death of the fish, and the protoplasm may be seen under a low power to escape in a cloud of bacteria. (It escapes in another and more deadly way to healthy fish than as zoospores or bacteria, but at present I have no time to state it.) The rod-like forms, which "Observer" thinks are the factors of putrid fermentation in beer, as without doubt they are, are components of the starved and disaggregated protoplasm of the yeast-cells, or they have their origin in the non-coagulated albuminoids. That they are in the air is beyond doubt, but the aërial forms are powerless in properly saccharated and salinated beers, as usually sold and protected.—W. A. THOMS.

[48134.]—**Water Snail.—To "Scotch Working Mechanic," or others.**—I do not even know what a water snail is, never having heard or seen the name before.—SCOTCH WORKING MECHANIC.

[48137.]—**Barker's Mill.**—Experiments conducted in France lead to the conclusion that, properly constructed, these machines give from 70 to 78 per cent. of the power of the water—say ¾; and let w equal volume of water expressed in lb. per minute, H height of fall, and p horse-power; then $p = (3\ w\ \mathrm{H})\ /\ (33000 \times 4)$. In making one, the branches in which the orifices are should not be straight, as generally seen in toys, but should, by a gentle curvature from where they leave vertical tube to the point, change the vertical movement of the water gradually to a horizontal one, thus avoiding a great loss of force in changing the direction abruptly. They should also be curved the other way; I mean that their plan in a drawing would not be straight, but curved lines, convex side going first when machine is revolving. The reason is, when straight out, like radii of a circle, a considerable amount of the power of machine is absorbed, giving the water a circular motion, whereas, when properly curved, the water flows nearly in a straight line. I am unable to help you further in your query.—SCOTCH WORKING MECHANIC.

[48140.]—**Coil.**—No.—H. STOOKE.

[48145.]—**Cleaning Morocco Leather.**—If you are not particular about colour, the following simple receipt you will find answer your purpose admirably: the yelk of two eggs, white of one, one tablespoonful of gin and sugar, add a little ivory black; this will produce a fine black; use as ordinary blacking.—JAMES PARKINSON.

[48145.]—**Cleaning Morocco Leather.**—Strain leather well over a board and scour with stiff brush, using tepid water and soft soap, made slightly acid, as follows: get a pennyworth of oxalic acid, and use a fourth of it only, dissolve in two quarts of water—if it is any stronger it might take colour out; when done unstrain leather and dry in a cool place; do not saturate leather, but keep board on incline, when dry, rub a little oil slightly over surface with rag.—E. MARTIN.

[48147.]—**Fixing Fretwork.**—If you use the best glue it should adhere firmly; but why not remove the polish where the work has to be secured, say in one or two places, and then you will have no difficulty?—JAMES PARKINSON.

[48148.]—**Harmonium Couplers.**—Does your correspondent "B. J. T." mean octave or manual couplers, or both; and what does he mean by asking what reeds are suitable for a two-manual which he has nearly completed? Surely he cannot have built an instrument without determining what reeds he intends to use. Each manual should, almost as a matter of course, have a 16ft., an 8ft., a 4ft., and half of 8ft.; but private taste must settle whether one of the 4ft. should be a small scale 8ft., and one of the half rows a 32ft. The question is the character of the voicing. "B. J. T." will see that no one can tell him how to arrange his couplers without knowing what his manuals are like, and what he wants.—ORGANON.

[48148.]—**Harmonium Coupler, &c.**—The following specification of an harmonium containing two manuals of 3½ rows each would, no doubt, produce a sufficient variety of tone:—Upper manual, stops: Treble, dulciana, 8ft. soft; hautboy, 8ft. reedy; flute, 4ft.; piccolo, 2ft. Bass stops: Diapason, 8ft. soft; bassoon, 8ft. reedy; principal, 4ft. The selection of the reeds for the lower manual, providing there are no separate pedal reeds, and that the pedals were merely required to bring down the keys of the manual, would be as follows:—Lower manual stops, treble: Clarinette, 16ft. reedy; baritone, 16ft., voiced soft; flute, 8ft., round quality of tone; celeste, 8ft. Bass stops: Bourdon, 16ft.; violincello, 16ft. reedy; diapason, 8ft., voiced less soft than that of upper manual. Two couplers will be required, viz., a manual coupler and a pedal coupler. The construction of both couplers has been explained in back volumes. For instruments constructed on the suction principle, the manual coupler, as explained by "Joiner" on p. 219 of the last volume, is as simple a coupler as I know of.—G. FRYER.

[48150.]—**Zinc Castings.**—These should be made in ordinary moulder's sand. If plaster of Paris is used, it should be mixed with about half its bulk of sand, and, after setting slowly, dried, the zinc being poured whilst it is warm. If any free moisture is left in the plaster, it is certain to cause bubbles and unsound castings.—THOS. FLETCHER, Museum-street, Warrington.

[48153.]—**Removing Stains from Marble.**—Try chloride of lime, applied like paste, and allowed to remain on about 12 hours, or potash and lime used in same way, or all three articles used together: if that does not remove stain, nothing else will. When writing on marble and some kind of stones, never use linseed oil (pure), but thin with small quantity of "boiled oil" and turps, as the oil always runs. As to smearing the marble all over, and then rubbing the waste off, writing as a professional, it is only done by those people who are aptly described as "a man from London," as a good job can never be done in that style; the surface of the marble is prepared with size rubbed over it.—WALLINGTON.

[48157.]—**Gas from Petroleum.**—If this is required for lighting purposes, nothing except gasoline is any use, and a mechanical blower giving a steady pressure is a necessity. Gasoline is difficult to obtain in many places, as, owing to its explosive nature, railway companies will only carry it by special agreement. As to cost, the item of carriage and other incidental expenses cause great variation, but it may be taken as a rule that about four gallons equal 1,000 cubic feet of average gas. There is no rule as to size of generator, but if too small it rapidly cools by evaporation of the gasoline, and the gasoline varies considerably. The larger it is the more uniform the gas obtained.—THOS. FLETCHER, Museum-street, Warrington.

[48159.]—**A Water Question.**—Replace *all* your old iron pipe with lead. No doubt it is corroded, and the flow of the water at one time forces the loose pieces of oxide into a mass, preventing free passage; at another time loosening it, and allow a little better passage, thus causing the intermittent action. This is a common experience with iron pipes, which will not last more than from 10 to 15 years with hard water, and if they are also subject to external corrosion, certain soils destroy them in five years. I can show pieces of iron pipe eaten quite through by corrosion.—M. F.

[48166.]—**Income-Tax.**—Claim for three years. The forms for application, as well as for the needful certificates, you can get from the local surveyor of Queen's taxes, who will also give any required information.—M. F.

[48173.]—**Locomotives.**—To MR. TRATMAN.—I should be very glad to afford Mr. Tratman any information he may desire by giving sketches. Will Mr. Tratman state one or two engines of which he requires sketches? I refer to the engines in my answer to query 47979, in the "E. M." of Sept. 22nd. I cannot give sketches of the tank-engines 798, 695, and 204.—METEOR.

[48176.]—**Platinotype Printing.**—To "Ll.B.A."—The Platinotype Company issue a prospectus containing all essential particulars. If you advertise your address I will send you that of the Platinotype Company. Captain Abney gives a short account in his "Instructions for Photography." The advantages of the system are simplicity, permanency, and the beautiful Indian ink tint of the shades, which do not shine like the silver prints. It is very easy to manipulate, and if over-printed, you have simply to cool the developing solution to correct it. Unless too far gone, I can always succeed in that way.—C. J. R., Ventnor.

[48176.]—**Platinotype Printing.**—I suppose you are aware this process is patent, and you would require a license from the Platinotype Printing Company, which is obtained for the small fee of 2s. 6d. per year. You will obtain all the necessary information desired by writing for a circular. The prints produced by this process are exceedingly beautiful, and are considered far more permanent than silver prints. The paper is floated for a short time on a solution of nitrate of silver, and then dried. The paper then receives a coating of the following solution: double oxalate of potassium and iron, together with a solution of chloro-platinite of potassium. When dry, the paper is exposed under the negative in the ordinary way, and a feeble image, due to the nitrate of silver, is produced. The prints are then developed until they appear in full force, and fixed with hyposulphite of soda.—James Parkinson.

[48177.]—**French-Polishing.**—The best filling, to my mind, is tallow, well washed in several hot waters; but for different kinds of wood, and also for different qualities of the same wood, you must add plaster-of-Paris and colouring matter. A plain, simple, stopping is plaster-of-Paris and water; but if "Ll.B.A." wishes to make a good job of any French-polishing, I would direct his attention to two capital articles on the subject, which appeared in Vol. XXXII., pp. 175, 227. They are really worth the whole price of the volume to anyone who wishes to learn French-polishing.—Nun. Dor.

[48177.]—**French-Polishing.**—Fill up with plaster of Paris; then rub all over the work with mahogany stain, which must be same tint as the wood. This will colour the plaster of Paris; when dry, it will be ready for polishing; if this is done in a workmanlike manner, you will not be able to see the plaster of Paris. Or use Wheeler's "American Wood-filler," obtained from Messrs. Fordham and Sons, Curtain-road, London. Full directions are given with each tin for filling nail-holes, loose knots, &c. Make a paste of plaster-of-Paris and the mahogany stain. Let the paste be a little darker than the wood, as it will be lighter when dry.—James Parkinson.

[48184.]—**Leather Bellows for Camera.**—You will never be able to make satisfactory bellows without using two plies of material and cardboard. The operation is simple enough. Why not make something substantial, and then it will last the camera out? I have tried all sorts of methods, but cannot obtain anything to give satisfaction without the two plies of material and cardboard. If you should desire to make one as above, I shall have pleasure in sending sketch of parallel and conical forms.—James Parkinson.

[48187.]—**Glue or Paste for Skins.**—Get a pound of rye flour, put it in a basin, and pour enough boiling water to make a stiff paste. It must be made almost as stiff as ordinary dough for puddings, but not quite. Stir, and beat up well with a stick for three or four minutes, then cover up, and put by for two days before using, when it will be much softer and will stick better. Spread thinly and evenly on back of skin with a stiff brush or pad; this will stick firmly and will not crack.—E. Martin.

[48190.]—**Boiler.**—A friend once told me that when working a leaky boiler in India, away from any means of repair, his engineer used daily to put in a bushel of potatoes, which, when boiled to a pulp, had the required effect—stopping up the cracks.—C. J. B. F.

[48190.]—**Boiler.**—It would be foolishness to attempt to put anything in boiler to stop leakage, as, when working, the fractured parts are continually in motion, stretching and crushing, so that nothing would adhere. The fracture has probably been caused by excessive amount of deposit in boiler; externally fired egg-end boilers should never work more than two or three weeks without cleaning; caulking alone will not do much in this case. Fully describe fractures, and I will advise best mode of repairs. Always avoid bolted patches.—Boswell.

[48196.]—**Small Brass Castings.**—The sand should be damp enough to adhere together without sticking to the fingers, and the patterns should be dusted over with either burnt sand or finely-powdered rosin, the same being used also to make the two faces of the sand part. The best thing to do is to get permission to watch an iron or brass moulder for a few minutes. This will teach more than half a dozen books. If "Amateur Engineer" is anywhere near, I could show him all he needs to know in five minutes.—Thos. Fletcher, Museum-street, Warrington.

The quantity of gas used in London last year, according to the analysis of the London gas companies' accounts, prepared by Mr. John Field, was, in round numbers, 20,230,000,000 cubic feet—which is equal to a bulk of one mile square by 725ft. high, and its cost to the public was £2,911,000.

In a paper read before the Academy of Sciences, Paris, on marsh fevers, by M. d'Abbadie, the author says that immunity from such fevers in bad Ethiopian regions is often secured by sulphur fumigation on the naked body. In Sicily the workmen in sulphur mines on low ground suffer much less from intermittent fever than the rest of the population. In Greece—M. Fouqué has shown—a once flourishing town of 40,000 inhabitants, Zephyria, has been almost utterly depopulated through marsh fever; and its decadence has corresponded to a transference of sulphur mining operations to the east, so that the sulphur emanations are prevented by a mountain mass from reaching the site of the town.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, Carstairs has replied to 29864, 30246.

47560. Barrel Piano, p. 508.
47584. Coil. To Mr. Tolman, 508.
47593. Paper-Making, 508.
47594. Chemical, 508.
47601. G.W.R. Engines, 509.
47602. Turkey Red, 509.
47606. Probable Errors, 509.
47614. Gas Analysis, 509.
47617. Logarithms, 509.
47619. Universal Joint, 509.
47624. Heberlein Brake, 509.
47626. Warping, 509.
47627. Pneumatic Bellows, 509.

47818. Horizontal Windmill, p. 604.
47826. Dandelion Beer, 604.
47832. Nickel Analysis, 604.
47836. Putt's Patent Irons, 604.
47841. Sifting Machines, 604.
47845. Canaries, 604.
47861. Photography, 605.
47868. Deep Sea Cables, 605.
47873. Revolving Shutters, 605.
47874. Plastering Rooms, 605.
47876. Irish J. P.'s, 605.

QUERIES.

[48202.]—**Shive-Making Machine.**—Will some obliging correspondent describe a machine for making wood bungs, and show how the bung is cut out of the board, and how the bevel is given to it?—Shive.

[48203.]—**Fishing-Tackle.**—Would any reader oblige me with the following information?—I wish to know how to soften bone for making minnows for fishing tackle? Also, how to make varnish of shoemaker's rosin for lapping rings of a fishing-rod? Also, how to bronze ferrules of fishing-rod?—Hutton Hall.

[48204.]—**Legal.**—Will Mr. Wetherfield inform me if I can sell a "specific" ointment—not being a chemist or druggist—and if so, must I use the Government stamp on each pot or box? And also take out a license to sell patent medicine? I notice your reply to No. 48027, but do not know whether it applies to my case; because when I lived in the country, I knew a hairdresser who sold and advertised a "Balm of Oldea" for the hair, and the Excise officer "dropped on to him" to use the "stamp," and take out a "license."—R. C.

[48205.]—**Tricycles.**—Can any correspondent inform me what is the best size of driving-wheel for all-round work, not racing, for a rider of, say, 5ft. 6in. height? Also, whether there is any advantage in double-drivers, and the relative value of plain and ball bearings?—Dick.

[48206.]—**Legal.**—September, 1881, I let a house in thorough repair to a tenant on a three years' agreement. January last he complained his study chimney smoked, stating he should leave the house when convenient to himself—by letter denied me admission into the house, and refused to have anything done unless I agreed to compensate him for any inconvenience he might be put to by workmen. Without notice, on the 29th ult., he has removed his goods from the house. I have received a lawyer's letter offering the rent to Sept. 29th last, threatening if I do not cancel the agreement, and release his client, he will claim damages and expenses on his client's behalf, and defend any future action for rent. Can I make him keep to his agreement, and has he any claim against me? He has purchased a house in the neighbourhood.—W. J.

[48207.]—**Legal.**—To Mr. F. Wetherfield.—Kindly advise under these circumstances: A. the father; B. the daughter, who inherits the father's property at his death by will and succession. Now B. is married to C., while the parent of B. is alive. The father, A., after the marriage, has the will altered in the wedded name of B. to have his property, &c., for her sole use, without seeking the consent of B.'s husband. One child is the result of the marriage. B.'s husband, C., dies before the child is of age. Can B., by law, will away any portion of her estate without the consent of her daughter, or suppose the daughter of B. should die before her mother, would the whole of the property revert to the family of the husband of B. at her death?—Rustic.

[48208.]—**Legal.**—To Mr. Wetherfield.—Having signed several bills of sale (unregistered) which have been running during six years, and having paid all the principal and interest by instalments except 10s., which they refused to give me a receipt for, but charged as a fine, I now cannot get a receipt in full of all demands or the securities I signed returned to me, and they threaten to take my goods. Their account appears not to tally with my receipts, which are given by one of the firm or their clerks. Am I compelled to lose my time taking my receipts to them so that they may rectify their books? How shall I proceed to get clear of them?—Nemo Mortalium Omnibus Horis Sapit.

[48209.]—**Regulating Boston Lever Watch.**—I have a Boston lever watch which gains about eight or ten minutes in twenty-four hours, and will not answer the regulator. I should thank any reader to kindly inform me how to proceed to alter the hair-spring.—Amateur.

[48210.]—**Legal.**—To Mr. Fred. Wetherfield.—I should feel grateful for your advice as to the following: Seventeen years ago my father died intestate, having built houses on land bought *for ever*. My mother, having received all rents, and paid all bills during the 17 years, is now dead, leaving a will bequeathing the property on trust to her children in equal shares. My eldest brother died some years before my father, leaving one son lately come of age, who now lays claim to the property. Kindly say is his claim barred by the Statute of Limitation, and is my mother's will valid? And if so, can I, as executor, sell the property as directed in the will, giving each party their share, and the buyer a satisfactory title?—J. Jones.

[48211.]—**Fret-Saw.**—I have one of the cheap treadle machines without blower. Will someone kindly inform me how I can make and fix one, giving full particulars?—Fides.

[48212.]—**Dynamo.**—I have been for some months waiting for the information promised by "Anglo Dane," and in a letter from him on p. 572, August 25th, he says, "I have built a dynamo which does, and has done, useful work for more than nine months;" but as for the particulars he promised, to the best of my knowledge, they have not been given. What I want is a machine to deposit copper at the rate of 1lb. in 24 hours. I should be very much obliged to one who would give me full particulars or reference to any published information that would enable me to make the same. In the *Scientific American Supplement*, No. 161, there is a full description of a small hand machine, with working drawings. This machine is claimed to be equal to six or eight Bunsens. The machine partly described by G. Tolman in "E. M." of June 23, I should think would suit me, if I knew what size and length of wire to use to get the desired effect. I propose to drive it by a weight.—Koening.

[48213.]—**Leclanche Cells.**—I have 2 doz. of these which have become useless. How can I remake them up into cells not requiring a porous pot? Must I have new manganese? Are the old porous pots any use? How do I fix the manganese and broken carbon round the carbon element?—C. H.

[48214.]—**Legal.**—Will Mr. Wetherfield kindly advise on the following?—A. died seven years ago, and by his will left £2,000 upon trust to his wife (who is still alive and receiving interest thereof from the amount invested in the funds). At her death, testator desires the money to be equally divided amongst his three brothers or their assigns. Certain provisions are made in the will in case either brother should die before A., but as such did not happen, I omit the clauses. Two years ago one of A.'s three brothers died, leaving his wife sole executrix and his share to her. Should the first-named widow die first, does a third share revert to the widow of testator's brother, as the executors to the £2,000 contend that the brother who last died could not will to his widow what he had never received, but that the share descends to her children.—Zuma.

[48215.]—**Legal.**—To Mr. Wetherfield.—Kindly give opinion upon the following:—A. obtains a loan from B. upon part of household furniture, as per an inventory upon unregistered bill of sale. Sum advanced and interest repayable by instalments. Upon A. signing bill of sale, B. has ready a promissory note for the amount of bill of sale payable on demand, which A. also signs. A. subsequently has, at three different periods, further advances, each time signing bill of sale, and also promissory note payable on demand. Firstly, what is the effect of an unregistered bill of sale? Secondly, was A. right in signing the promissory notes payable on demand in addition to bill of sale? The amount in all advanced exceeds £30. The instalments have been regularly paid by A.—Doubtful.

[48216.]—**Watch-Case Polishing.**—I wish to repolish plain silver watch-case which has worn dull and is slightly scratched. Have lathe. What materials required, and how applied?—F. W.

[48217.]—**Blower.**—Will "Lockstitch," or some of "ours," kindly give size and how many blades to put in fan to blow a full-sized smith's hearth, and what size fly-wheel to drive it direct to answer as well a double-blast bellows?—Fan.

[48218.]—**Varnish.**—I have some oak varnish, and find it dries too quickly. How can I make it less drying without reducing the brilliancy?—Decorator.

[48219.]—**Boiler-Setting.**—Would any engineering reader tell me which is the best way to set an ordinary two-flue Lancashire boiler, 7ft. diameter, and 30ft. long? Please give all particulars as regards grate area, width of flues, &c., and oblige a—Fireer.

[48220.]—**Binocular Field-Glass.**—Is exterior black polish on brass of these a japan or bronze? How are leather coverings cemented on evenly? What is meaning of twelve lenses and lines?—does it refer to size of object-glasses?—F. W.

[48221.]—**Brush Machine.**—Would "E.," or one of "ours" who has had practical working with the above kindly explain the following?—I have lately been running a six-light Brush machine for charging some accumulators (30 cells in series). I find, however, that when the brushes press on the commutator with the force given them by their natural spring (i.e., without bending them at all), they wear out so rapidly, that when the machine has been running three or four hours the copper wears right through, and the extreme tips of the brushes consequently come off, the part of the machine under the commutator being strewn with copper filings and dust. There was very little sparking at the brushes when in action, so I am inclined to think that the wearing away was entirely mechanical; the commutator was also slightly oiled, and was quite smooth at starting. I then tried bending the brushes slightly, so as to make them press with from ½ to ¾ their original pressure. This was very carefully done, so that there was still good contact everywhere. Now when the machine was driven at 900 revs. per min., not the slightest trace of current could be obtained even when the machine was short-circuited. If, however, the machine was rotated by hand at, say, from 60 to 100 revs. when short-circuited and broken, much flashing was obtained; but when again driven faster, all indications of current stopped. Can anyone explain?—E. C. R.

[48222.]—**Legal.**—Can Mr. Wetherfield kindly aid in the following?—A widow has three sons and four daughters. She makes and signs a will ten years before she dies. Directly after her death another will is brought forward; this latter is written on paper in the handwriting of one of her daughters, signed and witnessed on the day of her death, and leaving the bulk of the property to her daughters. The executors (viz., two of the sons and one daughter) carry out this will. The other son is entirely left out. Can he, by placing the whole matter in the Vice-Chancellor's hands, over-ride this will on the plea of an undue influence being used by the sisters, and also that his mother was not in a state to make a will in the last day of her life, having been seized with a mortal illness in the morning, so that he may obtain a fair distribution of the property from the Court of Chancery? The first of the above wills was made 30 years ago, and the latter 20 years ago. If the other members of the family declare total ignorance of the former will, will this destroy the objections against the latter one?—Cicero.

[48223.]—**Irish Locomotives.**—I should feel obliged for the dimensions of the driving-wheels and cyls. of the following engines:—G.N.R.—Those working the limited mail. M.G.W.R.—The Faugh-a-Ballagh and the Leinster class, the latter with single driving-wheels 7ft. diam., I think. G.S. & W.R.—The mail engines with 6ft. 6in. four-coupled wheels. Also, the 6ft. 6in. express engines of the L. & N.W.R., which are almost identical in appearance with those next proceeding. As to goods engines, the most powerful type on the G.S. & W.R., and on the L. & N.W.R.—More Light.

[48224.]—**Torches for Processions.**—Can some friend tell me what sort of torch is generally used in processions? Are there any different from tow, which I found very unsatisfactory? Are there some made from pine? Any information will be esteemed.—Guy Fawkes.

[48225.]—**Rust from Gun-Barrels.**—How can I best polish the inside of gun-barrels which are a little rusty, the guns being almost new? They are smooth bores.—Breechloader.

[48226.]—**Truss.**—Will some reader inform me of the best way to weaken the spring of my truss? It presses too hard against my body. I find half the pressure is quite sufficient to keep it up.—Truss.

[48227.]—**Automatic Lift Valve.**—I have made a small hot-air engine, which works well, with one detail exception—viz., I use an automatic lift valve to admit air, and when the pressure comes on to the valve, it falls on to its face with a loud noise. I have tried leather, and it takes the noise off, but it so soon burns. Can any reader inform me how to get over the difficulty? Is there a material which will stand the pressure without being affected by the heat? Any information will be gladly received.—Experimentalist.

[48228.]—**Artificial Bird's Eyes.**—Would any of your readers be so kind as to inform me how to make artificial bird's eyes from glass, or a composition that would melt easily in a common fire? I don't want to flux any coloured glass to form the pupils, as I can do that with common paint. The sizes that I want mostly are hawks, 5 millimetres diam. (it must be transparent). I've tried to melt broken glass, but I could never get the half-round form perfect—they all came out in circles. May be it would be better to make them in moulds. If so, be kind enough to mention the material used, and how to make them? I ask this as I'm in a place where they are impossible to get, except by writing to England, and then ten chances to one they would be lost at the frontier.—Cormorant, Ghidigeni, Jod Tulcea, Roumania.

[48229.]—**Locomotives.**—Wanted the principal dimensions of the different types of engines on the Metropolitan, Metropolitan District, London, Tilbury and Southend, North Stafford, Cheshire Lines, Maryport and Carlisle, East and West Junction, and Lynn and Fakenham.—Alaric.

[48230.]—**North London Engines.**—Wanted the dimensions of Nos. 13, 28, 30, 40, 45, 55, 66, 70, 80, 102, 104, 109, 110.—Alaric.

[48231.]—**Dulcimer.**—Would Mr. Fryer (48061) kindly say what kind of wire is to be used for dulcimers, and whether wire of one strength and size would do for the whole of the notes?—J. Marshall.

[48232.]—**Bennett's Tin-Pot Battery.**—I recently made up two of these cells, using, instead of a tin pot, a plate of thin sheet-iron well cleaned, placed in an earthen pot, the zinc in a porous pot which, when filled with liquid, was corked up and paraffined over. Round this was packed iron turnings. The liquid was a saturated solution of caustic soda (commercial about 70 per cent. sodium hydrate). After they had been set up 24 hours, the following measurements were made:—E.M.F., one cell ·58 volt; the other ·33. The resistance of one was about 3 ohms. As these results are not satisfactory, I should like to hear what some who have succeeded with these batteries can suggest.—Ll.B.A.

[48233.]—**To Mr. Lancaster.**—I wish to make a spectroscope with two limbs at an angle, and the prism in the middle. Can I use a prism of bisulphide of carbon? If so, please let me know what cement to use.—Ll.B.A.

[48234.]—**Butter.**—Will Mr. Allen or Mr. Belcher give the process usually adopted for estimating water, fat, curds and salt in butter, and the calculations necessary to find the percentage of the same?—R. J. W.

[48235.]—**Carbonic Acid.**—What is the specific gravity of liquefied carbonic-acid gas?—H. H.

[48236.]—**Iron.**—Have any experiments been made to determine the decrease of the tensile strength of iron when at high temperatures—from 300° F. up to red heat? If so, with what result?—H. H.

[48237.]—**Equatorial Circles.**—I have a small telescope mounted on an equatorial stand with slow motion, but without divided circles. I made some of cardboard, but could not rest satisfied with them, and I now wish something durable and cheap with verniers. Would some of "ours" kindly offer suggestion?—Jack.

[48238.]—**Setting Slide-Valve.**—Will anyone kindly tell me how to set an expansion slide-valve to cut off at half-stroke?—Learner.

[48239.]—**Fret-Saw.**—I have an old sewing-machine (Wheeler and Wilson). Is it possible for me to have it altered to a fret-saw? Its treadle and flywheel are perfect. It is a good strong table, and could stand heavy work.—Nil Desperandum.

[48240.]—**Insulation of Coil.**—Will some one kindly tell me how many layers of paraffined paper I should put on a coil of the following dimensions?—Core ¾in. diam., 8in. long; primary, two layers No. 16 insulated by a layer of resin and paraffin; secondary to consist of 1½lb. 36 silk-covered, wound in two sections. Also, how much spark I might expect from the coil?—A. G. P.

[48241.]—**Preserved Potato.**—How is preserved potato made on a large scale? I mean the dry kind used on board ships.—Highlander.

[48242.]—**Fishing-Rod and Tackle.**—I should be much obliged to anyone who could tell me of a good black varnish for a fishing-rod? Perhaps "M. A. W." could oblige. I should also be glad of a few directions for making trout-flies.—Geo. T. Fleming.

[48243.]—**Worm-Eaten Violin.**—I have a violin which has been shut up in case five months. On taking it out, I find it is worm-eaten. Can any of "ours" instruct as to the best way of getting rid of them? Also, what to fill the holes with, and if the label is of any known maker—

Lion Rampant.
I A G • S.

—T. A. G.

[48244.]—**Electro-Gilding.**—I should feel obliged if one or other of the chemical contributors to the "E.M." would give me a few practical hints on the preparation of the cyanide of gold. I have tried again and again to form the precipitate from the chloride solution by cyanide of potassium, but have, at least, had only partial success—much of the gold apparently remaining in solution. I have been careful to add it drop by drop both strong and weak, but with the same result. With ammonia I succeed much better; but then it gives a dangerous compound, and so better left alone.—An Old Subscriber.

[48245.]—**Burning Ballast.**—Will any reader skilled in the matter kindly inform me of the most approved method of converting clay into ballast, and what proportion and what kind of coal to clay is the best?—Navvy.

[48246.]—**Legal.**—Having bought some land in Ashton Clinton, and desiring to build a dwelling-house with a fence in front, how far can I bring my fence out in front so that I can make use of all the ground without annoying the surveyors of the village? It is an old turnpike road (main) leading from Tring to Aylesbury. Some tell me I must take 15ft. from the crown of the road; others 20ft. from the crown, and then again I am told 40ft. from the hedge or fence at the other side, and some 30ft. from the other side. Please oblige by informing me which is correct.—J. Ryall.

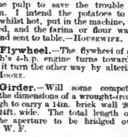
[48247.]—**Model Ship.**—I am about to carve out of a log the hull of a cutter, and want to know whether the sides should be carved to imitate overlapping planks or left plain? Perhaps one of our seaside readers would kindly say which is the case with real cutters of large size, and much oblige—Inland.

[48248.]—**Potato-Mashing Machine.**—Now that the potato crop is so short, and so many small ones amongst them, I beg to ask our mechanical friends to give us (as I have no doubt it would be a boon to others as well as myself, who are fond of a good potato) a description of a small machine that would separate the skin from the pulp to save the trouble and waste of paring them. I intend the potatoes to be first well boiled, and whilst hot, put in the machine, the jackets or rind retained, and the farina or flour warmed again if necessary, and sent to table.—Housewife.

[48249.]—**Flywheel.**—The flywheel of a Clayton and Shuttleworth's 4-h.p. engine turns towards the driver. Can I make it turn the other way by altering slide-valve rods?—R. Moore.

[48250.]—**Girder.**—Will some competent engineer kindly give the dimensions of a wrought-iron girder fully strong enough to carry a 14in. brick wall 20ft. high over an opening 24ft. wide. The total length of the wall is 32ft., and the aperture to be bridged over is in the middle.—H. W. F.

[48251.]—**Astronomical.**—I have a 3 7-10in. achromatic, by Tulley, mounted on a pillar-and-claw stand, with vertical and horizontal rack motion. I wish to mount this in such a manner that its axis may be parallel to the polar axis of the earth, and still I wish the telescope to be carried in and out. To accomplish this end, I purpose erecting a perpendicular pillar, whose top,



A B, shall be inclined at such an angle, that when the telescope is placed upon it, the line C D may be parallel to the polar axis, and I should be enabled to follow an object without using the vertical motion. I should secure the telescope by bolts through the holes in the "claws." Instructions and advice, including the angle at which A B would have to be cut, would be gratefully received by—A Young Astronomer, Sheffield.

[48252.]—**Insects in Fernery.**—Thanks to "Osmundo" for his information. The insects are of three kinds: small green ones with longish legs, small black ones ⅛in. to ¼in. long (like a fine needle-point), and small snails or slugs ⅛in. to ⅜in. long. The black insects are the most destructive. I have tried tobacco-smoke;—it kills the green insects, but does not seem to affect the black ones or the slugs. After one time smoking them, I fancied the ferns were slightly injured, as they drooped for several days. Any information on keeping ferns in good foliage will be thankfully received.—Boswell.

[48253.]—**Spiral Apparatus.**—May I ask Mr. Evans to supplement his welcome article on the "Spiral Apparatus" by giving a list of the different numbers of the change-wheels required for the same? And may I be allowed to return him my hearty thanks for all his kindness in giving us information on this and so many kindred subjects?—An Old Toolmaker.

[48254.]—**Tricycles.**—Could any reader tell me from practical experience if the Coventry Convertible in its single form runs as well as an ordinary Coventry Rotary? Are the footrests for the lady in the Sociable form of the Convertible placed any higher than those of the Salvo, or any front-steerer?—C. W.

[48255.]—**Breaking Weight of Rolled Joist.**—The rule for finding above in tons is, seven times the depth × the area of the bottom flange ÷ length of bearing or span. On comparing results thus obtained with lists published by iron merchants, I find differences which I can only assume to be owing to the method of calculating the area of the flange. Will any reader kindly explain how this is done—i.e., the point of division between the web and the flange?—G. F. B.

[48256.]—**Copyholds.**—Suppose A. buys a piece of copyhold property, and instead of taking it up in his own name, takes it up in the name of B., and then A. dies, and no mention of the said property is made in his will. Who can claim it—A.'s heir-at-law, or B. (in whose name the property is taken up); or suppose the said A. does will the property to some person other than B., who then, is the rightful claimant—him to whom it is willed, or B. (in whose name it is taken up)?—Rip Van Winkle.

[48257.]—**Milky Way.**—Respecting the course of the Milky Way where it crosses Cassiopeia, I find discrepancies existing among maps which I have been examining. I desire to know whether it passes the W in that constellation a little to South, just including *α* (*β*, *γ*, *δ*, *ε*, lying to the north, and completely outside); or *crosses* the W, leaving *α* just outside the southern edge, and *ε* just outside the northern edge; or whether, instead of being *narrow* here (as laid down in some maps) it is really *broad*, and includes *α*, *β*, *γ*, and *δ* (but not *ε*), within its northern border.—Draco.

[48258.]—**Mercurial Gauge.**—What is the correct height of a column of mercury to indicate 1lb. pressure per sq. in.? I wish to make a mercurial standard for testing steam-pressure gauges, and as I shall test up to 140lb., any slight error will be increased in the higher pressures. The nearest approach to accuracy I can make is 2·04in. Can any one say if that is sufficiently accurate?—R. K. Jones.

[48259.]—**Music Bells.**—I have had made to order a three-octave set (37 bells), pianoforte pitch, from middle C, of musical bells, with the special intention of arranging the same in an American organ, which I hope will give effects superior to the steel bars used in the organs of some American makers. I wish to arrange them so as to be used either in combination with, or independent of reeds. What would be best material to cover hammers with, and should they be of metal or wood? According to my own experiments, pianoforte hammers with their thick coating of felt, produce too soft a tone; while metal hammers, on the contrary bring out a tone which is very shrill and unpleasant, and, still worse, develop a number of overtones, which, in the lowest octave, are very disagreeable? Would not wood hammers with a piece of lead inserted in the head to make them heavier, and a thin covering of felt be best? I intend placing bells on an iron rod, the diameter of central holes in bells being ⅜in. Total diameter of largest or C bell, 5in., and smallest about 2in. What diameter should wood washers be between bells, and is wood sufficient for washers without rubber or cloth? Would a table pianoforte action do, whose hammers are usually harder than those of modern cottage pianofortes? Should be obliged for practical advice as to above, and, if convenient, a sketch of arrangement of action to produce the best result.—Musical, Durham.

[48260.]—**Telephone.**—As I am about to fit up telephonic communication between two houses, I should be much obliged to any subscriber of "ours" who could give me a few hints on the subject. Firstly, in the carbon transmitter are "12 contacts" any better than 6? I may state that the distance between the houses is about 400 yards. Secondly, what size induction coil ought I to make, what size core, what sizes of wire, and how many layers, &c., both for primary and secondary? I suppose no contact-breaker is necessary. I should also be very glad of a diagram for various connections. There is one in No. 867, Vol. XXXV., described by Mr. Tolman; but I should like to have the bell, and all the binding screws outside the case with the coil and transmitter inside. Can it be arranged to ring the bell at other end by merely pressing an ordinary push-button instead of moving a lever which breaks one connection while it makes another. This latter must be less neat than an ordinary push. I have a pair of bar-magnets for the receivers drilled and tapped at the N ends. Must the bobbins be wound in a particular direction, and must they both be wound and fixed on the magnets in the same direction. Is it advisable to have the movable contacts on the switch-board tipped with platinum? Is it easy to make a Gower telephone? And, if so, is it possible to dispense with call-bells? I think if someone would kindly answer these rather numerous queries, I could set to work at some part of the apparatus soon.—Cantab.

[48261.]—**Steam Heating.**—Would some subscriber of experience kindly give me description, with sketch, of a good boiler for low-pressure steam heating for a private house, such a one as could be made at an ordinary machine shop?—Ontario.

[48262.]—**Electro-Plating Solution.**—Will "Os" or someone kindly tell me how to get the silver out of solution, spoilt by paint or grease? "Os," in reply to query this week, says, "You can get the silver," but don't say how. I know it can be got by an evaporating pan, but that is not practicable in my case, and twenty gallons of solution means a lot of money to waste.—R. M.

[49263.]—**Home and Garden Carpentry.**—I for one am delighted that the English Mechanic is condescending to take up these matters, and that "J. L." and "Jack of All Trades" have opened the ball so gracefully and instructively. Testator dejoineth these writers can be understanded of the people. I write now to express the hope that they will in due course favour your home-loving readers with descriptions in their simple practical style of how to go about the construction of a garden frame, a fowl-house and run, a wooden stable for goat, pony, cow, or ass, and, eventually, perhaps of a greenhouse.—Domestic.

[49264.]—**Dreaming and Unsound Sleep.**—I should feel grateful, and, doubtless, so would many other possibly equally-tried readers, if Dr. Edmunds, or any correspondents who have been interested in the matter, and have now in any degree overcome the difficulty, would kindly specify in your columns the best measures for securing sleep of sound refreshing quality, and for avoiding dreams and mental excitement in sleep. The whole subject is well worth more than a brief reply, and, if the details cannot conveniently be discussed in this paper, which, however, is wont to touch on all matters of interest to human toilers and seekers after knowledge and truth, reference could perhaps be given to reliable works which not only describe the sufferings alluded to (I know them too well), but indicate hopeful means of relief or recovery. Food, discipline of the will, exercise, occupations, recreation, [illegible] and such like experience has taught, demand one's consideration. Hints bearings on the regulation of these must needs be acceptable to a large body of the community. Medicines to give tone to enfeebled nerves might be of value, but the benefit therefrom is generally temporary merely; sound habits, combined with mental, moral, and physical control, seem to be of most essential importance. As to my own case, I am aged [illegible], married, and do sleep fairly well as regards quantity, but the quality is sadly at fault. Avoiding to the utmost mental, social, and personal disturbance during the day, nevertheless nearly every night all sorts of adventures, discourses, and labours have to be undergone, and on the following day I am correspondingly depressed and fatigued. I take nothing after seven unless a glass of milk, and eat moderately at all three meals, abstaining now from tea and coffee, and all known stimulating and indigestible articles. My nervous system has in the past been largely taxed, but I am very anxious to live a healthy life, and this does not seem possible without sleep of an improved quality.—[illegible]kalm.

[49265.]—**Ventilation of Workshop.**—The firm where I am employed have a very hot workshop that receives its fresh air only from the top of the windows. If taken midway in the window it would greatly interfere with work, but by cutting through the woodwork level with the ground this would be avoided. To ventilate this they have introduced a large blower which sucks in the air by a perforated tube along the ceiling, and sends it out up a high disused chimney. We believe that the cold air passes from the top of the window direct to the tube and so away, as the heat seems in no way affected by the fan. Would the cutting of holes level with the floor as suggested above alter this? Or, will it be necessary to alter the tubing so as to blow in fresh air instead of sucking out foul?—Taxis.

[49266.]—**Cutting Cotton Cloth.**—Can any Lancashire reader tell me of a quick [illegible] machine that would cut cotton cloth [illegible] of from 6in. to 3in., in lots of several [illegible] length? If no such machine is in use, any [illegible] would oblige.—Taxis.

[49267.]—**Contact Series.**—[illegible] give the contact or electromotive [illegible] in solutions of common salt and of [illegible].—Mon.

[49268.]—**Potash.**—1. Will any [illegible] give the proportion of CO_2 in [illegible] of caustic potash? 2. What percentage of sulphates and chlorides are usually present in commercial potash or pearlash? And how can the sulphates be removed? 3. Is the formula K_2CO_3 correct for carbonate of potash? If so, what has become of the H of the KHO? 4. Does solution of potash absorb CO_2 to form a bicarbonate?—Mon.

[49269.]—**Power of Engine.**—Can any of our readers answer me the following questions?—I have charge of a horizontal engine [illegible] by [illegible], cuts off steam at half-stroke, boiler pressure 80lb., slide-valve and piston in good order. If my steam drops to 75 the engine is too slow for her work. Speed, 80 revs. per minute. What power will she be at the pressure given? And, can I make any improvements in her?—Flour Mill.

[49270.]—**Locomotives.**—Will "Perth" or any other reader, oblige with a few notes on the different classes of engines used on the Scottish North Eastern, Scottish Central, Dundee and Perth, and Edinburgh, Perth, and Dundee Railways, before the acquisition of the first three by the Caledonian, and of the last by the North British Railway?—G. H. F., Edinburgh.

[49271.]—**Boiler.**—I have an upright multitubular boiler 7ft. by 3ft., with 27 tubes in it, and I am greatly annoyed with the tubes choking up with me. Sometimes it will not steam two hours till the tubes are quite full. I think the tubes are too small, being only 1½in., and large one 1¾in. inside. Would any of "ours" give me their opinion what they think I should do with it? Would it be better to take out the tubes and put in new plates, and run the funnel down to the dome above the fire? Or, would a jet of steam do under the tubes to blow out the soot that gathers in them? Would feel obliged for any opinions as to what is best to do with it.—C. Weir.

[49272.]—**Magnesium Lamp.**—To Mr. Lancaster.—If you would give drawings or instructions to make your magnesium lamp for taking portraits at night, you would confer a great favour.—Alex. Morrison.

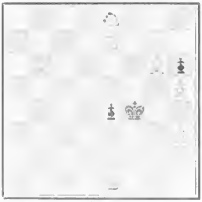
[49273.]—**Lighting Gas by Electricity.**—Will some reader inform me how to light gas by a current of electricity, whether by dynamo or battery, and what would be about the cost of same to light ten lights. Distance to furthest light about 150ft.—Puzzle.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXXIX.—By J. P. Taylor.

Black.

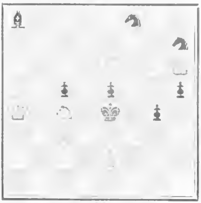


White.

White to play and mate in two moves.

PROBLEM DCCXC.—By S. Schett.

Black.



White.

White to play and mate in three moves.

Solution to 785.

White.	*Black.*
1. Q to K B 7	1. Anything
2. Mates	

Solution to 786.

White.	*Black.*
1. B to Q B 3	1. Kt to K Kt 5
2. B to Q Kt 4	2. Anything
3. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solution to 785 by "Schmucke." In 783 there should be a B P at Q Kt 5.

Mr. J. Mainwaring has joined the Game Tourney, making the number twelve. The first prize will now be £1 15s.

We have received a notice from the Troicoupian Chess Club drawing attention to a general meeting that was recently held, at which the following resolution was unanimously passed: To invite the co-operation of all the Chess Clubs of the United Kingdom in a scheme of federation for the purposes—

(1) Of organising an international tourney to be held in this country next year.

(2) To promote annual Chess Tournaments throughout the country, and otherwise contribute to the interests of the game.

The Club proposes to convene a meeting of the Clubs willing to co-operate in this scheme, to which meeting each Club shall nominate one representative. The Troicoupian guarantees a first subscription of not less than £10 to the funds of the association, if formed, or otherwise, towards the expenses of any meetings that may be held for its promotion. Provincial Clubs may, if they prefer it, nominate members of Metropolitan Clubs to represent them at the preliminary meetings. Subscriptions in aid of this object should be sent to W. R. Mumford, Esq., 22, Sandland-street, London, W.C.

Game recently played between Mephisto and an amateur:—

(Allgaier Gambit.)

White. (Mephisto.)	*Black.* J. L. W.
1. P to K 4	1. P to K 4
2. P to K B 4	2. P takes P
3. Kt to K B 3	3. P to K Kt 4
4. P to K R 4	4. P to Kt 5
5. Kt to Kt 5	5. P to K R 3
6. Kt takes P	6. K takes Kt
7. P to Q 4	7. P to Q 4
8. B takes P	8. P takes P
9. B to B 4 (ch)	9. K to Kt 3
10. B to K 5	10. Kt to K B 3
11. Castles	11. B to Kt 2
12. Kt to Q B 3	12. B to B 4
13. R takes B	13. K takes R
14. B to K B 7 and wins.	

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 11, and unacknowledged elsewhere:—

H. Blackham.—S. Martin.—J. Devey and Co.—J. and T. Greeves.—Rev. F. Carre.—W. J. Fahie.—S. Nicholls.—Jones Bros.—A. Monckton.—W. Wright.—H. Ash.—A. E. Oakes.—J. C. Montgomery.—J. Archibald.—W. Granger.—Aquarius.—W. Robinson, jun.—W. W. K.—Old Subscriber.—A Fellow of the Royal Astronomical Society.—Nelson.—F. R. C. S.—J. C. B.—Spike.—Il Penseroso.—Salicet.—Bruised Mechanic.—A.—S. C. W.—H. W. W.—Amateur.—Jack of All Trades.—Sydney Everhead.—L. L. L.—W. H.—Glatton.—E. H. E.

J. C. Newbould. (See recent back numbers for small electro-motors, and the index published Sept. 22.)—F. T. Bidlake. (Only by means of measuring instruments—galvanometers or rheostats. Explained in most textbooks.)—Subscriber. (Longmans and Co., Paternoster-row, E.C.)—Learner. (You do not mention any special metal; but you will find full directions in back numbers. The parts should be clean, covered with a paste of borax, into which the pieces of spelter are stuck. Then heat, and the spelter runs into the joint.)—Tarbox. (Double-boiled oil and vegetable black applied in several thin coats. If tarpaulin, boiled Stockholm tar thinned with whale oil. See several recipes in back volumes.)—X. Y. Z. (Answered many times. See index published Sept. 22, for instance.)—W. Jones. Fuse 46 parts prussiate of potash, 32 sulphur, and 16 of pure carbonate of potash in a crucible, keeping just short of a red heat. Dissolve the fused mass in water when it has cooled, and filter. To this solution add a solution of nitrate of mercury as long as precipitate falls. Filter again, but this time secure the precipitate, which is to be washed in several waters, and when nearly dry rolled up into little balls, which should be inclosed in thin tinfoil.)—F. Bill. (See p. 133, No. 912, and the indices generally.)—M. W. G. (Such a frame is of use only for keeping plants, not for raising cuttings, except of hardy plants. Several have, however, been given in back numbers.)—A. D. Gibson. (Electroplating with brass fully described in No. 895, p. 441. Tin-plating by the electro process is not only possible, but is actually in work commercially.)—Dandie Dinmont. (Have you tried any of those given in back volumes—soapmaking by the cold process?)—W. Newbould. (For the first, see a reply on p. 601, Sept. 1, Black Shellac Varnish. 2. There is an article on "Japanning and Japans" in No. 899.)—Fireman. (See pp. 19, 43, 73, 97, 272, Vol. XXX.; p. 77, Vol. XXVI., and many other pages in back volumes; but if you wish to practise the art you should purchase one of the small manuals, which can be had for a few shillings.)—A Would-be Maker. (There cannot be much doubt as to the position; the one horizontal, the other vertical at back. See p. 100, Vol. XI.; p. 150, Vol. XVI.; and p. 219, last volume, for sketches which will help. Such an instrument would weigh about a ton.)—Matriculating Student. (Get the "Calendar" of the University, and inquire at the College about the classes. Sometimes advertised in such papers as the *Athenæum*.)—Camomile. (We believe the machinery for turning 120-ton guns is actually in existence, and the officials are quite prepared to turn 200 guns when wanted; but as to that being the weight of the lathe, we know nothing of it, as the "lathe" used for the purpose is very different from the ordinary engineer's tool.)—Pan. (Collard, Pratten, Carte, Boehm, Radcliffe all have their advocates, as you will find by looking through back volumes. We do not understand the other questions.)—Philo. (Recipe in most cookery books. Mushrooms are salted, and the liquor draining from them is boiled with spices, &c.)—Barium. (Use sufficient drying oil to make a stiff paste.)—J. R. D. (No one can offer any useful advice without knowing what is the matter, and that could not be ascertained without sounding you. Surely in Glasgow you have no difficulty in obtaining competent advice.)—Brake. (There are plenty of brakes available; but the companies do not utilise them. We do not gather much information from your letter.)—Beta. (It might minimise the damage, but we fail to understand how it could affect the risk of explosion. 2. See recent back numbers.)—E. W. P. (There are several firms who supply small plant for making gas; but without knowing what is meant by "small quantities," we cannot assist you. 2. See the index recently issued for information about electro-motors.)—Manufacturer. (There are several water-meters which register with approximate accuracy. In the *Engineer* of Feb. 3, 1882, is an illustrated paper read at the meeting of the Institution of Mechanical Engineers, which will, perhaps, give you the information, or help you to a choice.)—Aqua Pura. (You want a double tank, one portion to receive the rain-water for settlement, from which it can be drawn into the store tank through a bed of sand and gravel. The first part of the shower should be allowed to waste, and it will wash the roofs and gutters clean. The spout leading the water to the tank is fitted with a valve, a balance weight, and a lever carrying a can, so arranged that the water, after washing the roof, &c., runs over the valve into the can. When the latter is filled it becomes heavy enough to pull open the valve, and the water then runs into the tank.)—John Robinson. (Place the shucks in a pan with water and plenty of salt. About two quarts of water to a bushel of shucks. Stir frequently, bruising the shucks, and after ten days or a fortnight, strain off the liquor and boil with suitable spice. Some add shallots or garlic. Most cookery books give several detailed recipes.)—R. A. W. (We do not know. Perhaps there are some published in that country.)—S. O. B. (Put them on the hand and rub over with a bit of sponge and benzoline.)—V. A. B. (Apparently a German bank token. We cannot afford to engrave illustrations of old coins.)—Locomotives and Mathematical Questions. (The increasing pressure on our space compels us to beg of readers to be sparing with mathematical queries and queries about locomotives. Both occupy much space, and are of but limited interest. We do not grudge space to mathematics when the subject is really important, but mere problems, often taken from textbooks, are an unwarrantable tax on our space and on the time of readers who are kind enough to send replies of which we can only use one or two. Similarly, with engine queries, we do not object to give queries and replies about the construction of locomotives and their accessories, but we must in future decline to insert mere lists of numbers, names, stations, and the like.)—E. T. Scott. (We have long since described the machine. We are not so sure of its safety as you seem to be, and do not think it easy to learn.)—Anxious Father. (There is no need for anxiety. The boy will outgrow the habit, but probably not for a few years. We are watching a similar case, due to the same cause. Give little or no drink at teatime, and take care to wake him when you yourself retire to rest.)—A. H. K. (1. Yes. 2. *Is* she a monthly tenant? It is much more probable that she is a yearly tenant, and that the landlord is right in demanding six months' notice, terminating at the time of year at which the tenancy commenced.)—Weakness. (Have patience, and give yourself time to get strong again. That really seems all you require to do.)—P. (Quite correct, as you surely must see for yourself if you think a moment. "The wheel question" has long ago been discussed in these pages.)—Electator. (1. Answered in many textbooks. 2. It is a matter for experiment. It is described as a constant battery in the article, and would, therefore, last until the zinc was worn out.)—H. C. B. (Add a paste of lime and water to it, stirring well. See pp. 457, 507, last volume, where full directions will be found.)—Forest. (According to the individual merits. 2 The flageolet. It depends on whether you can read the music.)—H. C. B. (Try Leroy's composition, advertised on front page. It has answered well in many similar circumstances.)—One in a Fix. (There is nothing to be said about it. They must be either filed or scraped into tune. There is no machine for tuning them, unless the trained ear and skilled fingers of a tuner can be regarded as a machine.)—Young Jeweller. (Special pincers are made for the purpose; but many operators use a stout needle, pinching the lobe well first. A piece of cork is placed at the back.)—Fanlight. (By making a scratch on the surface. 2. Take it off with a soldering-bit, and then apply sulphuric acid.)—R. K. Jones. (You really want a table with a supplement to correct for changes in atmospheric pressure. We insert query, as some of our readers may know where such is to be found. Your result is close, but it is usually given as 2·035; one atmosphere, or 14·7lb., being capable of supporting 29·9in. of mercury, but as the weight of the atmosphere varies, so also does the height of the column of mercury.)—An Amateur. (Model moving vessel and sea in No. 851, p. 456.)—A Would-be Engineer. (You should have consulted Molesworth's "Pocket-Book." The area of a safety-valve varies, but a rule is to make it ·006 of the area of the firegrate. For finding weight, all you have to do is to find the number of square inches in the valve, and then weigh that and whatever you put on it.) W. T. Braham. (Noticed on p. 54, Sept. 22.)—Inquirer. (See the indices for several replies on the subject.)—E. J. S. (Not suitable for the purpose, but excellent for bell-ringing, telegraphing, &c.)—E. S. (You can only expose them to a damp atmosphere, unless you can plane the wood off the back.)—D. M. M. (Saunier's "Watchmaker's Handbook," Tripplin, Bartlett's-buildings, E.C.; Britten's "Watch and Clockmakers' Handbook," Kent and Co., Paternoster-row, E.C.; also Sir E. Beckett's Book on Watches, Lockwood and Co., Stationers' Hall-court, E.C.)—E. S. Bruce. (We should prefer notes of the lecture.)—D. P. Glasgow. (See Lockwood and Co.'s catalogue, 7, Stationers' Hall-court, E.C.; and Spon's catalogue.)—Young Springmaker. (It is a matter for experiment, as any information of the kind is scrupulously guarded in the workshop, and especially as regards the smaller sizes.)—William Boyd. (You will find an article by Mr. Wenham on p. 629, No. 468. Since that was written, improvements have been made; but in principle the process consists in heating the plates, which "crystallises" the tin surface, and that is brought up by immersing them in a mixture of nitric and hydrochloric acid, equal parts, diluted with five times its bulk of water.)—E. M. (Write to Mr. T. Fletcher, of Warrington. We doubt if any one can serve you better than he.)—G. B. T. (No space to spare just now.)—E. J. R. Webb. (1. Yes. 2 We do not know. 3. Yes.)—Lockstitch. (We agree with you generally, but think we must wait a little before inserting more about the matter.)—Youth. (We cannot discuss the validity of telephone patents; but we expect they *will* be discussed elsewhere one of these days, and to the astonishment of a good many people.)

T. G.—One in a Hurry.—R. J. B.—T. Goldsmith.—Your queries can only appear in the "Sixpenny Sale Column." Please read "Hints to Correspondents," and especially Hint No. 4.

Engineman.—F. A.—H. Stooke.—Firer.—Phaeton.—E. W. W. T. W.—Carstairs.—W. A. W., have replied to queries already similarly or adequately answered.

USEFUL AND SCIENTIFIC NOTES.

◆

In a paper read before the British Association, by Mr. W. Sugg, on "Gas-Burners," the author said:—"One point of great importance in the construction of a gas-burner is, that the gas should not be heated until it arrives at the point of ignition. The body of the chamber below the point of ignition must, therefore, be made of a material which is a bad conductor of heat, so as not only to prevent the undue expansion of the gas before it arrives at the point of ignition, but also to maintain the heat in the flame. Sir Frederick Bramwell pointed out, some time since, that the important point in the proper combustion of gas is not so much to keep the gas cool as to keep the flame hot; and a non-conducting gas-chamber performs both these important functions."

The street lighting on the large scale by electricity in New York has already greatly increased the consumption of gas. The quantity of light in houses and shops which was previously sufficient no longer satisfies.

There are already thirty electric light companies in England, with a capital of over £6,000,000. The number in France is less, but the capital represented is nearly as great. There are over fifty companies in America, and the capital is considerably over £10,000,000.

The rumour that the German Government has now begun to devote serious attention to the project for the construction of a canal connecting the North Sea with the Baltic is said to be without foundation. Since the report on the subject by Lieutenant-Colonel Vogel von Falkenstein, the Government has taken no steps in the matter.

The second International Electrical Conference is to be opened in Paris on the 15th of this month, a subsidy of 90,000f. having been granted by the French Government towards that object. The principal aims of the Conference are to make experiments with a view to determining electric units, to fix upon methods of observation for atmospheric electricity, to gather statistics relating to lightning conductors, and to fix a definite standard of light.

In a paper entitled, "Study on the *régime* of the Maritime Loire," read before the Paris Academy of Science, by M. Bouquet de la Grye, the author says that between Nantes and Saint Nazaire there is deposited annually about 590,000 cubic metres of sand and mud. The volume of the channel has diminished about 56,000 cubic metres annually for sixty years. The outer bar of the river has risen 0·70m. since 1864, and will probably rise more, presenting a danger for large vessels coming to Saint Nazaire. The author indicates means of bringing the river back to its former constitution, such as replanting, covering slopes with turf, and he suggests a plan for carrying off quickly into the sea the 40 million cubic metres that have been deposited during the last sixty years.

Professor Fresenius has undertaken the superintendence of the manufacture of a new fatty matter, "adepsine," which is obtained from petroleum. It is produced as yellow and white solids, and as a transparent colourless oil. Adepsine is said to be free from acidity, and it is not oxidised or resinified by the influence of the air.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Twopence, at 31, Tavistock-street, Covent-garden, London, W.C.
"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.
Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.
The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

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	s.	d.
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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 5 p.m. on Wednesday to insure insertion in the following Friday's number.

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The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXX., XXXI., XXXII., XXXIII., and XXXIV., bound in cloth, 7s. each.
[Vol. XXXV. Ready shortly.]

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

*** Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the Post Office prevent their transmission through the Post.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Ointment should be well rubbed upon the pit of the stomach and region of the heart in that particular form of indigestion which gives rise to palpitation, shortness of breath, and a suffocation sensation. Every distressing symptom soon yields, digestion becomes easy, the spirits light, and good health returns.—[Advt.]

OUR EXCHANGE COLUMN.

◆

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆

Woodworking Planing and **Moulding Machine**, in good working order, worth £25. Will take Deal Timber in exchange.—T. G., 108, Pool-street, Wolverhampton.

50in. Challenge **Bicycle**, cost £13, in thorough order. What offers? Electrical preferred.—L. Sexton, Borden, Sittingbourne.

Lathe, 4ft. gap bed, 4in. centre, in exchange for a second-hand Tricycle, in good order, or a set of Tricycle Fittings (finished), or what offers?—F. Swingler, Beaconsfield Cottages, George-street, Syston, near Leicester.

Pair of **Telephones** (Bell's), Denny Telegraph Instrument, Electric Bell, pushes, &c. Electric Indicator, any of above exchanged for old lead or brass or tools.—Staves, Low Row, Sunderland.

Howe Treadle **Sewing Machine**, two patent Gas-Fires, complete, quite new. Will exchange either or both for anything useful.—Staves, Low Row, Sunderland.

"**Nature**," Nos. 431 to 582 (except No. 551), in exchange for opera or field glass, or offers. Many numbers uncut.—T. S., 22, Ernest-street, Regent's Park, London.

Wanted, **Tools**. Exchange handsome Wire-haired Terrier Bitch, game to anything.—W. Dawes, Merstham, Surrey.

Lathe, a bargain, equal to new, scarcely used, 4½in. centre, chucks, iron bed, table, and circular saw. Offers.—W. H., Deben Villa, Woodbridge, Suffolk.

Church Organ, 6 stops, including open diapason through, and cornopean. Fine old large scale pipes, open diapason alone worth £10. Exchange, offers.—A. Bucknall, Ynis House, Glais, Swansea.

2½ centre **Bar Lathe**, and several volumes English Mechanic. Offers wanted Lathe Heads, well fitted.—H. Nichols, Grange, Waterford.

Will exchange **Shorthand Works** (Pitman's new, 1881-2). List on application. Stamped envelope for works on steam, engineering, &c.—Fred. Newman, Catherine's Cross, Darlaston, Staffordshire.

Engine and Boiler (one-horse Vertical), in good condition, valued at £25. What offers? London suburban correspondents only.—Day, 36, Driffield-road, Old Ford.

Steam-Engine (Horizontal), unfinished, cylinder bored, bed-plate and flywheel turned. Harmonium wanted. London and suburban correspondents only.—Day, 36, Driffield-road, Old Ford.

Pair of **Lathe Heads**, nearly fitted up, back-gear, 6in. centre. Exchange for Portable Forge, or other tools.—Staves, Low row, Sunderland.

Remontoire Clock Movement, **Pin Wheel Escapement**, would work 3ft. dial. Cash £5, or exchange for Otto Bicycle.—Hannah, 9, Hanover place, Regent's Park.

Wanted, pair **Lathe Heads**, back-geared preferred. Exchange model mechanical Ships, Electric, Locomotive, and Stationary Engines, &c. Send for particulars.—30, Cross-street, Scarborough.

Twelve dozen 6½ by 4¾ **Dry Plates**; four quarter-plate View Lenses, Magic Lantern Condenser, Lens and Lamp, 15 by 12 Copying Camera, Cabinet Burnisher. What offers?—James Parkinson, Warrington House, Southport.

Microscope (small), in case, with 3 powers, and condenser; for Shooting Plane, Corner Cramp, or anything in picture framing.—J. Marshall, 3, Addison-terrace, Addison-street, Wednesbury.

3½ **Lathe Heads**, new, well finished, splendid opportunity. Microscope, Mathematical Instruments, or other offers requested.—H. Chapman, 17, Charles-street, Seymour-street, N.W.

Splendid-toned **Melodeon**, 23 silvered keys, 4 rows of vibrators, 2 stops. Also handsome French striking Clock. Part exchange for Household Furniture.—H. Hammer, 36, Lichfield-road, Aston, Birmingham.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 20, 1882.

THE FOSSIL LIONS OF CHARING-CROSS.

FEW of those who daily pass Sir Edwin Landseer's lions in Trafalgar-square know that not far beneath their feet lie buried the palæontological links in the historic chain which enables the geologist to trace with almost complete accuracy the changes which have taken place in the climate and surroundings of the London portion of the Thames Valley. It is only occasionally, when some exceptionally deep foundations are put in, that the surface gravel-beds are penetrated sufficiently to reach the floor on which the bones of the now extinct animals lie, though the remains of recent and still living species are more frequently met with in shallower excavations. The interesting fossils found at Charing-cross in the course of the operations for putting in the foundations of a new bank have now been identified, pieced together, and named. They are on view at Mr. Rowland Ward's, 166, Piccadilly, and consist of 100 specimens, most of them fragments of the larger animals which, in late pliocene and pleistocene times, inhabited this country. From the more recent deposits, bones of the horse, sheep, and Celtic shorthorn (*Bos longifrons*) have been obtained; while from the pleistocene gravels there are bones of the cave-lion (*Felis leo spelæa*); tusks and bones of the mammoth and extinct elephants (*Elephas primigenius* and *antiquus*); remains of the extinct Irish deer (*Cervus megaceros*); of red deer, and of a species allied to the fallow deer; remains of the rhinoceros and of extinct oxen (*Bos primigenius*). Besides these, various other fossil bones have been discovered at different places, notably at Ilford and in the marshes bordering the Lea at Walthamstow. In addition to the animals above named there have also been found in the London district the great cave bear, the wolf, the hyæna, with musk-ox, hippopotamus, beaver, bison, and others. Although the elephants and the rhinoceros were woolly-haired, the fact that bones of all the above-named animals have been discovered in this country, proves incontestably that the climate must have changed and changed again in a remarkable manner; for although Mr. Prestwich considers that the fauna of the London clay, taken altogether, indicate a moderate rather than a tropical climate, the flora of the same deposit is certainly tropical in its affinities. An examination of a geological map of London shows a surface mainly of gravel and clay, with here and there isolated patches of brick-earth, and to the south-east tracts of Oldhaven beds, with, near Greenwich, a "fault" at which the chalk is thrown up. The vertical order of the strata is as follows, though obviously all are not always present at any given boring:—Alluvium, gravel, sand, and brick-earth (forming the Thames Valley deposits); boulder clay, gravel, and sand (glacial deposits); lower Bagshot beds, London clay, Oldhaven beds, Woolwich and Reading beds, Thanet beds, chalk, the latter being present at greater or lesser depth over the whole London area. To give an idea of the relative thicknesses we may take the figures found when the well was sunk at Meux's brewery. The alluvium, drift, &c., had a depth of 21ft. at the Oxford-street end of the Tottenham-court-road; the London clay 63ft., the lower London tertiaries (i.e., the beds above named), 72ft., and the chalk 656ft. Beneath that are layers of greensand, gault, lower greensand, and some doubtful beds, until a ridge or spur of what is believed to be the Upper Devonian is reached. To show how the thickness of the London clay varies, it may be noted that at the Kentish Town well 236ft. were passed through before the lower tertiaries were reached, while the chalk was only 11ft. less thick than at Meux's brewery. North, west, and south of the metropolitan area the chalk crops out, and forms the boundary line of what is known as the London basin. In this hollow the beds we have above enumerated were deposited during the tertiary and quaternary epochs. The chalk was in all probability formed in a deep and open sea, and was thrust into its present position by one of those violent upheavals of the earth's crust, which in some cases have brought the rocks of the primary epoch to the surface. The Thanet beds are generally composed of a quartzose sand, not very fossiliferous, but containing fish, mollusca, and plants, and having the appearance of being deposited in a shallow sea. Above the Thanet beds are a series of mottled clays, pebble beds, and sands, the fossils of which sometimes indicate estuarine conditions, sometimes purely marine. Mollusca are numerous, and there are many fish remains, but the most remarkable fossils are the bones of turtles and the scales of crocodiles. The Oldhaven beds which are next in order of formation, are mainly rolled flint pebbles set in a matrix of sand, and have similar fossils to the Woolwich and Reading beds. Above the Oldhaven beds is the London clay, which, according to Mr. Whittaker, averages in the neighbourhood of London a thickness of 420ft. The London clay is very rich in fossils, the fauna consisting of crabs and lobsters, mollusca, fish, crocodiles, turtles, and a few mammals. According to Prof. Owen, the number of species of turtles obtained from the London clay at Sheppey alone exceeds that of those now living in all parts of the world. The nature of the stratum indicates a tranquil deposit at a time when the climate was certainly semi-tropical. For how many centuries this deposit went on we cannot tell, for the evidence is not sufficiently marked, and even the line which separates the London clay from the Bagshot beds cannot be clearly indicated, the deposits progressing upwards from clay through sandy clay, loam, and clayey sand to the Bagshot sand proper. The lower Bagshot beds are still to be seen at Highgate and Hampstead Hills, where they form the capping, and the difference in the indigenous vegetation is well shown by the change of subsoil at the lower portion of the Heath. The sea, which deposited the London clay, either became gradually silted out, or was rendered shallow by the rise of the land; and the Bagshot beds, which are practically unfossiliferous, were deposited upon it by the effect of denudation on the older crystalline and granitic rocks. In some parts, notably Brentwood, in Essex, the sand is overlaid by pebble-beds of rolled flints, undoubtedly of marine origin; in others, the Bagshot sands are interspersed with seams of clay, lignite, and iron sandstone, the clay being crowded, as at Alum Bay, with land plants of sub-tropical genera, such as fig-trees of lofty proportions, fig-sycamores, and an aralia, which lent their aid in producing the majestic vegetation of the period. The London basin was then probably dry land, where figs, palms, and ferns flourished, and prepared the district where the sabre-toothed lion, the bears, hyænas, and oxen of two or three species subsequently roamed at will. The action of rain and rivers on the dry land had, however, began to form the natural features of the country, the climate became colder, and then came the great ice sheet which brought to the valley of the Thames rocks and fossils from nearly all parts of England. This period is marked by the lower beds of sand and gravel, and by the boulder clay which indicates the submergence of the land in parts, and, as it is absent on the southern side of the Thames valley, almost complete subsequent denudation. After the glacial period the land was again raised, and the deposits were formed which are known as as the post-glacial drift — gravel, sand, and brick earth, which form the subsoil of London. At that time the river Thames was far larger than it is at present, and the beds of brick-earth and gravel show that it moved with greater energy than it does now. Its surface was probably about one hundred feet higher, and it flowed in immense volume across land which is now at the bottom of the North Sea to join the Rhine as a tributary. In the brick-earth pits at Ilford and other parts, have been found the remains of the cave-lion, the woolly elephant and rhinoceros, the hippopotamus, the musk-ox, the Irish stag, and other mammalia; while in the gravels of the Lea valley, skulls of human beings have been found in company with the remains of the *Bos longifrons*, which has been extinct for more than a thousand years. The fossils found at Ilford, and in several parts of London show that when the Thames deposited the brick-earth, and swept the gravels over its bed, it carried also the remains of quite an extensive fauna, which included the horse and the boar, besides the extinct mammoth and the Irish elk, both gigantic animals compared with the modern representatives of the genera. As mentioned above, with some of the remains human skulls have been found; but the evidence that man was a cotemporary of the mammoth rests mainly on the presence of flint implements in the same deposits, the earliest record of such a discovery being a large black flint, shaped to a spear's point, found with an elephant's tooth near "Grayes Inn Lane" before 1715. (No. 246 Sloane Catalogue, British Museum). When and why the mammoths disappeared and left the Indian and African elephant to represent them, we do not know; but we all but know that vegetation has changed in accordance with the law of the survival of the fittest, and we may assume that the gigantic animals of the past have retired in obedience to the same law. We cannot imagine that they all perished,—as many of those found at Ilford in all probability did—by being overwhelmed in their favourite marshes by a flood which choked them and buried them with river mud, for, in company with their bones are the remains of animals, the descendants of which still survive. The bones of the cave-lion found at Charing Cross are probably the oldest of the relics now exhibited at Mr. Rowland Ward's, and they may be coeval with the first appearance of man, whose antiquity, great as it is, is only as a day in the age of the earth, for, as Mr. Evans says: "When we remember that the traditions of the mighty and historic city now extending across the Valley of the Thames do not carry us back even to the close of that period of many centuries when a bronze-using people occupied this island; when we bear in mind that beyond that period lies another of probably far longer duration, when our barbaric predecessors sometimes polished their stone implements, but were still unacquainted with the use of metallic tools; when to the historic, bronze, and neolithic ages, we mentally add that long series of years which must have been required for the old fauna, with the mammoth and rhinoceros, and other, to us, strange and unaccustomed forms, to be supplanted by a group of animals more closely resembling those of the present day; and when remembering all

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this, we realise the fact that all these vast periods of years have intervened since the completion of the palæolithic period, the mind is almost lost in amazement at the vista of antiquity displayed."

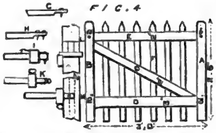
HOME CHIPS.—II.

As that absolute precision required in joinery and in-door work is not necessary in rough out-door carpentry, the axe often takes the place of the plane, and this tool, in practised hands, is capable of producing a fairly level and true surface. The colonist will build a house by means of saw and axe alone, with the help of a good auger to bore the necessary holes for the wooden trenails, which pin the logs and frames. But of all tools of this class, the adze is that of greatest precision. This will face planks or timbers of various curves, with an accuracy which no other chopping tool can equal. It is the universal tool of the Eastern carpenter, and the *sine quâ non* of the shipwright. The home carpenter, therefore, who is but a small edition of his Colonial brother, should by all means take the trouble to acquire proficiency in its use. The tool is like an axe with its blade set at right angles to the handle, but it is of a curved outline instead of being flat, and for heavy work is swung from the shoulder as a centre of motion, and for lighter work from the elbow. The Eastern tool is much heavier, and has a short straight handle, while that of a carpenter's adze is long and slightly curved. The work is very generally laid horizontally, and the workman standing upon it uses the adze with a swinging motion, so as to cut the wood almost under his own toes. I will not say that I ever saw one split a 6d. in that position, though it has often been reported to have been done; but any carpenter will remove very thin chips, and gradually work a plank level, or will cut away larger chips with great precision by giving more swing to the tool. The hand-axe should be broad in the blade; the narrow ones are not nearly so useful. One of 3lb. weight will be found most convenient; but a heavier, long-handled one for both hands will be often necessary, as it answers for driving framework together as well as for heavy cutting. The felling-axe, which is still heavier and with longer handle, need not be included in the list of tools, especially as Mr. Gladstone is about the only amateur who can use it efficiently. We shall get along well enough out of doors if our tool-basket contains a hand-saw, hand-axe, mortise-chisels (1in. and ½in.), firmer chisel 1in. or 1¼in., mallet, hammer (heavy enough to drive a stout nail and without claw), a pair of pincers, chalk-line and reel, two-foot rule, three or four gimlets, a couple of augers, preferably of the old shell pattern, ¾in. gouge (with socket not tang for the handle), a pair of compasses, a gauge, square, and a carpenter's pencil. With this assortment in a strong tool-basket, nearly any outdoor job may be done. Advancing a step nearer to joinery, there may be added a jack-plane, adze, smoothing-plane, and tenon-saw, with a mortise-gauge, which saves trouble, but can be dispensed with for rough work. A bevel is also a very useful tool, often home-made by the carpenter. It is like a square, with moveable blade that can be set at any angle, and will be referred to again in describing details of work.

Whatever the building or other job, it should be well-considered and sketched out on paper before the stuff is cut out; otherwise rafters may prove too short, doorways too wide, or the contrary, and a number of difficulties will crop up in carrying out the work, which would be avoided if reference could be made to a detailed drawing. Neither should the work be attempted until the stock of available material has been overhauled and assorted. These bits of timber set aside for posts, these for rails, these longer and lighter ones for rafters, and so forth, thus avoiding waste on the one hand, and unnecessary labour on the other. Sawn stuff is, of course, always best and easiest to work and fit together; but it frequently happens that rougher material has to be made use of, either round or partially so.

There is no more common necessity out of doors than palings, rails, and gates, and of the latter I will speak first, as affording a very good example of simple carpentry. We will first construct a small one, 2ft. 6in. high and 3ft. long, which would go by the name of a garden wicket. Of course, the actual size will depend on its destined site, but the one drawn is of good proportions. The heel-post A is of stuff 3in. wide; the head-post B 2in.; E, the top rail, 2in.; D, the bottom rail, 3in.; C, the cross stay, or brace, is of the same scantling as B. All these are 2in. thick, and can, therefore, be cut from the same plank. F, the slats, are 1½in. wide, and ½in. thick; a ½in. board will, therefore, supply them. The first thing to do will be to get out the stuff, and in this case it ought to be planed—for, even, if a fence is tarred, it is usual to paint all gates. Try it with square, and the winding strips, and get it all fairly true. I have represented the rails as inserted at about 3in. from their respective ends of the post, the upper one, perhaps, at a little less distance. They are attached by mortising. A good proportion for such is to make the mortise and tenon each ⅓ of the whole thickness of the stuff, and it need not be reduced in the other direction, but may be of full width. L M show how to make a mortise with the square and gauge, the drawing being on a larger scale. The lines at top and bottom, ruled along the edge of the square, are carried round three sides of the stuff, so as to be a guide equally on both the opposite sides of the timber, as most mortises are cut half from each face of the material, the cut finally meeting in the centre. By this plan the mortise will be correctly at right angles to the faces of the wood when so required. The perpendicular lines parallel to the length are usually marked by a gauge, of which there are several kinds. The simplest, G, is made by cutting a rebate in the end of a bit of ash or hard wood, and driving in a small nail or screw, which is then filed to a point. This answers perfectly, but is incapable of adjustment. H is similarly made, but with two points, the advantage of which is that both lines are simultaneously marked, and from the same side of the piece, whereas with the other it must be done first from one side and then from the opposite one. It often happens that the mortise is not intended to be equidistant from the sides of the stuff, and then this tool becomes useless, while that with two points set at the right width is all that is required. These non-adjustable tools are very much used in rough work, and sometimes both ends are rebated on both sides, so that four permanent gauges are made of one piece. Such tools answer particularly well when a number of articles are to be made of exactly similar dimensions, as, for instance, a set of field-gates, or sashes for a house, or doors, because there is then no need to alter the set of the gauge-points. But in very many cases adjustable gauges are a matter of necessity, and those similar to I and K come into use. In the first, which most carpenters make for their own use, the tool consists of a bar of beech, about ¾in. square, or sometimes of elliptical section, upon which slides a head of similar wood, about 1in. thick, and an inch and a quarter square. This has a mortise to fit the rod, and a smaller mortise or square notch cut into the larger one to take a wedge, which serves to secure the sliding head in any desired position. A brad is driven through and filed to a point as the marker, by which lines are scratched upon the wood. K is a similar tool, but more complete in arrangement. The head is held by a side-screw tapped into it, and a second screw at the end is attached to a brass slide, which has one of the points firmly fixed in it. It can be thus gradually drawn down and separated from the other point fixed in the wooden rod. This is a mortise-gauge of best make, generally of ebony, with brass fittings, and the slide likewise moves in a brass channel, bevelled to fit it exactly. The posts A and B, having had their mortises carefully marked out by the gauge and square, are in turn laid upon a stool, bench, or block of wood, and the mortises cut out. For rapid work this is frequently done by the centrebit, with which a part of the stuff is quickly removed, the chisel being subsequently used to clear out the hole and square up its angles. The gouge is another tool which, if of suitable size, will begin such work well and get out the stuff more rapidly than the chisel. Always use a mallet—never a hammer, or you will batter the handles of your tools terribly, and quickly split off large portions. Besides this, your own fingers will be safer, and you can get on a great deal faster. It is usual to begin a mortise about the centre, cutting out a deep notch, which is then expanded by cutting at each end, if the centrebit is not used to begin with. After getting about half-way through the stuff, turn it over and begin on the other side. Keep clear of the lines and work well within them. To cut into them is at once to lose all guide and to make a badly-fitted joint almost a certainty. Leave the parts, therefore, near the lines to the last, and with a sharp chisel pare away the inside of the hole until the aforesaid lines are just visible all round the edge. Sharp chisels, remember, will alone make sharply-defined and accurate tenons and mortises. The tenons are to be marked in exactly the same way, only, of course, the cheek-pieces, or outsides, are the portions to be removed, and for this the tenon-saw is specially suitable. After sawing across the stuff at the end of the cheek-pieces, they can generally be detached by splitting off and paring the wood as they are in the direction of the grain. But try first of all a thin slice, and see if it runs straight; for, if the grain is at all crooked, the whole must be cut away with the saw: the hand-saw, not the tenon-saw, for all cuts in the direction of the grain. Here again, the lines are to be left on the stuff, and if both have been cut carefully, the tenon will just enter its mortise tightly, and fit it closely, without danger of splitting it. Never rest satisfied with a partial fit. The two pieces may show no gap when put together, yet not half the faces of the wood may be perhaps in actual contact, and cannot be, unless every surface is true and quite flat. When the main frame of the wicket thus made is put together, it ought to be not only square at the angles, but quite flat, i.e., out of winding. If it is twisted, it is because the pieces were not planed square and true before the mortises and tenons were marked out. The mortises are not glued in outdoor work, but pinned together,

FIG. 4



and even in this simple operation there is a right and a wrong way, and with the latter, the pin often keeps the joint open, instead of drawing it close. Having put a corner of the wicket together, bore for the pin with a small centre-bit till its point just begins to penetrate the mortise; then draw out the latter and continue the hole on the other side of the mortise, and when nearly through so that the point begins to appear on the other side, turn it over and finish from the latter. This will make a nice cleanly-cut hole without ragged edges on either side. Now take the tenon, which is already marked by the point of the centre-bit, and put the point just a very little nearer the shoulder of the tenon than the mark and continue the hole through it. When, now, the slightly-tapered oak or ash pin is driven in, it will draw the tenon very closely into the mortise, rendering the joint very strong. If the dimensions given here are adhered to, it will be found that the upright slats, placed 3in. apart and nailed on (with 2in. nails which will not quite come through), will leave 1in. of the whole width undivided. This odd inch must be wasted by placing the slats 1-6th wider apart than the specified 3in., or giving the slats themselves a little extra width. C, the diagonal, is an important piece in every such structure, as without it the gate loses much of its stiffness. It is nailed to A and B, the sloping ends being first accurately cut and fitted; the slats are also nailed to it. J. L.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XLVII.*

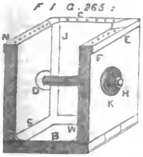
By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 129.)

Stays to Cisterns.

LARGE cisterns—such as 10ft. by 3ft. and 3ft. deep; or say one 7ft. deep by 3ft. wide and 7ft. long—should have stays across the width, and oftentimes across the ends. These stays are nothing more than iron rods passed through lead pipes, as shown at A, Fig. 265, and screwed up with nuts from the outside, as illustrated at K H in the above diagram. When fixing the lead pipes for such rods, let the ends of the pipes just enter the holes of the wood sides, and not to butt against the side, otherwise it will be a troublesome job to get the iron bolt through the woodwork. The ends of the lead pipe should be soldered as at D. Do not wipe the lead to the side when the rod is passed through, it cools the metal too much.

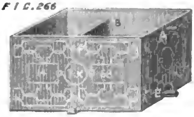
FIG. 265:



Battened Cisterns.

I have already referred to the ancient cisterns, and now propose to give a few lines upon the old battened lead cisterns. Let me, therefore, refer you to Fig. 266. This is a drawing of a good lead cistern, now 414 years old, and in a perfect state of preservation. The size is 3ft. 2in. long, 2ft. 6in. wide, and 2ft. deep; the bottom, sides, and ends are ¼in. thick, with strengthening work as shown in front. On the two front squares is to be seen the date, and on the circle the initials of the maker. Two of the upright corners are wiped up, as also the bottom. All round the joint is rough, but the solder is at least ¾in. thick, and untouched by the action of the water. This cistern was formerly used for rain-water, but latterly for street-supply water. Fig. 267 is another old batten cisterns, but of circular shape.

FIG. 266



This bears the date 1552: it is therefore 330 years old, and in as good condition as on the day it was made. This shape tells a tale that even in those days plumbers knew the strongest form and manner of construction.

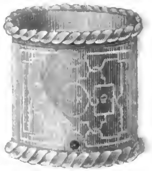


FIG. 267

Modern Battened Cisterns.

Fig. 268 is a modern battened cistern, made by myself in the year 1880, for holding sulphuric acid. The sides and ends are strengthened with raised ornamental work; the substance is ½in. thick, the angles are all solidly burnt up, and it is about 3ft. square and deep, with a lead top, but not soldered. Its weight is 14cwt. 3qrs. 24lb. Fig. 269 illustrates a large battened cistern, cast and made by myself last year. The design, as also Fig. 268, is my own. The ornament gives great strength to the sides; but notwithstanding this I have 18in. plates, 3ft. by ¼in. thick, soldered to the sides at B, and from about E to F, and the ends from G to H, to keep them in their proper shape. This cistern was made for a vault, where it is impossible to be got at, excepting just at the front. It is supplied by a 1in. 12lb.-to-the yard pipe passing through the front at R, and from a small feed cistern fixed some distance away, and level with the top of large cistern. The top of the cistern is covered with a 1¼in. slate slab, and the brickwork is arched over close to the slab. K is the outlet pipe. The reason for fixing the inlet pipe at R is to allow the water to fall into the cistern with force, in order that it will wash itself out when the pipe K is open. Should the pipes burst with the frost (which is not very likely) or otherwise, the pipes can be repaired or newly fixed.

FIG. 268.

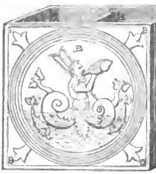
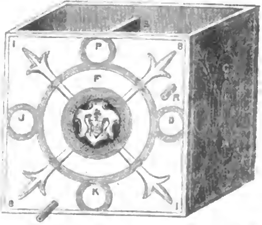


FIG. 269.



For the method of casting these cisterns, refer to the sheet-lead casting, Chap. I. Having the pattern of the front or sides, &c., prepare the sand; but let the bed be much thicker than is required for sheets, in order to allow for the ornamental parts. Say the pattern is 3ft. square: lay it face downwards upon the sand, and well beat it down all over, and perfectly level. This must be done with great care, in order to get the print true and sharp without an uneven surface. After this, two persons must lift the print with the four handles provided for that purpose—the handles are fixed at the four corners—then proceed to cast as though it were sheet lead, leaving the proper distance between the sand and the strike for the substance of the lead.

The best method of casting the ornamental fronts of batten cisterns is as follows:—Take the pattern (say it is 3ft. square with ½in. fillets nailed all round the outside of the pattern, and on the face side)—let it be smooth at the back—lay it flat upon the table, face upwards, as at A 5, Fig. 1. Now sift the sand in sufficient quantity to stand ½in. above the face of the pattern, level the sand with the strike to the level of the fillets, then tread or otherwise beat the sand hard and smooth on what is now the surface; next take what is known as a backboard—this is the same size as the back of the pattern, but this backboard must have a quantity of say ½in. steam-holes, as in the bed of the frame—lay this board flat upon the levelled sand, and keep it firmly pressed upon the sand; now lift the pattern, sand, and backboard altogether, taking care not to shift the backboard or sand from the pattern. Now, the sand is between the two boards, turn the backboard to lay flat upon the bed of the frame, and carefully lift up the pattern, when you will have a good print from the face of the pattern; and, if care has been taken in preparing the pattern with proper fillets suitable to the substance of the lead, you need not again touch the sand, more than just the making up the edges suitable for the lead to flow from the head-pan into the mould, and the surplus from there into the foot-pan. Prepare the stripe to suit the substance of the lead required. Tip or cast the lead a little colder than is required for sheets, and as thoroughly explained in Chapter I.

(*To be continued.*)

BULLOCH'S NEWER "CONGRESS" MICROSCOPE STAND.

IN this journal, Nos. 804, p. 567, and 806, p. 618 (Aug. 20 and Sept. 3, 1880), figures of Bulloch's microscopes—binocular and monocular

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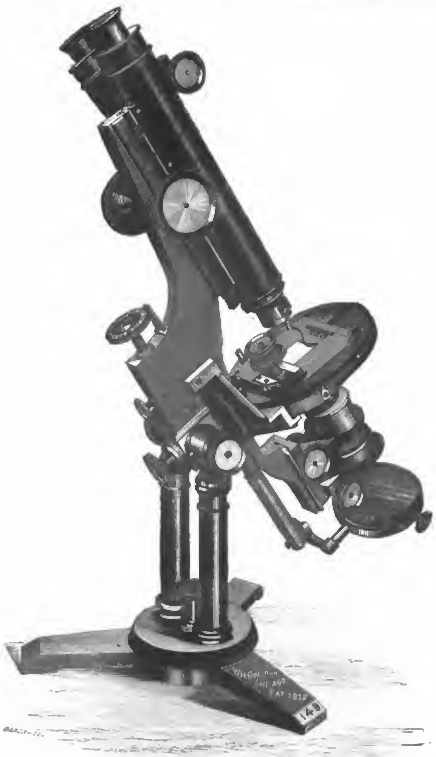

—were given. Sundry modifications in the construction have since been made, which will be understood by comparing the new figure* here given. These modifications may be described under four headings:—(1) Increased strength has been given to the attachment of the stage to the limb; saddle-pieces, forming part of the main support of the stage, now grip the limb on both sides, and aid in rendering the stage more rigid. (2) The mechanical motions of the stage are now controlled by milled heads on the surface, acting entirely within the circumference, so that *complete* rotation can be effected; this system of stage appears to be essentially similar to Wenham's, Watson's, and Tolles', which have been figured and described in this journal. (3) The centring arrangements of the substage have been altered; they are now effected by means of rack and screw movements applied to the shoulder-piece behind the substage ring; the lower ring, as formerly, carries polarising apparatus, &c. (4) A graduation and vernier are applied on the slide, carrying the optical body for recording focal distances, &c.

SIR T. PARKYNS' STEAM TRICYCLE.

SINCE the memorable judgment which decided that a steam tricycle came within the provisions of the Act relating to the passage of traction engines along the high road, we have heard but little as to the progress made with Sir Thos. Parkyns' device. The patentee, however, while endeavouring to remove the legal obstruction to the introduction of a tricycle propelled by steam, has been engaged in improving his machine, and in its latest form it is a steam tricycle pure and simple, capable of running at a rate of about twelve miles an hour. The original machine ran at between seven and nine miles an hour, and had gear fitted for working it by the feet, either separately or in conjunction with the steam engine. The foot gear was also necessary for starting the machine. The invention consists really in the design of the boiler and the general arrangement of the propelling power; but in connection with that several other improvements are patented. The machinery is especially applicable to any of the ordinary forms of tricycle, but is equally available for use on all kinds of velocipedes. The patentee prefers to alter and enlarge the framework of the ordinary back-steered tricycle by placing the hind-wheel a little further to the rear, and in the space between the seat of the rider and the hind wheel he places a tubular boiler for the purpose of generating steam for driving the steam-engine. This boiler is adapted for burning liquid fuel, such as paraffin, rock oil, or other volatile and inflammable oils, methylated or other spirits, in the following manner:—On or near the boiler is a tank containing the liquid fuel, from the bottom of which tank a pipe is carried underneath the boiler. This pipe passes along the bottom of the boiler, and is then bent back in a ⊃ shape, and closed at the end. The top side of the lower half of the ⊃ tube is perforated with small holes to allow of the escape of the gases which are generated in the upper half of the ⊃ tube by the heat of the burning liquid fuel and gases escaping through the perforations in the lower half. A tap on the pipe near to the liquid fuel tank regulates the flow of the liquid. In some cases the liquid fuel is volatilised by placing a small burner under the tank instead of using the ⊃ tube, and the inflammable gases are conducted to the burners. The steam from the boiler is expanded in one or more steam cylinders, the piston rods of which are connected to the driving axle by means of gearing or straps. A surface condenser composed of small thin tubes is also employed.

In the annexed engravings Fig. 1 shows the arrangements as applicable to a front-steerer with foot-gear, the engine being of the horizontal type with two cylinders. In the back-steered tricycles the boiler and condenser are carried nearly underneath the seat, with the fuel tank forming the back, and the engine oscillating at the left-hand side, connected by spur-gearing to the driving axle. In tricycles of the Coventry Rotary pattern (i.e., one large wheel at one side, and two smaller ones at the other running in one track), the boiler and condenser are conveniently carried on the frame, with the fuel tank immediately beneath the seat. Either horizontal or oscillating engines may be used, or a form of rotary engine, somewhat resembling the three-cylinder type. The illustration, Fig. 1, shows the various parts clearly, but is not given as an intimation that it is the best form to which the steam-engine can be applied.

The engines are connected to the driving-axle either by spur-gearing or chain and wheels, the latter being shown in Fig. 1, where B is the boiler, C condenser and water tank, while F is the fuel tank. The boiler is represented in Figs. 2, 3, 4, which are respectively end view, longitudinal, and transverse section (or plan). The hollow metal casing seen in Figs. 2 and 3 is connected by horizontal crosspieces of cast-metal A perforated on both sides to receive the bent tubes B. These tubes, when inserted into the holes on one side of the crosspieces, are fixed by being expanded, and the holes on the other side are then closed by screw-plugs as shown. At D D are holes for attaching a water-gauge, and E is the hole for attaching the inlet from the pump to the boiler.

F F are lugs to which is attached an outer sheet-iron casing to inclose the boiler, and so keep in the heat. G is the steam outlet at the top of the boiler, on which may be fixed a steam-gauge, safety-valve, and steam regulating-valve; H is the inlet-pipe for the liquid fuel from fuel tank or reservoir to the burner; I is the retort through which the liquid fuel passes, and in which it becomes volatilised or converted into inflammable gas, in which form it is conveyed to and burned in the burner K, which consists of a tube perforated with a number of small holes through which the gas passes and is burned, and flames from which impinge upon the water tubes and also the gas-retort I, thus keeping up the supply of gas for the burner. The mode in which the burner is lighted is as follows:—A small portion of spirit or liquid fuel is burned under the retort, which, becoming hot, volatilises or converts into inflammable gas the liquid fuel in the retort, which, flowing into the burner, may then be ignited. In some cases the condenser is carried on the top of the boiler, and in its simple form consists of a water-tank with tubes to condense the steam. The device it will be seen thus avoids the nuisances of escaping steam and smoke; and with rotary engines, similar to the Hodson type, revolving at a high velocity, sufficient power will doubtless be obtained from a minimum weight of engine to overcome the friction of the necessary gearing

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* For the use of this woodcut we have to thank the editor of the *Journal* of the Royal Microscopical Society.

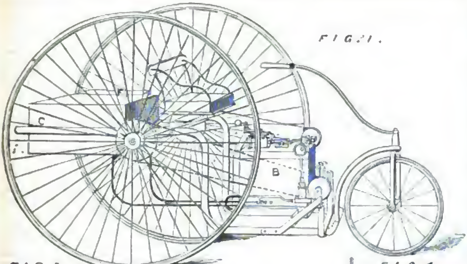


FIG. 1.

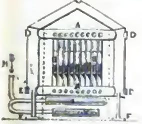


FIG. 2.

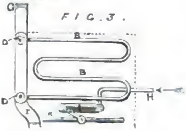


FIG. 3.

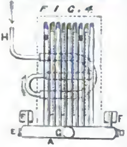
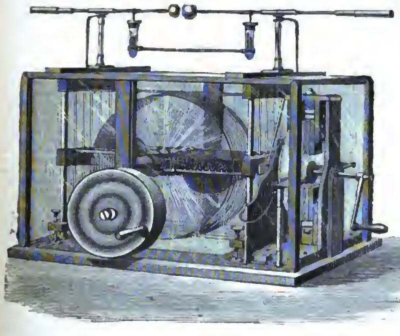


FIG. 4.

and leave a surplus to propel the machine at the speed aimed at. A velocipede with a 5ft. wheel must make in round numbers 350 revolutions to cover a mile, and if that is to be accomplished in six minutes the wheel must revolve about 60 times in a minute. As it is impossible to carry an engine of heavy weight, a motor running at high speed must be used, and the power be transmitted from the crankshaft of the engine to the driving-axle by means of gearing.

WIMSHURST'S INDUCTION ELECTRICAL MACHINE.

ALTHOUGH the development of the electrophorous has proceeded steadily with the advance of electrical knowledge, it has scarcely kept pace with the development of machines for producing current, at all events in recent years. We have, however, had an opportunity of examining an electrostatic induction machine which is certainly much in advance of anything of the kind previously known. The method of developing electricity by the inductive action of a body previously electrified was known and utilised previous to the commencement of the present century; but although several designs had been brought forward it was not until Herr Holtz introduced his well-known machine in 1865 that much attention was devoted to the subject. The Holtz machine and its varieties (see p. 327, Vol. XXIII., p. 80, Vol. XXV., p. 179, Vol. XXXIII.) are all difficult to make and troublesome when made, for in a moist state of the atmosphere it is only by a great deal of labour they can be made to work at all. The Bertsch machine, which consists of an ebonite disc revolved in front of an electrified piece of the same material, is in that respect an improvement on the Holtz, but it is less powerful. Carré's dielectrical machine is a combination of the older and newer forms, an ebonite disc revolving to the extent of about one-third of its surface in front of a glass disc provided with friction rubbers and turning in the opposite direction (p. 116, Vol. XXX.) To obtain successful results with these machines, a comparatively high speed is necessary, and, with the exception of Carré's, a damp atmosphere is productive of a great deal of vexation to the experimenter. The Voss machine, the latest invention of the kind that is well-known, which was illustrated and described on p. 335, Vol. XXXIII., has the reputation of being indifferent to the state of the atmosphere, but its power is limited by the difficulty of multiplying the number of plates. Mr. James Wimshurst, a member of the consultative staff of the Board of Trade, has recently introduced a machine which possesses all the power of the Holtz, if not more, with the great advantage that it is practically indifferent to the state of the atmosphere; and further, can be made at a comparatively small cost. Its inventor is one of the gentlemen amateurs who have done so much to advance science, and the time is not far distant when the name of Wimshurst will be as widely known as that of Holtz. A few machines on his plan have been already made by Messrs. Paterson and Cooper, of Little Britain; but that constructed by himself is probably the most powerful electrostatic induction machine in existence. It consists of 12 circular plates of common window-glass, 32in. in diameter, which run between 24 strips of similar glass, supported in such a manner that the discs rotate freely between them. Twelve of the glass strips rest on bearers at the bottom line of the discs, and the other twelve are supported a little above the centres, leaving room for the passage of the spindle on which the discs are mounted. There is thus little friction of a mechanical nature, except that of the spindle and the paper armatures on each side. It is in connection with these armatures that the great merit of Mr. Wimshurst's invention is found. In the machines made up of many plates different polarities exist in the armatures on the same side, and there is consequently great loss of effect from neutralisation; but Mr. Wimshurst prevents that by connecting all the armatures on one side by a copper wire, which is led to a conductor, and thus forms a handy means of imparting the initial charge to the machine—a small spark sufficing for the purpose, when the machine is properly insulated. At a comparatively slow speed the large machine we saw gave dense bundles of spark discharge in the open air between terminals separated by 7in. and more, and when small condensers were hung on the terminals the sharp cracks of the discharge produced an almost deafening noise. Turning the large wheel of the winch at a slow rate, the machine gave from four to five sparks of three inches in length for each revolution, the line of fire being solid and apparently continuous. Such an experiment is sufficient evidence of the power of the machine, which is a decided advance, and one upon which Mr. Wimshurst, the inventor, is to be congratulated. It is not the least merit of the machine that any ingenious amateur can construct one for himself at a very moderate outlay; and as soon as it becomes known it will find an important place in all the physical laboratories of the world, at any rate, in climates where a damp atmosphere renders the Holtz machine almost useless. The illustration annexed, for loan of which we are indebted to Messrs. Paterson and Cooper, shows an ordinary plate machine added, for the purpose of charging the induction machine; but, as we have said, a simple spark is all that is needed.



ELECTRICAL ACCUMULATORS, OR SECONDARY BATTERIES.*

By PROF. OLIVER LODGE, D.Sc.

(*Continued from page* 131.)

IT is now time to consider the action of ordinarily coated lead plates. Sulphuric acid acts upon most salts and oxides of lead, decomposing them and forming plumbic sulphate. The peroxide escapes this action, but both the protoxide and minium are rapidly acted on when immersed in dilute sulphuric acid, without evolution of gas, but with some generation of heat. The action for litharge is simply,

$$PbO + H_2SO_4 = PbSO_4 + H_2O;$$

but, as litharge has commonly absorbed some carbonic acid from the air, a few bubbles of CO_2 are commonly evolved at the same time; no other action is perceived, and the colour of the powder hardly changes, though it does become a shade lighter. The reaction for minium is not quite so simple—it is this,

$$Pb_3O_4 + 2H_2SO_4 = 2PbSO_4 + PbO_2 + 2H_2O.$$

No adulteration of carbonate is commonly met with in minium, and accordingly no gas is evolved, but the formation of black peroxide makes itself manifest by a rapid darkening of the immersed powder. In either case, therefore, the quantity of free sulphuric acid present in the liquid is diminished, and if plenty of powder is put into the dilute acid, it will in time get reduced to plain water with no sour taste. A cell containing an excess of oxide of lead, and allowed to stand some time with the acid in before charging, cannot therefore be expected to conduct the charging current properly. When, however, oxide of lead—and especially minium—is packed pretty tightly together, it would be a very long time before its interior parts get acted upon much; for though, no doubt, the acid does soak all through it, yet as it is a very clogging substance, there will be scarcely any circulation or renewal of the acid in its interior. The coatings of an ordinary unformed Faure cell will, therefore, consist of a large amount of unaltered minium, together with a perfectly intimate mixture of peroxide and sulphate, the latter occurring more particularly at the outer face and edges.

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* From the *Engineer*.

To such a cell let a charging current be applied, and consider first what happens at the + plate. If the electromotive force available be not as high as two volts, a clogging crust of hydrated protoxide or of sulphate is formed—see page 131; but if the electromotive force applied is about three volts, the hydrogen of the hydrate is removed, and a brown or puce-coloured coat of PbO_2 is at once formed, thus:

$$PbH_2O_2 + O = PbO_2 + H_2O,$$

while some metallic lead is also acted on and apparently peroxidised direct.

As soon as a complete thin coat of conducting peroxide has been formed, the oxygen is liberated at its surface, and is no longer able to reach the lead beneath it, except in small quantities. It therefore is ready to oxidise anything it finds to hand, and a good deal of it in all probability oxidises the Pb_3O_4 direct into $3PbO_2$; some more acts upon the sulphate of lead present, with the help of a molecule of water thus:

$$PbSO_4 + H_2O + O = PbO_2 + H_2SO_4$$

reproducing the sulphuric acid which was absorbed from the solution while the cell was standing idle; while another portion is apt to combine simply with itself, and to rise as gas. The quantity of oxygen which escapes under the last head depends very greatly upon the intensity of the current—that is, on the strength of the current divided by the area of the plate—and by keeping the current weak it may be reduced to a minimum. At the same time a slight escape of gas is not of very great moment, and it serves a useful purpose in promoting circulation in, and therefore uniformity of, the liquid.

I incline to think it most probable that the direct oxidation of Pb, or PbO, or Pb_3O_4, into PbO_2, is not performed until the oxygen has united with itself into ozone; for I have always found that a visible layer of oxygen bubbles is necessary before any peroxide makes its appearance, and that directly any visible gas appears some peroxide is instantly formed.

I have made special experiments to find out whether peroxide of lead requires for its formation an intensity of current above some particular limit; but I find that an exceedingly weak current is still able to form peroxide, though, of course, with extreme slowness. But its presence is unmistakable, from the violent energy of the return current as long as the peroxide lasts. The strength of current used in charging was about a milliampère; the plates were clean bright lead in dilute sulphuric acid, and each plate exposed an area of about 15 square centimetres. The current was driven by two Groves, and it strength was brought down by adding resistance, not by diminishing the electromotive force. This we know is essential whenever peroxide is to be formed. The coat so formed exhibited colour of thin plates, and in about twenty minutes its colour was a greenish yellow.

Beginning then at the surface of the + plate, and spreading out gradually through the mass of stuff with which it is coated, there grows a dense formation of conducting peroxide of lead. It is mainly at the front and advancing surface of this formation that gas is liberated and futher peroxide formed. But the peroxide, though conducting, is slightly porous, and a certain amount of oxygen is being liberated pretty well all through it, so that, if a cavity of unaltered minium should happen to be left, it is not altogether, though it is very nearly, protected from peroxidising action. The minium in such a cavity would probably, however, scarcely be touched until the outer portions had all been acted on; but as soon as this has occurred, and there is nothing more outside to absorb the oxygen, then the opposition electromotive force is so much higher there than it is where there is still an absorbent left, that a good deal of the current may be diverted to the enclosed cavities, in spite of the extra resistance offered by the porous substance in which they are buried.

Now consider what is happening at the − plate. The nascent hydrogen liberated by the charging current against its surface first reduces the slight coat of rust on it, producing a clear metallic surface alloyed more or less with hydrogen gas. More hydrogen, being liberated against this surface, will either combine with itself and escape as gas, or will act on and reduce whatever oxidised substances are in intimate contact with the lead plate. If the current is too intense, some gas will certainly be evolved, but it takes a much stronger current to liberate free hydrogen from coated plates than it does to liberate free oxygen. There is, in fact, always a slight escape of oxygen, whereas it is easy to absorb every trace of hydrogen. The Pb_3O_4 thus gets reduced, first, no doubt, to PbO, then probably to the sub-oxide Pb_2 O, and finally to metallic lead. A growth of metallic lead, therefore, begins at the surface of the − plate, and spreads gradually out through the mass of oxide which coats it.

When lead is deposited in this way *from a solution*, as, for instance, from the acetate, it grows in a fantastic crystalline, or "tree," form, but when it is formed, as above, from an insoluble and closely packed powder, it formed a dense, coherent, though certainly porous, cake.

This is not the whole of the matter, however, for the coating consisted of some PbO_2 and $PbSO_4$, formed while standing in the acid, in addition to unaltered minium. The growth of metallic lead must sooner or later spread into districts occupied almost wholly by these substances, and the hydrogen will be liberated in contact with them. Now the peroxide offers no difficulty: it will naturally be reduced step by step down to metallic lead; but there is some uncertainty with regard to the sulphate. It is certainly *difficult* to reduce the sulphate of lead by the action of nascent hydrogen, and if it exists in even small lumps it usually escapes action altogether. When, however, as in the present case, it is so intimately mixed with other substances which have been already reduced, that every atom of it, one may say, is in contact with a hydrogen generating surface, it is pretty certain that it does become reduced, with the re-formation of the free sulphuric acid which had been absorbed.

We observe, therefore, that during the operation of charging the cell, sulphuric acid is being generated at both the plates, so that ultimately the full strength of the solution is exactly restored; in fact it is a trifle stronger than it was, by reason of the absorption and evolution of the elements of water at the two plates. If the plates have been originally coated with a mixture of minium and sulphate of lead, mixed together with the intimacy of firework composition, fresh sulphuric acid is produced inside the coatings at the expense of the sulphate, in addition to that which had been absorbed on standing. The effect of this is usually to whiten, and sometimes to destroy, the cloth in which the composition is wrapped.

The sulphuric acid in any case produced or reproduced during the process of charging, is apt to sink towards the bottom of the cell by reason of its weight; and, especially if there has been no evolution of gas or thermal or other convective disturbance, it will be found that the solution near the bottom of a nearly charged cell is distinctly more acid than that near the top. The lower portion of the cell, therefore, conducts the current better than the upper portion, and accordingly it is common to find the bottom of the plates most acted on, and I have seen the composition there fully peroxidised and reduced respectively, while that near the top was as yet barely touched.

In an ideally perfect operation, however, the charging should proceed with absolute uniformity, beginning at the surface of the lead plates and gradually spreading outwards as a steadily advancing plane layer, until the free surface is reached; for in such a process the maximum of gas would be usefully absorbed, and the opposition electromotive force would be kept down as low as possible all the time. But it is next to impossible to secure this steady advance by the layer of operation; for besides the tendency to concentration of acid at the bottom of the cell, which tendency may be counteracted by agitation, the layer is very apt to protrude itself capriciously in one or more places; and wherever such a protuberance occurs it is sure to increase, because of the diminished distance between the conducting surfaces; so that a local growth of metallic lead, or of peroxide, is often found to have penetrated through the composition and to have reached the free surface, where it begins to spread out, screening off a quantity of unaltered substance behind it. The oxide so screened can ultimately be acted upon, because the screen is more or less porous, but it is a slow and wasteful process; it takes a pretty high electromotive force, and a good deal of gas is being uselessly evolved from the already completed portions while it is going on.

In order to diminish the chances of this local inequality of action, the thickness of the composition, and distance between the plates, ought to be very uniform, so that there be no thin places to offer less resistance to the current than others. Again, the edges of the plates ought in some way to be protected; for it is well known in electrolysis that the amount of deposit on the edges of a plate is greater than on the flat portions, and for the same reason the growth of the peroxide and reduced lead is pretty sure to be completed first at the edges and thence to spread over the front face, protecting the middle portions.

Finally, the liquid must not be allowed to become stagnant and of different densities. A fairly powerful charging current, by the heat it generates and the gas it evolves, automatically secures the uniformity of the liquid; though this can hardly be considered an economical mode of stirring. I am by no means sure that the plates would not do better if "formed" in a large electro-plating sort of tank, and afterwards inserted in their separate cells for use. When cells come to be made on a large, stationary, gasometer-like scale, various improvements may be introduced in the directions I am indicating, which in the small portable affairs now constructed are scarcely practicable.

THE TERCENTENARY OF NEW STYLE.

ON the 15th of this month three centuries had elapsed since the first adoption of New Style. As the true year does not contain an exact number of days, the object of the Calendar is to let the fractions accumulate, and throw in a whole day at such times as will make the average length of the civil year sufficiently accurate for practical purposes. The device of Old style, by which one day was added every fourth year, made the average year too long. As the civil year thus outstretched the true year, dates got out of harmony with those relative positions of the earth and sun with which they were expected to be synchronous. The spring equinox, which in the fourth century had happened on the 21st of March, was found in the sixteenth century to be on the 11th. The problem to be solved by New Style was to correct this error of excess. Two points had therefore to be arranged. First, ten days had to be dropped from the year; and, secondly, such a plan had to be adopted as would effectually prevent the Calendar from again falling behind. The clock of time had not only to be set, but had to be so regulated as to go right in future. There was, indeed, no such glaring discrepancy as on the introduction of Old Style itself, when a "year of confusion" of 445 days had been necessary before even a fair start could be made. On the contrary, when New Style was introduced in 1582, the error of excess had to be corrected by making that year contain only 355 instead of 365 days. Various endeavours had been made before 1582 to reform the Calendar. Gregory XIII., who had drawn attention to the subject in 1577, was able, on the 24th of February, 1581, to promulgate the Calendar of New Style, since known by his name. He ordained that the day following the 4th of October, 1582, should be known as the 15th. And instead of having every fourth year without exception as bisextile or leap year, he enjoined that those years of which the number was divisible by 100, but not by 400, should be treated merely as common years. Thus, instead of having a hundred bisextiles in 400 years, Gregory had only ninety-seven. On the first Friday morning of October, the folks at Rome, in Spain, and Portugal, and all places that at once adopted the Roman example, found that although they had gone to bed on Thursday night, the 4th of October, they had risen on the 15th, which became the first day of New Style! Its centenary in 1682 fell on Thursday, and its bicentenary in 1782 on Tuesday. This year its tercentenary has fallen on Sunday. In another hundred years it will return to Friday, its original day of the week. This period of four hundred years is the grand cycle in New Style, after which the year of the century, the day of the month, and the day of the week recur together. Instead of the Gregorian plan of having ninety-seven bisextiles in 400 years, it has been suggested that it would have been better to have had eight bisextiles in 33 years, thirty-one in 128, or even seventy in 289. These methods would have given a closer approximation to the true year, but would not have been so easily available for popular use. The refinement on the Gregorian Calendar proposed by Sir John Herschel, by which the years of which the number is divisible by 4,000 are reckoned as common years, is so much out of practical reach that further reference may be excused, not only to it, but also to a somewhat similar suggestion by Lalande.

When the New Style was introduced in 1582, the difference of styles was ten days. This continued till 1700, which in New Style was taken merely as a common year, and the divergence between the styles thus increased to eleven days. The difference of eleven days in the eighteenth century is referred to in one of Hogarth's cartoons, in which the dissatisfaction at the introduction of New Style in England in 1752, on the part of those whom Cowper describes as "bumpkins," is embodied in the placards—"Give us our eleven days." The progressive difference of the styles became twelve days in 1800. This may be seen at present on examining Russian dates, for the Russian New Year is still held on the 13th of January. Were Russia to adopt the New Style to-morrow, she would have to lop off twelve days. Were she to wait for eighteen years, thirteen days would require to be elided, and no further increase in the divergence would occur till 2100. A person born on the 29th of February already finds it rather awkward that his exact birthday only happens once in four years, and the Gregorian device, by which the 29th of February is excluded from rendering intercalary service in 1900, will produce a further complication by preventing many from having their exact birthday from 1896 till 1904. Although the Gregorian Calendar is comparatively easy for popular use, yet, except by reference to the almanac, we may expect considerable blundering about the last day of February, 1900.

The commencement of the civil and legal years, which was formerly on the 25th of March, was altered by New Style to the 1st of January. Scotland was before England in the adoption of this latter date as New Year's Day. At "Haliruid Hous," on the 17th of December, 1599, "the Kingis Majestie and Lordis of his Secreit Counsall," ordained "that in all tyme cuming the first day of the year sal begin yierlie upoun the first day of Januar." "His Majestie and Counsall," although altering the comencement of the year, yet clung to the Old Style, which remained throughout these islands until the 2nd of September, 1752.

THE PROPAGATION OF FLAME IN GASEOUS MIXTURES.

WHEN a combustible, gaseous mixture inclosed in a tube, which is closed at one end and open at the other, is ignited at the free end, the flame is propagated at first slowly, very regularly, and without giving any sound; but after travelling a certain distance, it begins to tremble, its velocity is accelerated and becomes very irregular, and at length one hears a more or less intense sound. These phenomena have been observed and studied by MM. Mallard and Le Chatelier. In a paper to the Paris Academy last year, they described experiments in which they had sought to measure the velocity of propagation corresponding to the initial and regular period of the combustion, and an artifice was described whereby they succeeded in prolonging considerably the duration of that period. More recently they have given their attention to the variable state, which is equally interesting. We propose to give a short account of these researches.

The irregularities were so numerous and sudden, that only the photographic method seemed capable of sufficiently elucidating them. This was accordingly adopted.

A gaseous mixture was first selected, the flame of which is known to have good photochemical qualities—viz., a mixture of binoxide of nitrogen and sulphide of carbon. But the results were such as to encourage the hope that the same method could be applied to phosphoretted hydrogen, sulphuretted hydrogen, and, perhaps, carbonic oxide.

The tube used was about 10ft. in length, and 1·2in. in diameter. The binoxide of nitrogen was saturated with vapours of sulphide of carbon, at a temperature of melting ice. A photographic object-glass threw the image of this tube on a cylinder covered with sensitised paper, and moving with a known velocity. The photographs obtained give a distinct idea of the phenomena.

It is seen, at a glance, that the flame, after having advanced with a sensibly uniform motion, progresses with very rapid oscillations, the regularity, duration, and amplitude of which vary from point to point.

The *uniform motion* was propagated as far as 30in. from the mouth of the tube, i.e., about one-fourth of its length. The velocity was about 44in. per second.

The undulations in the curve further on indicate the *vibratory movement* of the flame, and consequently of the gaseous mass. They have sinusoid forms, indicating a simple vibratory motion, or more complex forms, indicating superposition of several vibratory motions, having, or not having, common periods. The points where the vibratory movement is simple, are generally separated by one or two-fifteenths of the length of the tube.

The durations of the different successive vibratory movements vary from 0·025s. to 0·0034s. They are to each other in the simple ratios of the numbers 1, 2, 3, 4, 6. But no relations were observed between those times and the position of the flame in the tube.

The amplitude seems to be greater for vibratory movements of longer period, but it increases especially towards the last third of the length of the tube; that is, the point where there is one of the ventral segments of vibration of the tube, when it gives the first harmonic of its fundamental. The amplitude may thus become very great; in one experiment it was more than a third of the total length of the tube.

It is remarked in passing, that the oscillations being precisely those of the gaseous sections in combustion, the experiments give for the first time a precise idea of the vibratory movements of a gaseous mass which emits a sound.

To these movements, necessarily, very high pressures correspond. Calculating the pressure from the variations of volume as measured by the oscillation of the flame, a mean pressure of, at least, five atmospheres was arrived at. This pressure, indeed, was maintained only a few ten-thousandths of a second; but during that time it was sufficient to violently project the stopper of the tube, though tightly inserted, a length of 1·2in. We must understand from this what enormous pressures may be similarly developed in very rapid mixtures, with an initial velocity, not of 44in. merely, but of over 60ft., as in the mixture of H + O.

The mean velocity of propagation seems to be accelerated as the amplitude and rapidity of the vibrations become more considerable. The extreme limits of the velocities were in one experiment 3ft. 8in. and 18ft.; in another, 3ft. 2in. and 28ft. 8in. In another experiment there was a production of the explosive wave of MM. Berthelot and Vieille. It arose in the period of the greatest vibrations—that is, at two thirds of the length of the tube. The last third in which it was propagated was completely pulverised.

The brightness of the flame varies during the successive phases of a given vibration. During the return movement the brightness is less than in that of advance. The differences of brightness increase with the amplitude of the vibratory movement. They are, doubtless, related to changes of pressure. It is known, indeed, that the brightness of gaseous flames increases quickly with their density.

The experiments were repeated with a tube ·4in. in diameter. The flame was always extinguished after a course of about 5ft. The vibratory motion commenced much sooner, and the amplitude of the vibrations was increased more rapidly. The mean velocity of propagation, very small at the outset, reached 15ft. at 1ft. 8in. from the orifice, then it was almost completely annulled a little before extinction of the flame.

The narrowing of the tube thus favours the development of the vibration motion, and so all the consequences of this agitation; perturbations in the velocity of propagation, development of more or less pressure, &c.

COAL-GETTING BY THE LIME PROCESS.

THE opening lecture in the Coal Mining Department of the Yorkshire College was delivered last week by the instructor, Mr. Arnold Lupton. Mr. Lupton said that the danger of using gunpowder in mines had long been recognised, and it ought, as a rule, never to be used in any mine, or part of a mine, unless examination had proved the mine to be free from inflammable gas in such proportion that it could not be detected with a safety-lamp. In mines liable to sudden irruptions the use of gunpowder was often altogether prohibited. Twenty years ago it was generally believed that no explosion could occur in a mine unless there was a proportion of gas varying from 6 to 20 per cent. of the mixture of air and gas. This had now been found to be a mistake, for it had been discovered that a violent explosion could take place where there was present only 2 or 3 per cent. of gas, if, in addition to the gas, there was a great deal of dust in the air. All dry coal mines were dusty, and therefore liable to explode, even when reported quite clear of gas, so that in fiery and dusty mines the use of gunpowder was always attended with risk. Consequently, in many mines the use of gunpowder had been either entirely prohibited or only used when most of the workmen were out of the pit. In such mines it was important to find a substitute for gunpowder. In order to estimate the importance of that question, it was necessary to consider what was the cost of getting coal. In ordinary cases coal could be got and put on railway trucks at a cost varying from 3s. 6d. to 5s. 6d. a ton, and of that sum only 9d. was for work requiring powder. What had now to be considered was how that item of 9d. was affected by the disuse of gunpowder. At some collieries the abolition of explosives would cost 1s. 1d. per ton, and it was doubtful whether that amount would be exceeded in any colliery in the kindgom. Having dealt with various processes of getting the coal without the aid of explosives, Mr. Lupton said that the last method to be introduced was the lime process. It had been known for ages that quicklime when mixed with water developed considerable heat and power from expansion in volume. It was not until recently that a practical method of using quicklime for coal-getting was discovered. In this process lime was applied exactly in the same way as gunpowder, only in a much larger quantity, ten pounds of lime being used in a charge, where one-third of a pound of gunpowder would suffice. Having described how the holes were drilled, Mr. Lupton went on to say they were charged with the purest kind of lime, in the form of a cartridge 4½in. long by 2¼in. in diameter. The pressure used was 1¼ tons to the square inch, and the cartridges as soon as made were packed in an air-tight box. Seven cartridges were gently rammed into each hole, which was them stemmed with clay. When the holes were charged, a hand force-pump was connected in turn by a flexible tube, with small tubes projecting from each hole and fitting into grooves moulded on the side of the cartridges. By this means quantity of water was pumped into each hole, a given equal in bulk to the lime. A tap at the end of each tube was then closed, and in one or two minutes the chemical action of the lime and water caused a great deal of heat, which converted the remaining water into steam. The pressure of this steam caused the coal to crack. In a short time, however, the steam either escaped or condensed. Still the lime continued to work and expand, and, on examining the cartridges after they had broken down the coal, it was seen that they had enlarged the bore-holes. About half an hour after the charge had been watered the sprags might be withdrawn, and the coal would come down. This process had been successfully tested in hundreds and thousands of cases in South Wales, Lancashire, Durham, Derbyshire, Yorkshire, Belgium, and elsewhere, and had been approved by many most competent mining engineers. Compared with Grafton Jones's hydraulic wedge, the lime process had the advantage of cheapness, safety, and economy of labour. When, however, the wedge machine was applied with good luck, it could no doubt be worked as cheaply as the lime process; but it sometimes happened that the machine got fixed in a hole, and some trouble was then required to extract it. One advantage of lime over gunpowder was that several cartridges could be working at one time along a considerable length of face, each helping the other; whereas in gunpowder blasting only a single shot was fired. Only an approximate estimate could be given of the cost of working the lime process. Allowing five hours for boring fifteen holes, two and a half hours would have to be given for charging and watering the same number, and in practice the work would have to be done by an experienced collier, paid say 5s. a day, assisted by a lad or a labourer paid 2s. 6d. a day. Supposing, then, that fifteen cartridges broke 1,200 cubic feet, or 40 tons of coal, the cost would be equal to 3¾d. a ton. With gunpowder the same amount of work could be done for 2 1-10d. a ton; but on the other hand, time was lost in consequence of men having to get out of the way while a shot was fired or while the smoke cleared away, and extra deputies had often to be engaged to fire the charges; so that taking into consideration the greater proportion of large coal, the balance of profits might be found to be on the side of the lime process. It must, however, be borne in mind that the process was not applicable where great power was required, in narrow headings, and in stone. The ideal mine of the future was one free not only from gas, but from dust, and in which the use of gunpowder was superseded by lime or other flameless substitutes; and certainly the progress of engineering warranted the supposition that these conditions would ere long prevail.

THE ORIGIN OF THUNDER-STORMS.

IN a paper recently presented to the Belgian Academy, M. Spring takes exception to the prevailing theory as to the genesis of thunderstorms, according to which the air yields its electricity to the vesicles of the forming thundercloud, which also acquires electricity through the act of condensation; the electricity accumulates at the cloud's surface, and when the cloud comes near another oppositely electrified, or near the earth, there may be recomposition of the two electricities, with lightning and thunder. It is objected that all the vesicles must take the same electricity, and should so tend to disperse. One cannot speak of the surface of a cloud as of a metallic conductor; its surface presents a gradual transition. Further, in view of the poor insulating qualities of moist air, how is the tension capable of producing sparks several leagues long to be accounted for? And, once more, no production of electricity has ever been observed, experimentally, during condensation of aqueous vapour. From some recent Swiss experiences, M. Spring has come to form a different theory. In a hut on the Urnenalp (at a height of 2,198 mètres) he experienced a violent thunderstorm one night. There was for about half an hour, terrific hail, without a single drop of rain, and whenever the hail grew momentarily more intense a vivid lightning-flash occurred, and at the same moment loud thunder, like the report of a powerful cannon. The travellers were evidently at the very heart of the storm. Before long some rain-drops began to fall, and as they increased the flashes and peals became less and less frequent. Now M. Spring's is as follows:—Each hailstone, of whatever size, is the result of union, by regelation, of many crystals of sleet. In this process an enormous free surface disappears in a body that is a non-conductor of electricity—viz., ice—and in presence of another non-conducting substance—viz., dry air. Experiment leads us to expect in such a process a large development of electricity, and to this has to be added electricity arising from friction of the hailstones with the air. Thus we have a large number of electrified spheres near each other and separated by an insulating medium; and those forming, in some sort, the surface of the region should, according to Faraday's researches, acquire an electric charge equal to the sum of the charges of the central spheres. Hence enormous electric tension in that superficial part, relieved, from time to time, by discharge between the hailstones and the air or the ground. M. Spring supports his view by a variety of facts observed both in Alpine regions and in the laboratory.

HYDRAULIC MACHINERY.—V.[*]

By Prof. Perry.

GAUGE notch observations made from day to day on a stream, enable a person to make very exact calculations as to the power available for the driving of mills by turbines, for the working of hoists, cranes, and lifts, and for hundreds of other purposes.

I wish I had time to tell you how Thomson employed that same theory of his in proving that the famous Lowell empirical formula, for rectangular gauge notches, was really a rational one. I must finish here my talk about gauge notches; but if I have incited any of you to criticise the absurd statements in nearly all the books, and to go for exact ideas to Thomson's paper in the *Proceedings* of the British Association, I have done you a most important service.

You see now what a lot of important and rather abstruse looking questions are easily explainable, when we fully grasp the significance of that energy law.

The fundamental fact which makes any hydraulic problem clear to you is this. If we may neglect friction, then a pound of water at any place has its total energy in three shapes. It has h foot-pounds of energy, because it is h feet above a datum level. It has $2{\cdot}3\,p$ foot-pounds of energy, because its pressure is p pounds per square inch, and it has $v^2 \div 64{\cdot}4$ foot-pounds of energy, because its velocity is v feet per second.

To take another example:—

Suppose, now, that we have a pipe which is in the main horizontal, so that we may neglect differences of level. Then we have to remember that the pressure energy, plus the kinetic energy, of a pound of water, does not alter. Now, when water flows along a pipe, there must be the same quantity flowing everywhere. We are sure, therefore, that there must be greater velocity wherever the pipe is contracted. But greater velocity means greater kinetic energy, and if this water invests more of its energy kinetically, it must have less in the shape of pressure energy. That is, the pressure of the water at B (Fig. 3), is less than at A or at C. The pressure at B may become very small indeed. It is easy, in this way, to reduce the pressure to much less than the atmospheric pressure—merely contracting the cross section of the pipe is sufficient. You cannot make the pressure less than than that of a vacuum, for before that limit is reached, we get vapour formed

FIG. 3.

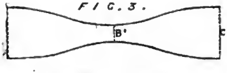
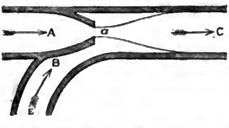


FIG. 4.



Now, suppose a conduit of this kind were carried over my fields, and that a quantity of water lay in my fields, at not too great a depth below the conduit. If I bring a pipe from the point B, underneath the field-water, this becomes a suction-pipe, and I get my fields drained at the expense of the conduit owners. I spoil their water, if it is clean, but at all events I get my fields drained.

In this lies the whole theory of jet pumps, and injectors, &c. The jet pump of Professor James Thomson simply consists of a small pipe, A (Fig. 4), which ends in a nozzle. Through this, let me suppose, I have a small supply of water flowing from some pretty high cistern or other reservoir. Suppose that this water flows into the atmosphere at C. Evidently the pressure at a is much less than the pressure at C. It is less than the atmospheric pressure, and hence the neighbourhood of a is a partially vacuous space, so that the pipe, B, E, become a suction-pipe, and water tends to flow from a point at E, to B, and on to C. Thus, if we have a small supply of water from a high cistern, we are able to drain a marsh with it.

I have not time to tell you of the other hundred ways in which our simple principles comes in to simplify all sorts of puzzling phenomena, but I may be pardoned in referring to my brother's siphon, for the discharge of flood-waters at the weirs in rivers. It has no moving parts in the water, being simply a wide, open pipe of varying sectional area, through which an object as large as a bullock might pass, without injury to the sluice. It has been found, by actual trial, that the quantity of water passing per minute through such a sluice is independent of the fall, so long as there is sufficient fall to balance the waste by friction in the pipe; a few inches being enough in the case of inside pipes; and a velocity of 45ft. per second, at the smallest section, may be calculated upon when the sluice is working full power. The cross-section of the siphon is like the letter **D** at the tail; the masonry, or concrete basin, is actually a portion of the siphon, and the horse-shoe shaped space between the lip of the basin and the iron edge of the siphon proper is the actual opening. The quantity of water passing at any time is regulated by the admission of air to, or its exclusion from, the siphon. There is a throttle-valve arrangement by means of which the siphon may be adjusted at any time, so as to vary what may be called the normal water level in the reach above the sluice, and to vary the opening through which a constant stream of water falls on a ridged-shaped portion of the siphon. This stream of water is needed to exhaust the siphon of air, so that action may be set up at any time, even when the water is not passing over the top of the throttle-valve. The manipulation of such sluices is perfectly simple: they may be made self-acting; but it is proposed in important places to work all the sluices on a river from a single station electrically.

I told you that friction, loss of energy by friction, in water is proportional to the square of the velocity at such speed as are common in pumps. I shall not trouble you with the exact rule by which we are able to calculate the loss of energy which a pound of water experiences in going along pipes. But I want to impress on you the fact that this loss always becomes very great and abnormal when the flow of the water has to occur abnormally. In this pipe (Fig. 5) you see that the wide and narrow parts gradually change into one another by continuous curves. Remember that it is absolutely impossible for a liquid to flow in a discontinuous curve. Suppose you try then to make it flow along the pipe (shown in Fig. 5). What the water does is this: when it comes to the corner it produces for itself wheels, little eddies or whirpools, as we would put rollers under a log of wood that we wanted to get along easily, and there is great loss of energy due to this, for the eddies have not only to be in the corners, but there are smaller eddies carried along by the water itself, maintained so long as they are needed. I have been speaking of actual discontinuity in the flow. But there is a fact, which I am sorry to say that ordinary hydraulic engineers seem to be quite ignorant of, namely, that a liquid cannot flow along a path which suddenly changes in curvature. A liquid cannot, for example, flow along this path (Fig. 6). At A it changes from a straight line, suddenly to the arc of a circle, and, consequently, the water digresses at A, and creates little casters, little eddies to carry it by a path of continuous change of curvature from B to C. Now this view of mine can be shown to be true experimentally. Thus it has been found that if water flows along this bend (Fig. 7) it loses a certain amount of energy on account of the bend; but if you make the pipe bend as much again in the same direction you do not get again the same loss; indeed there is comparatively very little loss at the second bend. But if you bent the pipe in the opposite direction, there is as much loss at the second bend as at the first.

FIG. 5.

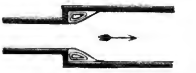


FIG. 6.

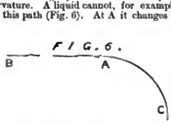
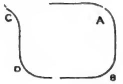


FIG. 7.



The little wheels, or casters, or eddies which the fluid creates for itself to carry it through the bend A are available when the water needs them again at B, whereas the wheels or eddies produced at C have to be destroyed, and new ones created, rotating just in the opposite direction to carry the fluid through the bend C.

You see now how necessary it is that all curved vanes or other surfaces along which water flows should be drawn, not with a pair of compasses, but rather with a batten, a thin strip of wood, which can bend gradually.

Now I want you to regard a pump as a contrivance, which gives to every pound of water passing through it an additional store of energy. From the pond to the entrance to the pump, every pound of water has just the energy it has in the pond, barring frictional loss. From pump to cistern, every pound of water has an additional store of energy, and it is the pump which gives it this store.

Suppose we have a centrifugal pump going at a regular speed, and discharging a regular quantity of water. In this supply-pipe a pound of water has a certain total amount of energy which we know, if we know its height above datum, its pressure, and its velocity. But, in passing through the wheel, it receives a supply of energy. The total energy of a pound of water in the discharge-pipe is greater than what it is in the supply-pipe. We can make all sorts of calculations, if we know what is the clear gain, the clear gift of energy it gets in passing through the pump. The calculation of the work which the vanes of any wheel, whether centrifugal pump, water wheel, or turbine, give to water in passing through it, has been made so difficult by ingenious students, that I am afraid many of you, recollecting your old struggles with the difficulty, think me foolish to endeavour in a short popular lecture to give exact ideas to you.

Suppose a man jumps into an American railway train anywhere, and after wandering about fore and aft, jumps out again. Find the man's momentum in the direction of the train's motion just before he alights on the train. Find his momentum in the same direction when he has just sprung from the train; the difference of these is the total impulse with which he acts on the train, It is the momentum which he gives to the train. Suppose that a number of people could perform this acrobatic feat every second with the greatest regularity, then the momentum given in one second to the train could be calculated. But momentum given per second is what we call force; hence we have found the force acting on the train due to these jumping individuals, and this force multiplied into the space passed through by the train in one second, gives the propelling work done upon the train per second. I have nothing to do with whether it is a propelling force or a retarding force. In the one case the acrobats do work on the train, in the other the train does work upon them. That is quite clear; the loss of momentum per second in a regular stream of people, going on and off the train, is a force which is applied to the train. We only have to do with their momentum in the direction of the train's motion.

Suppose that, instead of its being a train, it were a sort of circular turntable, or a merry-go-round, and that a regular stream of people jumped on and off. In this case, the place where a man jumps on may be going at a different speed from the place where a man jumps off, but our rule is not very different. Find how much is added per second to the momentum of the wheel at the point where people leap on, and regard this as a force. Multiply by the speed of the wheel there, and this is the work done by the mere leaping on, and staying on the wheel. Now, find how much per second is taken from the momentum of the wheel at the place where leaping off occurs, and regard this as a force opposing the motion. Multiplied into speed at the leaping-off place, we have the work taken by the stream of people from the wheel, per second, because they leap off. The difference in these two things is, of course, the work done in the jumping on and off.

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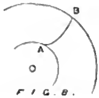
[*] Condensed from a series of Cantor Lectures delivered before the Society of Arts.

Now the water moves towards the vanes of this centrifugal pump, merely radially, and hence the water entering the vane cannot add to or diminish the momentum of the wheel just there. It has no momentum of its own, previously, in this direction. What occurs inside the wheel now we have nothing to do with, excepting that we know frictional loss occurs there. We are only concerned with how the water leaves the wheel. The way in which it is made to leave the wheel determines how much energy it gets from the wheel.

Take the simplest case. Suppose the vane to be radial at B (Fig. 8). That is, besides moving outwards radially at B, the water leaves the vane with the same tangential velocity as the vane at B has. Suppose this velocity to be v. Then every pound of water leaving B per second, leaves with a tangential momentum, $v \div 32{\cdot}2$, and retards the wheel with a force of this amount acting at B. This force $\times$ v is the energy which it receives per second from wheel or $v^2 \div 32{\cdot}2$. One pound of water, therefore, receives the energy $v^2 \div 32{\cdot}2$ from the wheel in passing through it.



F I G. 8.

You understand, then, that a pound of water in the discharge-pipe of that centrifugal pump has this greater store of energy than a pound of water in the supply-pipe, except for frictional losses. If we make the water go out from the wheel as these vanes make it go, and as it would be dangerous for you to do from a railway train, less work has been done upon it by the wheel. If it goes out in the direction of motion relatively to the wheel, more work is done upon it than I am now supposing.

You understand, then, that the wheel gives $v^2 \div 32{\cdot}2$ foot-pounds of energy to one pound of water. If you know how many pounds of water pass through the wheel, you know, then, the total amount of work done by the wheel.

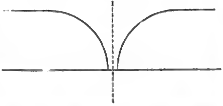
Remember that the water gets this energy to squander or store as it pleases, and it does squander it in friction to a large extent. But suppose it squandered none of it, but converted it all into potential energy in lifting itself up to a cistern, it would lift itself $v^2 \div 32{\cdot}2$ feet high; that is, it would lift itself above the pond to twice the height due to the velocity of the rim of the wheel. Suppose the rim of the wheel has a velocity of 45·7ft. per second, a stone would have to fall freely 34ft. to acquire this velocity, and hence the total rise of water would be 68ft., twice the height due to the velocity of the rim of the wheel. In this case we should say that the pump was perfect. Remember, however, that the wheel itself receives energy from the engine through this shaft, else it could not give energy to the water. It gives out all the energy that leaves the engine, except what is wasted in bearings everywhere, and what is wasted at its own friction with the water. You understand, then, the energy given out by the engine per pound of water, divided into $v^2 \div 32{\cdot}2$, is the efficiency of the shafting, belting, and wheel. The real height to which water is lifted by the pump, divided by the ideal height, $v^2 \div 32{\cdot}2$, is the efficiency of the water-passages all through the pump. The loss in these places is due to friction. Make the supply-pipe wide, make it bell-mouthed at the bottom, where water enters it, so that it may enter by gradual curves; make the approach to the wheel at B as gradual as possible, let the vanes of the wheel make the calculable angle with the central circle, which will reduce the shock there, make the discharge-pipe wide, and let the velocity with which the water enters the upper cistern be as small as possible, and you will greatly reduce the waste of energy. But there is one particular place where there is usually much greater waste than anywhere else, and that is the discharge-chamber.

Just when the water leaves the wheel a large portion of its energy is kinetic. It is in rapid motion. Now in the large discharge-pipe there may be as little kinetic energy as we please. Hence, from the time the water leaves the wheel, till it enters the discharge-pipe, there ought to be great care taken in allowing the kinetic energy to become converted into pressure energy.

Professor James Thomson discovered here the efficiency of a whirlpool chamber. When you let water escape from a wash-basin, you know that the surface of the water takes a shape like this (Fig. 9).

The velocity of the water is greater the nearer it is to the centre. The pressure is greater the farther away from the centre. The spiral motion which you observe in this case is the only steady motion of water which allows a constant radial discharge without the water making objections, setting up little eddies of its own, and thus wasting energy in friction.

F I G 9.

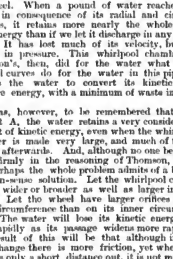


Hence, in Thomson's pump, after the water is discharged, it circulates in this cylindric whirlpool chamber, which he made of twice the diameter of his wheel. When a pound of water reaches this place, in consequence of its radial and circular motions, it retains more nearly the whole of its total energy than if we let it discharge in any other way. It has lost much of its velocity, but has gained in pressure. This whirlpool chamber of Thomson's, then, did for the water what these gradual curves do for the water in this pipe—it enables the water to convert its kinetic into pressure energy, with a minimum of waste in friction.

It has, however, to be remembered that even here at A, the water retains a very considerable amount of kinetic energy, even when the whirlpool chamber is made very large, and much of this is wasted afterwards. And, although no one believes more firmly in the reasoning of Thomson, I feel that perhaps the whole problem admits of a better common-sense solution. Let the whirlpool chamber get wider or broader as well as larger in diameter. Let the wheel have larger orifices on its outer circumference than on its inner circumference. The water will lose its kinetic energy far more rapidly as its passage widens more rapidly. The result of this will be that although in this rapid change there is more friction, yet when the water is only a short distance out, it is not moving much faster than it will do in the discharge-pipe, and there is much less loss in entering the discharge-pipe.

I have always thought that since Thomson's chamber cannot be made very large indeed, we ought to submit to a modification of the theoretically perfect conditions even from the place water leaves the wheel. Inasmuch as the pumps of Gwynne and Appold are not so very much lower in efficiency than Thomson's, their want of a true whirlpool chamber seems to be made up for by a rough approach to the shape of discharge chamber I have suggested. Such a discharge chamber is less efficient certainly than a very large whirlpool chamber would be, but it may be made more efficient than such whirlpool chambers as are not inconveniently large.

F I C. 10.



My rule is, give larger discharge chambers to pumps than Gwynne and Appold do, but do not think it absolutely necessary to give great space radially. In fact, ease the water-flow from the wheel, not merely by giving larger radial space, but also, laterally, taking care that the lateral easement is regular, and let it be as slow as convenience will allow. Remember, too, that there is much friction against fixed sides of whirlpool chamber's if Thomson's idea is thoroughly carried out.

DRUGS AND DOCTORS.

ANOTHER offspring of modern medical thought, remarked Mr. Seymour J. Sharkey, M.A., M.B., Oxon, in his opening address delivered at St. Thomas's Hospital on the 2nd inst., is the tendency to scepticism—a tendency which we must not sweepingly condemn. It has arisen mainly with regard to the treatment of disease by drugs, and is the natural result of increasing knowledge. When a medical man studies disease from our present point of view, and is brought face to face with the wreck which it makes of the most vital structures, he must indeed be illogical if he does not rapidly cease to believe in the efficacy of any drugs whatsoever, either to repair the damage done, or to act as a substitute for the diseased organ in the economy. This scepticism regarding the possibility of finding specific cures for diseases in general is a most laudable trait, and shows an appreciation of the principles of modern therapeutics which is likely to lead to a far more effectual treatment of the patient than any blindly empirical administration of remedies. But you must not misunderstand me, and suppose that I have less confidence than I really have in our Pharmacopœia. I believe it to be composed of—first, a small number of very useful drugs, the physiological action of which is known, and the application of which to diseased conditions is of incalculable value; secondly, it contains a considerable number of remedies, the efficacy of which has been proved in many abnormal conditions, though the *rationale* of their action is still unknown; and, lastly, it contains a host of articles which some people assert to be useful for one thing, some for another, but about which very little of any value is known. Now the sceptic who seems to me to be culpable and unscientific, is not he who has no belief in, and consequently discards, the motley collection of substances contained in the third category, but he who declines to use any drugs except those of the first, the physiological action of which is well understood, and for the administration of which he can see a *rationale*. Such a one will not use those medicines the properties of which have been ascertained by a long series of observations, while their mode of action is obscure. This is an illegitimate and reprehensible scepticism. For although it must be the aim and glory of medical science to add constantly to those drugs the physiological action of which is known, and the application of which to disease is so much the more certain; still the medical art must always remain one of observation and experience, and it is rational and scientific to act upon the results of these, though we may have long to wait for an explanation of what occurs. It has often been remarked that the best physicians use few drugs, and, compared with the whole contents of the Pharmacopœia, the rational scientific sceptic will have only a small number of remedies which he cares to prescribe; but making himself by constant observation more familiar with their action, and with the conditions to which they are applicable, he will use them rather as arms of precision, and his treatment will be to the point and effectual; while what may be called the "mitrailleuse" system of the less sceptical practitioners of former days relied rather upon the number of substances which were mixed together in the hope that some might hit the mark.

EFFECTS OF WEATHER ON INSECT LIFE.

AT the Royal Agricultural College, Cirencester, last week, Miss E. A. Ormerod, F.M.S., the consulting entomologist to the Royal Agricultural Society of England, delivered a lecture on the above subject. At the outset the lecturer referred to the current opinion that weather affected all insect life alike; this was far from being the case. The golden chafer, or turnip-flea beetle, throve in very hot sunshine, while the daddy longlegs or crane fly liked the cool dampness of overshadowed meadow grass. What one species of insect thrived on in its fully developed state might be precisely what would not have suited it as a caterpillar or a grub. We also required to distinguish the meaning of the word, "weather," for differences in the amount of heat or cold acted very differently, according to the amount of rainfall or of moisture accompanying them. Many grubs, such as those called surface caterpillars, would stand severe cold so long as they were in their own specially prepared wintering-places, but if thrown out so as to be exposed to wet also, would die. A sudden downfall of cold rain in summer would clear off caterpillars, but with regard to some kinds of eggs, though heavy rain might destroy them, yet they would not hatch as well in drought or heat as when there was a certain amount of moisture in the air. Insect life was also affected, not only by the state of the weather for the time being, or shortly before any given time, but the effects of weather might be traced for one or two years or more, sometimes directly in the condition of the insects themselves, sometimes by promoting the growth of special weeds, which might be the food plant of some special plant pest (the charlock, for example), and also by so affecting the state of the ground that regular measures of cultivation by which plant and insect vermin were usually cleared out could not be carried on. If they considered the condition of their common farm insects during autumn and winter, the time when the farm operations of the year commenced, they would see some of the reasons why they were uninjured even by severe cold. The winter state which they called hibernation was not simply a torpidity caused by the cold, for it was found, in cases where the regular time for hibernation had not arrived, that insects had carried on their occupation quite undisturbed by a drop in the temperature of some degrees lower than the warmth of some weeks later, when they were retiring in due course to their winter quarters. Hibernation appeared to be quite a distinct condition from mere effect of cold; rather a constitutional seasonal influence in which insects, while they had still all their instinctive faculties in good order, prepared a shelter for the coming cold and want of food. They did not just pass into a state of torpor indifferently wherever they might be, but selected some special locality under leaves and stones, or some safe protection, or formed a cell, or in some way supplied themselves with shelter; and here they—or such of them as hibernate—passed into a quiet, motionless state, the animal functions decreasing in power with the increase of cold. Still, if even totally frozen so that they could be broken like sticks, many kinds of caterpillars were not injured so long as the freezing took place in the shelters they had made for themselves. The true remedy here was for farmers to cultivate the land in the autumn, and throw them out of their cells and lay them open to drying winds and frost and thaw and wet. This would effectually kill them. So far as the egg-laying is concerned, Miss Ormerod pointed out that the laying places—rank grasses and weeds—should be destroyed. Liming and chemical manures and sheep-folding were all sure means of destroying the eggs. In conclusion she asked for further information from farmers, to help us, by better knowledge, in destroying these pests to our farm crops.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE second session of this society was inaugurated on Monday evening, October 9th, by an address from the president, Mr. R. C. Johnson, F.R.A.S. Astronomical observation, the president said, is a most comprehensive term, whether considered from the extensive range of celestial phenomena or from the instruments required for their study. Even with unaided eyesight a great deal can be done—and indeed ought to be done—before a telescope is called into requisition. The position and conformation of the northern constellations should, for example, be familiar to every student, and many of the phenomena of comets can only be apprehended by the naked eye, or at most with a field glass of a power of two or three diameters. The identification of meteor paths among the stars is also one of the most important of eye observations, and the care with which the numerous tracks of these apparently insignificant objects have been mapped out by our army of observers has led to the most remarkable discovery of recent years—that of their connection with comets. Where telescopes of low power are employed, observers should be cautioned against the repeated endeavour to separate close double stars, for, besides the inutility of such a practice, there is often positive injury—sometimes of a serious character—inflicted upon the eye. It does not matter about going from a bright light into darkness, if no attempt is made to immediately perceive faint objects, but to turn the eye from an almost black telescopic field, where perhaps a faint nebula or star is being sought, to the page of a notebook, brilliantly illuminated by a bull's-eye lantern or a gas jet, is a strain to which the strongest eye should not be subjected. No one will be rash enough to run the risk of damaging eyesight by viewing the sun without proper precautions, but with instruments of more than 5 or 6 inches in diameter it is hazardous to view the illuminated parts of even the moon's surface without using a shaded eyepiece.

Wet v. Dry Coal.—Though it is generally conceded now that wet bituminous coal will not make as large a quantity of steam in a boiler as dry coal, we have few figures to substantiate this. A series of tests has been recently made at Bochum, Germany, which substitutes facts for theoretical considerations. A lot of washed slack, holding 18 per cent. of water and 9·9 per cent of ash, evaporated 5·7 pounds of water per pound of fuel; while the same coal, with only 3 per cent of water, made from 8 to 8·5 pounds of steam. Making due allowance for moisture by reducing to a standard of like quantities of coal, free from moisture, there is found to be a direct loss by using wet coal of 14 per cent.

SCIENTIFIC NEWS.

A COMET was discovered by Prof. Schmidt, of Athens, on October 8th, only 4° south-west of the great comet, and having the same motion. *Dun Echt Circular* No. 64, in announcing the fact, says, "Should further observations confirm the last statement, this new comet would seem to be a companion of the great comet, and may have formed part of it at a former, not necessarily very remote, time, judging by the history of the celebrated comet Biela."

Dr. Wentworth Erck, writing on Oct. 12th, from Sherrington, Bray, says that an observation made that morning, confirmed Dr. Oppenheim's elements which indicate a parabolic orbit, or, in other words, that the comet is a stranger that has never visited us before, and never will again. Letters continue to arrive from different parts, the West Indies, Cape, Brazil, &c., giving glowing descriptions of the splendour of the comet. It will be a great disappointment if, after all that has been said, it should not return in three or four months, and fall into the sun.

The report of the directors of the Chicago Astronomical Society, which includes that of Prof. Hough, director of the Dearborn Observatory, has been published. It gives an account of the work done with the 18½in. equatorial on the great comet of 1881, on Jupiter, the satellites of Uranus, and on double stars. The notes on Jupiter are specially valuable, as the spots and markings have been carefully studied, micrometric measures made, and sketches taken. From these it appears that the great red spot has been retrograding with an accelerated velocity, the apparent rotation period in March, 1882, being 9h. 55m. 37·8s., or four seconds greater than at the opposition of 1879. That appears to indicate a total drift of the red spot 40,000 miles in longitude, or about 10,000 miles in the first year, and 30,000 in the second. Prof. Hough says: These observations prove that the red spot is not the solid portion of the planet, as has been held by a number of astronomers. One of the most curious features of this interesting object is its stability. Here we have an immense floating island, 29,600 miles in length by 8,300 miles in breadth, which has maintained its shape and size without material change for more than three years.

Letters received from Ceylon announce the death of Dr. Thwaites, F.R.S., the director of the Botanic Gardens at Peradenyia, in his seventy-second year. Dr. Thwaites was known in this country as an expert microscopist and a diligent student of cryptogamic botany. The success of the Chinchona culture in Ceylon is largely due to the labours of Dr. Thwaites.

Commander Bartlett, of the U.S. Navy, says that the temperature of the Gulf Stream in the early part of its course rarely exceeds 83° in June and July, except under a hot sun in very calm weather. The temperatures of the stream at corresponding depths are the same as those found between the Windward Passage and the Gulf of Mexico. The width of the Strait of Florida is forty-eight miles, the greatest depth 439 fathoms, giving an area of cross-section of about 430,000,000 square feet, and at the average velocity (three knots) the delivery is about 436 billion tons per day, which is much less than enough to account for the volume of warm water which spreads over the Atlantic. Commander Bartlett has negatived the idea that the Arctic current as such underruns the Gulf Stream to the Gulf itself, or even to the Straits of Florida.

The amount contributed by the gas companies, for the purpose of supplying the necessary funds for the forthcoming exhibition at the Crystal Palace, now exceeds £5,000. According to present arrangements, the gas exhibitors will light the south end of the nave from the entertainment court to the crystal fountain, while the electrical light exhibitors will occupy the north nave and the transept.

The sixteenth annual report of the Aëronautical Society of Great Britain has been issued. Besides the papers read at the annual meeting, it contains a reprint of Dr. Pole's "Study of the Problem of Aerial Navigation."

MM. Frézon, Dumont, and Francon have succeeded in solidifying petroleum, in which state it burns like tallow. This solidification is, according to *Cosmos*, effected by adding to distilled petroleum 25 per cent. of the purified juice of plants belonging to the family of the *Euphorbiaceæ*.

It is known that M. Decharme has been lately engaged in some interesting experiments with water-currents in tubes, the phenomena variously resembling those of electricity and magnetism. He has lately made what he calls *hydrodiapasons*, which act like tuning-forks. An elongated U-shaped brass tube is connected through a tubular stem with a pipe giving town water. The upper ends are bent round nearly to contact with each other. Discs, or pieces of various forms, are adapted to those ends with screws. On passage of water, the fork enters into regular vibration, owing to attraction if the nozzles have thick edges, and to repulsion if they have thin ones. The sound is more distinct if the branches are so far separate as not to touch at each vibration. With the ends of the branches immersed in water, the instrument without any discs gives a note. The vibration felt on touching the fork when in action is like that from the rheophores of a weak induction coil. These hydrodiapasons act also with a compressed current of air, or with steam. They may be utilised to keep ordinary tuning-forks in action, or as hydraulic counters.

Steps are being taken to connect the islands of Mauritius and Réunion, about 134 miles apart, by a system of optical telegraphy. M. Adam is taking out two of Col. Mangin's large telescopic apparatuses for the purpose, and he has devised what he terms an *automatic eclipser* for the light (that of an ordinary petroleum lamp will suffice). The signals will be photographically recorded. The system is expected to be specially useful in signalling the approach of cyclones.

The employment of phosphor-bronze wire in telephony, as proposed by a Belgian physicist, *L'Electricité* regards as of great importance for the development of the art. The conductivity is somewhat less than that of copper; but as it is more than sufficient with the high tension of the currents used, this is of little consequence. There is great advantage in the superior tenacity of the wire; lengths of 3 to 400 metres may be suspended without intermediate support.

The Governor of Lower Austria has lately issued a detailed police-ordinance regarding precautions to be taken against fires in theatres. It has been carefully prepared by a select commission, and contains 110 articles. Each theatre must be isolated, and have no communication with neighbouring buildings. The stage and the house must be separated by a wall at least 0·60m. thick, and rising about 0·45m. above the roof, so that the stage may be isolated entirely, if necessary. The stage must be separated from neighbouring spaces, and must be high enough for the curtain to be raised without rolling. No habitation is allowed in the theatre; only the secretariat, the wardrobe, the room for accessories, and the porter's lodge. The workshops and stores of scenery, and the buffets must be outside. (These rules will be applied to existing theatres). All stuffs used by actors, or for scenery, must be dipped in a fireproofing composition during the vacation. Fireworks and explosives must not, under any pretext, be kept in theatres. In new theatres there must not be more than four galleries, besides the pit and lowest tier of boxes. The orchestra must not be utilised for spectators. In the pit and galleries must be passages, so that there are not more than six places in a row. The number of persons appointed for relief service in case of fire is to be regulated by an agreement between the police and the magistrate. An ordinance as to the interior service, drawn up by them, must be printed and sold to the public at entrance. The chief of the theatrical enterprise is bound to give the alarm directly the danger has declared itself, and to ask the public to leave.

Prof. Palmieri has observed considerable difference in oils as regards electric conductivity, and he proposes to apply his data, with the aid of a diagometer constructed by him, to investigation of the oils occurring in commerce.

By a recent order of the Czar, the admission of women students into the Nicholas Military Hospital will cease at the end of the year. The students will be authorised to complete their course, after which clinical instruction of women will cease at the hospital. The Academy of Medicine for women, with a curriculum exactly like that of the old universities, has numbered 367 students. Since 1877, when the first students passed their examinations, 281 ladies have completed their studies; 152 have passed successfully the examination for doctor in medicine, and 105 have entered the service of the universities or the hospitals.

Blotting-paper, which not merely dries, but removes a freshly-made ink-blot, is prepared (according to the *Pol. Notizbl.*), by passing thick blotting-paper through a concentrated solution of oxalic acid, and then drying quickly.

The Berlin Society of Architects lately made inquiry into the cause of many bronzes becoming black. The statue of Frederick the Great, e.g., has acquired a quite dark coat, while an old gun before the Arsenal has retained its fine green colour, though both have been similarly exposed to atmospheric influences. On analysis of the bronze of the gun it was found to consist of nine parts copper and one part tin, while that of the statue contains a considerable percentage of zinc. It is inferred (and other observations confirm the view) that zinc is the cause of the blackening in question.

The subterranean telegraph line between Paris and Nancy is now completed, and greater security so acquired for telegraphic communication with the capital. The cable between Paris and Marseilles is also well advanced, and will soon be tried.

A door capable of being opened in four directions has been invented by Herr Wiegandt, of Berlin. The arrangement is applicable to windows.

It is pleasing to learn that applications for space at the Hygienic Exhibition of Berlin are abundant, and, indeed, likely to be more than can be met. Not only have nearly all the former exhibitors applied again, but there is a large accession of new ones. The closing day for application is Oct. 15.

An interesting discovery has been made at Dorgali, in the island of Sardinia: it is that of a large subterranean grotto, containing many beautiful stalactites, in the side of a mountain. There are 15 long lateral galleries, the arch of one of them resting on a range of high pillars having a whiteness like that of marble. The floor of the grotto seems to be of very fine basalt. When the grotto is lit up with torches, a marvellous effect in colours is witnessed.

It has been found by M. Clemandot, in experiments by his new method, that in steel tempered by compression—that is, cooled under pressure, the coercitive force is maintained, notwithstanding reheating, and even forging. In other words, instead of being ephemeral and unstable, like the coercitive force due to tempering in baths, that impressed on steel by compression is permanent and indelible, whatever the successive operations. This is thought to be due to the greater homogeneity produced. The metal so treated has also the advantage of being soft; it may be filed, drilled, &c.—a useful quality for makers of apparatus with magnets, magneto-machines, telephones, &c., who often lose precious time in working on magnets which break at the last moment.

The following is a list from the *Deutsche Ind. Zeit.* of the principal Steamship Companies conveying passengers between Europe and the ports of North and South America:—

	Steamer.	Reg. Ton.
North German Lloyd	27	77,402
Hamburg-American Co ..	15	48,647
Cunard Co.	49	90,372
Inman Co.	16	43,955
White Star Co.	10	37,000
Anchor Co.	51	127,546
National Co.	8	25,342
Guion Co.	8	25,164
Brazil and River Plate Co.	31	49,955
Royal West Indian Mail Co.	24	53,806
Peninsular-Oriental Co. ..	49	—
Pacific Steam Navigation Co.	54	119,807
	342	708,996

The pressures used in locomotives have gradually increased from about 60lb. a generation ago, to 130lb. and 140lb., and now the Boston and Albany Railway Company is using 165 to 175 in its new engines.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden,* W.C.

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

ERRATUM—STAR MAGNITUDES—POSITION OF THE EARTH'S AXIS AS REFERRED TO HER ORBIT—APOLOGIA SUFFICIT—OCCULTATION OF ε ARIETIS—EQUATORIAL MOUNTING FOR A PILLAR-AND-CLAW TELESCOPE.

[20635.]—I notice that the compositor, in line 12 of the penultimate paragraph of my letter (20590) on p. 111 has put "1sec. = 159″," where I wrote "1sec. = 15″."

Penning these words some 250 miles from my own library, in a part of England in which even a London newspaper is absolutely unprocurable, I need scarcely tell "Draco" (query 48169, p. 123) that I cannot possibly consult Flammarion's "Les Etoiles," at present to answer his question. On my return home, however, in the course of another fortnight or three weeks, I will at once refer to that work, and reply to "Draco's" query.

Never having had occasion to consult the work referred to by Mr. Firth in query 48174 (p. 123), I am necessarily ignorant of the illustrations it contains. With regard, however, to the position of the Earth's axis, as referred to the direction of her motion in her orbit, I may say that on September 21st the Northern Pole of that axis does practically point in the direction which the Earth is pursuing. On the 21st of December, though, it will be pointing in a direction square to that of her motion. On the 21st of March the Northern half of the Earth's axis will be inclined from her actual path; and on the 21st of June will be again square to the direction in which she is moving. At intermediate points in her orbit, as my querist will see, her axis will gradually change its direction with reference to that of her motion round the Sun. If, then, we had to make a Sun picture of the Earth as seen on September 21st, we ought to incline the Northern end of her axis to the left. If, on the other hand, we wished to represent her as seen from the Sun on March 21st, her North Pole should incline towards the right. Whether the diagrams in Professors Huxley, Roscoe, and Balfour Stewart's "Astronomy" do so represent the Earth at the times of the Autumnal and Vernal Equinoxes respectively, I am, of course, ignorant. If they do not they are wrong —that's all.

Let me assure Mr. S. M. Baird Gemmill (letter 20612, p. 135) that it never struck me for a single instant that his silence on the subject of γ Virginis arose from any discourtesy on his part. I know, too well, how often bad weather and cognate hindrances have stood in the way of the redemption of my own promises to my brother-readers to look at stars, to attribute any such motive to him.

In the absence of any means of reference to the records of my observations, I cannot say off-hand whether I did witness the occultation of ε Arietis, to which "H. S." refers in letter 20615 (p. 135). As far as my memory serves me, I did not happen to observe it; but if I find on my return home that I actually did so, I will copy the entry from my observatory book in the next letter I write in these columns.

I do not know, and cannot ascertain where I am, what the latitude of Sheffield is, but suppose that it must be 53° 20′, or thereabouts. If I am right in this, "A Young Astronomer" (query 48251, p. 146), may draw a horizontal line from A in his own figure and letter the distal end E. Then the angle B A E must be made = 36° 40′, that being the co-latitude of 53° 20′, or angle left after subtracting 53° 20′ from 90°. If your correspondent's latitude be 53° 27′, then he must bevel the top of his block to an angle of 36° 33′, and so on.

A Fellow of the Royal Astronomical Society.

THE SIMPLEST METHOD OF USING AN EQUATORIAL TELESCOPE.

[20636.]—The improved method proposed by your correspondent, "A. S. L." is correct, as far as it goes; but your readers require to be reminded that the *differential* method is impracticable in the day-time, when no star is visible, and, possibly the sun and moon are hidden from view by buildings or other obstacles.

Besides this, a movable R.A. circle is seldom supplied by the maker, unless specially ordered. The simplest co-ordinates of a celestial body are:—(1) The declination (or N.P.D.); and (2), the angular distance from the meridian, which last necessitates a calculation similar to that supplied last week.

James Pearson, M.A., F.R.A.S.
Fleetwood Vicarage, Oct. 13th.

NEW MOON FOR NOVEMBER, 1882.

[20637.]—With reference to the sixth parag. of "A Fellow of the Royal Astronomical Society's" letter (20590), I inclose a calculation of new Moon for November, 1882, from Fergusson's table. The result differs 7m. 24s. from the value given in the *Nautical Almanac.*

From the title of the tables in Fergusson's "Select Mechanical Exercises," it will be seen that they are only intended to be "near enough the truth for any common almanac."

With this limitation it is presumed the error may pass, supposing the calculation to be correct.

Time of New Moon in November, 1882, by Fergusson's Tables.

Old Style—	d.	h.	m.	A	B
New moon, Jan. 1782, Tab. I.	2	1	11	195	259
100 years ,, VI.	4	8	11	3	256
New moon, Jan. 1882	6	9	22	198	514
Nov.—Jan.=11−1=10 lunations ,, III.	295	7	20	291	258
	301	16	42	489	772
Equat. A 489−360=129 ,, IV.			53		
,, B 772−720= 52 ,, V.		17	52		
	302	11	27		
1800 Diff. Old and New Styles +	12			auxiliary table.	
	314	11	27		
Deductions for Nov., Tab. III.	304				
New Style—					
New Moon, Nov., 1882	10	11	27		
By *Nautical Almanac*	10	11	19·6		
Error +			7·4		

Tables for calculating the true time of any New or Full Moon from the creation of the world to A.D. 7800; near enough the truth for any common almanac.

A. D. L.

EPSILON ARIETIS.

[20638.]—I remember watching the occultation of the above double star on January 20th, 1880. The night here was very fine, and definition almost as good as possible. With a 2¼in. Wray I then had, and power 140, I could plainly see the star was double, although not divided. I have the following note of it made at the time:—"Occultation of ε Arietis. Although so close a double, I could see on which side was the smaller star. Unfortunately, I adjusted the telescope almost at the moment of disappearance, but my impression was that it appeared to get *less* a moment before it disappeared."

Walsall, Oct. 14. **F. T.**

NEW MARKINGS ON JUPITER.

[20639.]—I wish to call attention to the new and striking features which have been visible in Jupiter's northern hemisphere during the last two months. These consist of numerous dusky patches which have appeared, some on the north equatorial dark belt, some projecting northwards from that belt, reaching in some cases even to the next belt to the north, and others extending for a considerable distance to the south of the same belt. Several of these new features are very conspicuous, being nearly as prominent as the great red spot ever was at its best, and attaining, in one or two cases, to nearly similar dimensions. The exact number of these objects is uncertain, but at least six are visible, and at whatever time an observer happens to be watching Jupiter, one at least of these dark masses will probably be visible, and very frequently too. I mention these features particularly, because from their position and prominence they offer an admirable opportunity for the re-determination of the rotation period of this belt, and one which has been entirely absent during the last year or two.

On Oct. 12 last, at 15h. 10m., Jupiter had a curious, striped appearance. Definition was superb, though rather misty, and with power 150 on my 5¼in. Calver, the appearance was very striking. This was caused principally by the two broad, dark, red belts, which now form the south equatorial belt; the dusky, double, north equatorial belt; the double belt still further to the north; and two other fairly conspicuous bands, one situate on the south edge of the north polar cap, and the other some distance south of the equatorial belts. Besides these markings, the whole surface was one mass of complex detail.

Brighton, Oct. 14th. **A. Stanley Williams.**

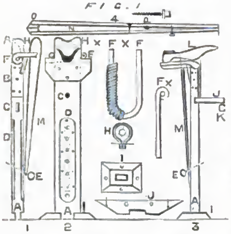
ASTRONOMICAL.

[20640.]—With regard to η Coronæ (letter 20591), I tried this last evening at 6.30. My observatory is on low land, near a river, and I never use quite the full aperture with my 8½in. generally 7¼. With this, and power 350, I can only say distinctly that η is double, and every now and then I fancy I see a black line between the components. **F.R.C.S.**

BOOT AND SHOEMAKING.—III.

[20641.]—Now I must digress a little bit, to get at your work properly. You cannot get to work properly if sitting in an ordinary chair, as your knees would incline from you; that would be a back-breaker. As the old and easiest position on a seat, which brings the knees up to a level with the chest, although a cramped position and a great strain on the system, is still the easiest if you are going to nurse your work. But there are very few who would like to cut a figure like an old cobbler when it can be done for a trifling outlay, and be a pleasure to work. I have tried to introduce this and other machines for years; but it has been a failure, and why I do not know. Some folks count attitude everything; but let me tell you that this attitude is very irksome to those who are used to it, and it is very injurious, and no tongue can describe what some in the trade suffer. Fig. 1 illustrates a machine that I have used with success, at which you can sit or stand, lowering your work, fixed and handy, that you can get at it at a moment's notice; at any odd time can be put up in less than five minutes, and struck and stowed away in a box 9in. deep, 9in. wide, and 4ft. long, in a cupboard or other convenient place out of the way, to be got out at a moment's notice, or taken about the country.

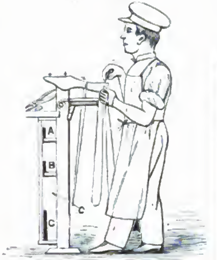
FIG. 1



Now we will take the figures at the bottom, 1—A A is an upright, consisting of a piece of spruce fir, 4in. wide, 2in. thick, 3ft. 6in. high, checked with two pieces of vat-hooping, about ⅛in. thick, 8in. long, and 2in. wide; the top ends made semicircular with a ⅜in. hole drilled in, and a few holes drilled in and countersunk to screw them on. When these are put on both sides opposite one another, bore the hole right through the upright. This should be 3in. from the top for a piece of ⅜in. iron rod to drive through. C is a mortise hole, in which an iron nut is let in, the same as a nut in a wooden bedstead, for a bedstead-screw to go in. At D are two plates of the same width, with a series of ¼in. holes drilled in 1½in. apart; but the holes not to come opposite one another. The back to be ½in. above the front, that the pin E, made of a piece of ¼in. iron rod pointed taper, may take the position shown when inserted. At the bottom is a tenon, made 1in. long, 1in. thick, and 2½in. wide. H at the top is hollowed out, as shown at H × Q. G is a piece of elm, or birch, or beech, 1in. thick, 3in. deep, and 6½in. long, let into the standard as shown, and the corners cut off, and glued and screwed; this is the stop for the shackle F × F; this is made of a piece of ⅝in. good iron rod, F × being the side view, bent round the shape of a horseshoe, with two eyes turned for ⅜in. iron rod to go through, as seen at 1 F in position, length 8in. from the eye; this forms the platform to fix your work upon, and from the stop G should be wound round with some small jute line, untwisting the line to make it lie flat and tight as you wind it, and afterwards covered with a piece of tight cross-belly hide. See H section the core-iron, next ring line, the other outside leather, either stitched as shown underneath or felled over the two edges butting. I is a plate or shoe for the bottom of standard, with a mortise to fit tenon, about 4in. by 8, chamfered off, and to be glued fast, and skew-nailed upon the standard. Four holes made in it to screw it fast to the floor. J is a piece of wood, elm, 30in. long, 12in. wide, and 1in. thick. A notch is out in to fit the standard tight, and the two corners cut off 10in. each way. Fillets can be nailed upon the top outer edges to keep the tools from rolling off, and one or two screws passed through the standard to fix it, the height of window-sill bead, and two screws through the ends to fix it to the window-sill inside. 3 shows the machine erected before a window, K being the bead, L the last or shoe upon it. M is the stirrup drawn down by the pin E, for holding the work. 4 is the clams before mentioned. N, the two battens; O, the fillets for the jaws; P the bedstead screw to fix these in position at the nut at the mortise C, passing between the battens of clams at 10, with 3ft. 6in. of batten 4in. wide, and a piece of inch elm 11 or 12in. wide, 4ft. long, with iron fittings, which are not very expensive; as little or any labour is required, you may have something to work on with pleasure. The place 1 H, again shown at 2 H X is hollowed out, and a piece or two of felt packed in; but it is worth the trouble and expense of getting a piece of rubber, as sold for shoe-soles or insertion, about 3-16 thick, and glued and tacked in, covered again all over with a piece of stout russet, and strained tight to shape, and tacked all round with ⅝ tacks—round headed tin-tacks if you can get them, or brass gimp-pins, and then the attitude becomes as shown in Fig. 2. Fig. 3, the places A, B, C, in the dotted line, is a receptacle for tools made of ½in. stuff, 3in. deep, the cheeks nailed on the upright, and top and bottom upon the cheeks, with a door on the back side, and this I found held all I wanted, with hemp, flax, brads, tacks, wax, &c., &c. I have made the machine with a revolving table, but there is more work in that case.

Jack of All Trades.

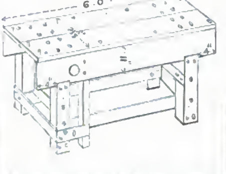
FIG. 2.



AN EFFICIENT AND EASILY-MADE CARPENTER'S BENCH.

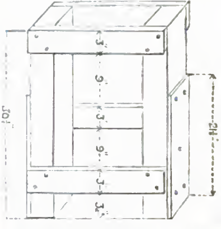
[20642.]—Supplementing the excellent article on page 101, October 6th—and which should be referred to before making use of the following,—below is given particulars of a rough-and-ready carpenter's bench made by the writer. It is very easily made, costs but little in materials (from 7s. to 8s.), and can be made in a few hours by any one who can make a straight saw-cut, while it is capable of being used for all the probable wants of 99 out of every 100 amateurs.

FIG. 1.



The sketches almost explain themselves. No. 1 shows the bench complete, with its various dimensions; No. 2 shows the arrangement of the end. The legs are 3in. by 3in. by 30½in.; the top boards are two 11in. by 1½in. thick; the side boards are 11in. by 1in.; the strips screwed on each end, and along the inner face of the legs, are 3in. by 1in. Both sides of the bench are alike, except that one side has a bench-screw fitted. The timber used is all unplaned, the same as it comes from the timber-yard. The whole of the bench is put together with 2½in. and 3in. screws; consequently, it is easily taken to pieces, either for the purpose of getting it into an awkward room, or using the timber for any other work when the bench is no longer wanted.

FIG. 2.



The space underneath the bench may be utilised by using the cross strips at each end as rests for shelf-boards, or in many other ways. The bench-screw is not shown, but its position is indicated, and the slot for the runner and pin (described on page 101) is also shown. The bench-stops consist of three thick screws, about position as shown.

Handsworth. **E. B. S.**

THE "ARTFUL DODGER" AS AN AMATEUR PRINTER.

[20643.]—Now that the season for making the negatives is over, the amateur photographer looks over his summer's work, and prepares to make the prints.

Some of the negatives are good, some poor, and some bad. Many a poor neg. will print well, and many a bad one better if we try a little "artful dodging."

Let us take the doubtful negs., and see what can be done with them.

The first is one in which the lens would not cover the plate. The corners print black. Yet it is a shame to cut the print down to make the corners square. We can vignette it!

Get a cardboard, or piece of thick paper, large enough to cover the front of the printing-frame, and cut an opening in it about ½in. smaller all around than the image on the plate. Put the neg. in the frame and fit the card on the front, raising it about ½in. or 1in. away from the neg. Cover the opening in the card with tissue, then look through the negative from the back, and see if the corners are shaded well. If not, bring the card a little nearer the negative. Now it prints right; but the sky comes out too dark. Take a proof-print and cut out the sky for a "mask." When the sky has printed dark enough, take the mask and fasten it down on the outside of the tissue, just to cover over the sky, while the rest of the view prints up as dark as need be.

This vignetting of a view has a very pretty effect, and may be adopted with success where there are dark rocks or foliage in the corners of the plate. Next comes a pretty river scene. If printed "plain out," the foreground comes out nicely, but the distance, which is all in the centre of the plate, is too light. Another card, and cut an opening in it, as nearly like the part which prints too light, as possible. Fasten it on the frame, as in the previous case, fitting it to cover all but the light part. Print the distance as many shades darker as you may desire it; then, without removing the print, take off the card, and let the whole negative print until the foreground is done.

This is the *best* way, as by printing the distance *first* it is *kept distant*. It is also the most difficult on account of the printing appearing much darker than it really is. If trouble be experienced the following plan may be tried. Print out plain until the foreground is done, then, without moving the print, place the card over the frame so as to shade the foreground, then let the distance print to the desired shade.

No. 3 has a bit of wooded bank running out into the water, which prints entirely too dark. The detail is all in the neg., but is not strong enough to print.

Clean the back of the plate, and pour a little "ground glass varnish" on the back of the neg., just over the weak part. Take care that the varnish does not flow on the film side. Now with a penknife scratch off all, excepting that which covers the weak spot. If it still prints too dark, rub a little fine plumbago or powdered black crayon on the ground glass.

Ah! this looks like a bad case. Overtimed; so thin that it has no life; yet we want a few prints off it. Try the ground glass again, and *cover* the back of the neg. this time.

Prints better, but not strong enough yet. Cover the frame with one or two thicknesses of tissue, and that will make as good print as we can expect.

My! This is just the reverse. Regular cast-iron neg. prints black and white. We must tint the paper before printing. Take the silver paper and hold it in daylight until it has a slight tint. Now print it. If it is too flat do not tint quite so much—if too chalky, tint more. The reason I say *before* printing is that if done *after* it will flatten the print dreadfully.

The next would have made an excellent print, but, unfortunately, the sky has been badly damaged. We must put in a new one. Get the cloud neg. Make one any cloudy day, taking care not to have the mass too broadly lighted. Having the cloudy neg., proceed thus:—Make a print full size from the view on any old paper. Cut out the sky, following the outline of the view as much as possible, then lay one half on a card the size of frame, and draw a pencil line by the part cut. Cut the card in two through this pencil line, saving both pieces.

Now, having made the "masks," put the cloud neg. in the frame, and shade just so much of the paper as will be needed for the view, with the view mask. Cover the whole with tissue, and print. Be very careful not to have the clouds too dark, as then they will appear much too forward. When the clouds are done, remove both neg. and mask, and place the view neg. shading the sky with the sky mask. Hold the frame up to the light, and adjust the paper to the view in such a way as to make the *softer shadings* of the vignetted sky *overlap the view a little.* Cover with tissue and print. If the sky has been *nicely vignetted* and *adjusted*, it will be *unpossible* to tell where the sky begins. If, however, the vig. is *too sharp*, or the *adjustment poor*, the print will look like a "botched" job," and the sooner it is torn up and made over, the better. I have seen skies put in by professional photographers which were *disgraceful.* A broad white band between the print of view and sky. Looking as though the sky had taken to itself wings, and "fleed" away. **M. Herbert Bridle.**

1018, Wood-street, Philadelphia, Pa.

HARDENING AND TEMPERING STEEL TOOLS.

[20644.]—I beg you will allow me to inquire of your readers who are interested in the matter, whether any experiments have been made in a mode of hardening and tempering steel tools which it has occurred to me might have several important advantages? It is well known that a great many articles of steel, about which a great deal of trouble has been taken, fly or crack from the sudden shock of the cold water into which they are plunged at a high temperature to harden them. This is notorious: I could produce instances frequently occurring in some of the best workshops in London. But supposing that the steel article, whatever it may be, is successfully hardened, it is, in nearly all cases—not absolutely in all cases—too hard, and then has to be lowered; that is, to have its excessive hardness reduced, in order to lessen its extreme brittleness.

Now it has occurred to me that it would be very feasible to heat the steel article in the usual way, and instead of dipping it into water say of about 60°, to use water of 100° or 150° of temperature, or whatever temperature experiment might determine to be suitable. I think it probable that an average temperature might be arrived at which would at once give the requisite temper to the steel, and from the higher temperature of the water avoiding the sudden shock which is so often fatal. I merely put this forward as a suggestion, as I shall probably not have time to experiment myself; but if any of your readers can throw any light on the subject, I for one shall be much obliged. **C. A. T.**

"NOTES ON DYNAMO MACHINES."

[20645.]—As one who has read with much interest the letters under the above title by your correspondent "E.," will you allow me to call the attention of your electrical readers to letter 20519, note 75 (p. 60), where "E." mentions the necessity of moving the commutator-brushes from the position of symmetry, which he considers to be due to the "retardation of magnetism of the iron cores"? Is this the case? Does it entirely account for the facts? In a research on this subject (a resumé of which appeared in *Engineering* early in 1880), M. Antoine Bréquet conclusively shows that some, if not all, this displacement is caused by the armature current deflecting the lines of force due to the field-magnets. The pith of his explanation was as far as I can remember somewhat as follows:—Let Fig. 1 represent the elements of a dynamo (say of Siemens type); here A B are sections of opposite wires rotating on the axis O in the direction of the arrow; the induced current will then be upwards in A, downwards in B. This will continue till A and B arrive on the line C D, drawn at right angles to the lines of force. At this point the current will be reversed, and obviously this seems the correct place for the commutator brushes. But let us consider what effect the magnetic field due to the armature current will have. The direction of the lines of force due to this current is indicated in Fig. 2 by the small arrow round A and B (a line of force being assumed to flow from a North to a South pole outside the magnet). Under these circumstances the lines due to the field-magnets will no longer be straight; for, remembering that lines flowing in the same direction repel, and those in opposite directions attract, we see that the lines will tend to take some such position as that shown by the dotted lines, and when A and B arrive at the old neutral point they will still have some distance to move before ceasing to cut lines of force, the new neutral line being at C D, this line giving the new position for the brushes. This action is plainly quite independent of any iron in the armature, and it remains to be seen what the effect of introducing iron will be.

FIG. 1.

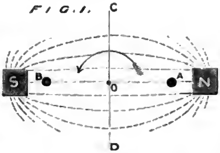
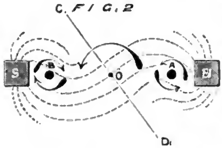
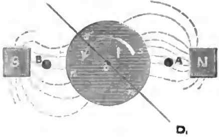


FIG. 2



Still keeping to the Siemens type, let I (Fig. 3) be the iron of the armature; I will be magnetised by the field-magnets, and its poles will be at *n*, *s*; but I will also be magnetised by the armature current, and a moment's consideration will show that n^1 s^1 will be the poles due to its influence. Now nn^1, ss^1 will combine to form opposite poles on I, having a considerable lead on the normal position, thus helping to rotate the neutral line (the amount shown in the figures is of course much exaggerated); and, moreover, this must take place, even if the iron is at rest, and only the wire moving, as in one form of Siemens' machine. I should be glad to know if "E." or others can say from practical experience whether, other things equal, the brushes of this machine need the same or less lead at given speeds than in other types?

FIG. 3.



It seems to me that the amount of lead necessary for the brushes must depend chiefly on the relative strengths of the field due to the armature current, and that of the field-magnets; and one would expect a great lead of the neutral line when the field-magnets were weak and armature current strong, and vice versâ. The first condition might be present in a shunt-dynamo working on a short external circuit with high resistance in the field-magnet circuit. The latter conditions would obtain with permanent or separately-excited field-magnets and high resistance in armature circuit.

I feel sure that others (besides myself) who are interested in the theory of the dynamo machine would be glad of some further remarks on this subject from those who, like "Sigma," "E.," etc., really *know* what they are writing about.

Sydney Evershed.

JERK IN RAILWAY TRAINS.

[20646.]—We all know that when a moving body, say a train, is brought to a standstill, the tendency of any loose body, such as a passenger, is to continue the motion, and consequently a jerk is felt in the direction of motion or towards the engine.

Almost all constant passengers by train must have noticed that when a train is brought to a standstill in a station in the usual way by the application of the brakes, that at the moment of stoppage the passenger experiences a jerk, not in the direction of motion, but in the direction of the guard's van. This jerk is very marked on the Sheffield-Midland, and eminently so on the Manchester and Bowdon, M.S.J.A. line, sometimes being quite sufficient to make you stumble into a fellow-passengers lap if you are reaching down your hat at the time.

As this peculiar jerk tends to make you fall from the engine, or from the direction of motion, one would naturally suppose that the engine gave a sudden jerk forward; but this is not the case. I have examined many trains from the platform, but have failed to see any movement after arriving at a state of rest (except a slow backward one, due to the easing of the springs), and yet have seen the passengers who were descending at the time experience the jerk in question.

The application or release of the brake has something to do with this, and I should esteem it a favour if Mr. Stretton, who is an authority on such subjects, could give a solution for the benefit of all your readers.

I am a director of an accident insurance company, and many cases come before me during the year, of sprained ankles through getting out of a train in motion, and the evidence brought to bear is most conflicting. Our claimants generally state that the train was absolutely stationary, and then jerked on again. The railway companies invariably say that the claimant descended before the train stopped; in one case, compensation is due to the claimant, but not in the other; and companies, whether railway or insurance, naturally look to their side of the question.

I feel confident, from my own experience, that in many cases the accidents have been due to this jerk, and although the train may accurately be said not to have ceased motion, yet it has done so apparently, and this pitfall of the railway companies adds another horror to railway travelling, and I should much like to know the cause of it, and a method of obviating it. **S. J.**

P.S.—The jerk above mentioned may be felt sometimes in a tram-car if quickly stopped, and if you are walking towards the door at the moment of stoppage you may take a header into the guard's arms.

THE RECENT ACCIDENTS AND CONTINUOUS BRAKES.

[20647.]—Colonel Yolland's report upon the cause of a passenger train separating into two parts near Acton station, on the Great Western Railway, on the 8th of July, has been published.

It appears that the 6.30 p.m. train from Paddington was made up in three sections—1st, the main-line train, consisting of twelve carriages fitted with the modification of the Sanders and Bolitho automatic vacuum brake; 2nd, two slip-carriages for Twyford, with one hand brake and guard; 3rd, nine slip-carriages for Windsor, with two guards and two hand brakes.

When running near to Acton the whole of the eleven slip-vehicles became uncoupled in consequence of a carriage body moving and affecting the slip-coupling.

These eleven vehicles were not provided with either continuous brakes, nor had they any means of communication between passengers and servants, as required by the 22nd section of the 31 and 32 Vic., c. 119, and as this train was intended to run for a far greater distance than 20 miles without stopping, Colonel Yolland expresses the opinion that the company has rendered itself liable to the penalty of ten pounds for non-compliance with the section of the Act relating to the providing of the necessary means of communication.

The first question for consideration is, Whether it is a safe practice to run as many as 11 slip-carriages upon the rear of any passenger train? I think the general opinion of your readers will be that it is not.

In the present instance, had the driver applied the continuous brake to the first portion of the train a serious accident might have resulted from the rear portion running into it.

If the practice of slipping carriages is continued it is most necessary that they shall be fitted with continuous brakes. It will, therefore, be advantageous to consider what are the requirements.

1st. The driver must have control over the whole of his train (including the slip portion) up to the point of "slipping."

2nd. The guard of the "slip portion" must (to fulfil the Board of Trade conditions) be able to apply the whole of the brake power even upon the engine, so long as his portion is attached to the train.

3rd. The brake must be automatic upon the whole train, and apply itself to both portions, in case of a break-loose, or separation at any other part of the line, except where the vehicles have to be slipped.

4th. When "slipped," the continuous brake must be left in perfect working order upon both the train and "slip portion."

5th. The guard of the "slip portion" must be able to take "off" and put "on" the continuous brake upon his portion, in order to regulate it in running to the platform. In case of any emergency, or the train being suddenly and unexpectedly stopped, it is most important that the "slip guard" should have a good continuous brake upon his portion, or a serious collision may result.

Trains are daily running upon the Great Eastern and Brighton lines, also in France, provided with the Westinghouse brake, arranged to comply fully with all these very necessary conditions.

The tap in the main brake-pipe at the rear of the train-van, and the one at the front of the slip portion, are so arranged that the guards can close them before "slipping"; and, as the slip-carriage or van is provided with a reservoir of compressed air, and also with a driver's valve, the brake can be taken off, put on, and regulated, precisely as is done by a driver from the engine.

General Hutchinson has issued his report upon a passenger engine leaving the lines in consequence of the rails having been taken out during relaying, near to Chorley, on the Lancashire and Yorkshire Railway, on 1st August.

A platelayer, *the servant of a contractor* (with a gang of men), was employed to relay. He had not a copy of the railway company's rules, and, even if he had, it will be seen that he was not amenable thereto. This man, by some mistake, thought that the train had passed, after which he was to break the line, the result being that when the 10.13 a.m. train from Chorley arrived at the spot, the rails had been taken out. Fortunately the driver saw the danger when about 180 yards off; he reversed the engine and whistled for the guard to apply Fay's brake, which was fitted to the four rear carriages and the van. The train was pulled up, with four wheels of the engine dropped into the gap.

Fay's brake was thus able to prevent what might have been a very serious accident, but General Hutchinson remarks that, "Had the continuous brake been applied also to the engine and tender wheels, and been under the control of the driver, the accident would have been altogether prevented."

An accident took place on the 12th of September, near Remicourt, the details of which are now published. It appears that when the express from Cologne to Brussels was running at a high speed down an incline, the engine left the line in consequence of the leading axle breaking.

The trains upon the Belgian State railways are fitted with the Westinghouse automatic brake, and it did very excellent service in this case, as immediately the engine ran off the rails, this brake brought the carriages safely to rest upon the line without any loss of life, or telescoping of the vehicles. The circumstances of this case are very similar indeed to those of the Ely and Kleen (Russia) accidents; as in all three instances the Westinghouse brake, by its powerful and instantaneous action, prevented what might have been fearful disasters.

Of course it is a fact well-known to your readers that passengers are not killed by the actual collision between any two trains, or between a train and buffer stops, or by an engine leaving the line, the loss of life which follows is the result of the "piling-up" and "telescoping" of the carriages in consequence of the front part of the train being very suddenly checked or stopped, and by the rear portion running or "telescoping" into it at full speed. Hence it follows that to save life it is necessary that this "telescoping" should be prevented by destroying as quickly as possible the *vis-viva* or "smashing force" of the rear portion of a train; this can only be done by an instantaneously-acting automatic brake applying itself to every wheel and preventing the latter part of the train from overrunning the former. An efficient automatic brake I have often pointed out is not only a good "train-stopper," of great use in case of a "break-loose," but in my opinion, its most important advantage is that it prevents "telescoping" of the carriages, and thus saves the lives of passengers.

In my latter, page 91, I referred to the accident at Hugstetten. A German paper, the *Illustrirte Zeitung*, has given a very excellent photograph of the wreck, and also a ground plan or diagram showing the positions of the vehicles as they were found after the disaster. This diagram furnishes very valuable information, and I feel convinced that it would be a great advantage if all the reports of the Board of Trade inspectors were accompanied by similar ground plans of the wrecked vehicles. In this country it is frequently the case that the débris is cleared away before any ground plan has been made or the actual distances measured.

Clement E. Stretton.

Saxe Coburg-street, Leicester.

LEGAL REPLIES.

[20648.]—Patent Medicine — Stamp License. (48204).—The Statute 52 Geo. 3. c. 150, requires stamp duty to be paid on all articles sold as medicines, or held out to the public as beneficial to the prevention, cure, or relief of any disorder or complaint affecting the human body. This definition would clearly include a "specific," by which I presume the querist means an ointment to cure certain maladies, and it would, therefore, require a stamp upon each pot according to its price; while a license to sell the same as a patent medicine would also be necessary.

Lease—Smoke—Damages (48206).—Without reading the agreement and knowing all the facts I cannot safely advise upon this case. But if the lease be valid and in the usual form, I am at a loss to see how the tenant can get out of it because a chimney smokes, and, still less, how he can bring an action for damages. Either the tenant's solicitor is trying to frighten the querist, or there is more in the case than is disclosed. The proper course would be to sue for the rent as it becomes due; thus treating the lease as existing; but I cannot possibly answer for certain without seeing the document.

Will—Separate Estate (48207).—Here again I cannot give a decided answer without seeing the will which I am asked to construe, especially as the question is confused, and does not state clearly whether the daughter B. took only a life interest, or took the whole; neither am I told whether the property was real or personal. If the daughter B. took the whole, absolutely for her separate use, then she could will it away as she liked, or, if she did not, it would go to her heir or next-of-kin. On the other hand, if, as seems probable, the mother had only a life interest, while the reversion was in the daughter, then, of course, she could not will it away, with or without her daughter's consent. Supposing the daughter died before the mother, it would go as the will directs, or to B's. heirs, or next-of-kin. But without seeing the will, it is merely guesswork.

Bills of Sale—Receipts (48208).—The querist must exercise his own discretion as to showing his receipts to the Bill of Sale holders; and certainly, he cannot be compelled to do so. If they choose to proceed upon their Bill of Sale they run the risk of an action for damages, should he have paid all that is owing. I do not think the mortgagees are bound to give any receipt in full, but if they will not return any securities they hold, the querist can sue them for the same in the County Court. If he wishes to know more of Bills of Sale generally, and under the new Act, he can read my handbook, just published.

Heir at Law—Statute of Limitation (48210).—The land being freehold, there is no doubt that upon the death of the owner intestate, it descended to his heir-at-law, who was his infant grandson. But it seems that the deceased's widow obtained, and kept possession of the land for 17 years. By the Statute of Limitations of 1874, which came into operation 1879, an action to recover land must be brought within 12 years, unless the claimant is an infant when the right accrues, in which case he is allowed six years more from the date of his coming of age. In this case, therefore, the grandson has a clear claim to the property, which, as he has only just come of age, is not barred by the statute; and the matter is one upon which the executors should take legal advice, with a view to an arrangement.

Will—Reversionary Share (48214).—In this case it is clear that, after the wife's life interest, the testator left his property in equal shares to his three brothers; and even took care to add their assigns, which was unnecessary. The effect was, that upon A's. death, these shares at once became vested in the three brothers, and they could, therefore, do what they liked with them as their own property. The deceased brother had thus a perfect legal right to give his share by will to his widow; for the property in it was his although he never had the possession; and having so bequeathed it, his children have no claim whatever.

Bills of Sale—Registration (48215).—By the present law, an unregistered Bill of Sale is valid, and binding as between the parties to it, but is void as against the creditors of the grantor, and in bankruptcy. The querist has done no harm by signing the promissory notes, for as long as he pays his instalments, neither they nor the Bill of Sale can be enforced; while if the Bill of Sale were acted upon, the notes would become useless; except, of course, as against any surety who may have signed them, and it is for the purpose of having a surety, that they are commonly employed. If the querist wishes to know more about Bills of Sale, and the New Act, he can read my Hints thereon, just published.

Will—Revocation of Probate (48222).—It would require a very strong case indeed, even if it could ever be done, to get the Court of Probate to set aside a will twenty years after it has been proved. Revocation of Probate, if it be not made in solemn form, can be obtained sometimes, but it would be a costly and uncertain proceeding here; and the delay would have to be satisfactorily explained. Cases of this kind generally arise when a later will is discovered after one has been proved. But here the grounds for upsetting the will are, that it was obtained by undue influence, and that the testatrix was incapable. Why, then, was not the probate disputed at the time? Now it is too late.

Building—Highway (48246).—The conveyance ought to contain an accurate description and measurement, and plan of the land bought by the querist, so that he could know the boundaries of his own property. But if this will not tell him, he must find the limit of the road from the local authorities. Roads vary in width, and I am not aware of any rule by which this question can be more definitely answered.

Copyholds—Resulting Trust (48256).—Presuming A. to have paid for the property himself, and not to have had any intention of giving it to B., then the effect of buying it in B.'s name, was that B. became the legal owner, but held it in Trust for A., who would be the equitable and beneficial owner. There was in truth a resulting trust which will be enforced by the Court of Equity. A. can demise it by will as he chooses, and if he does not do so, then it will go to his heir, according to the custom of the manor. B. has no title to it at all, unless he can show that A. meant to give him the property, and not simply that he was to hold it in trust for him. If B. will not convey it to the beneficial owner, or act as a trustee should, then he can be compelled, by means of an action in the Chancery Division, to carry out the Trust. **Fred. Wetherfield,** Solicitor,

2, Gresham-buildings, Guildhall. E. C.

THE PRODUCTION OF LOOPED (?) FIGURES BY GEARS.

[20649.]—When I asked "J. L." to tell us whether he meant that true loops could be produced by the geared rose-engine, I hoped he would have explained how such loops as those in his illustration, page 583, could be traced.

He kindly noticed my query in your last issue, but only to state that figures really looped can be cut.

Were "J. L." a less great authority on lathe matters, I should boldly say the thing is impossible. Is it not strange that in a series of articles on "the production of looped figures by gearing" we should have to be content with the statement on page 583 that such figures can be produced, whilst all that is explained is how waved figures are traced.

All figures produced by the rose-engine alone are the result of two movements—a radial caused by the rocking of the head or of the slide-rest, and a continuous circular, caused by the revolution of the work on the mandril. Now, I contend that these two movements will produce waves, but not loops, except when the waves reach the centre.

F. A. M.

HUYGHENIAN EYEPIECES.

[20650.]—Having fitted up my own set of these eyepieces, and arranged them so that the distances between the lenses may be varied at will, I have experimented with them in various ways, in order to get best results. I find three defects, which it seems impossible to remedy altogether. There is the tinge of colour on objects just entering into, or going out of, the field of view; the curved field which necessitates a slightly different focus for the edge than the centre; and, lastly, reflections between or from the lenses, which often may be mistaken for real stars. As regards the first of these, it may be much decreased by placing the lenses nearer together than the usual distance; but this brings into existence the last defect—namely, a reflection, upon which no turning round of the o.g. or eyepiece has any effect (if they are truly centred), but which may be known to be spurious by its moving in an opposite direction to the real star. The closer the lenses are together the larger does the reflection become, and it can only be eliminated by placing them far enough apart. This is about, if not exactly, half the sum of their focal distances; but if this point be passed (and I find it limited to about the 50th of an inch), there will be another reflection which increases in size as the lenses are still further separated. When placed beyond the above point the eyepiece is not much better than a single-lens one. When the lens are placed the distance apart which admits of no reflections, we have then the first and second defects plainly apparent. I should judge that the above distance can only be obtained by actual trial from the difficulty of getting it in my own eyepieces. I believe that the above defects cannot be removed altogether in the Huyghenian; but why should they not in the achro' construction? I have tried achromatic lenses, but they have the same objectional reflections as the others. I should be glad if some one who has a ¼in. achro' e.p., consisting of two or three lenses cemented together, would say how it performs in reference to the points I have mentioned: also, if the field of view is as large as is generally the case in the Huyghenian, for the angular aperture of an ocular seems to be important. I once tried one of the cheap ¼in. micro. lenses, plano-convex; but it showed a much darker image than a ¼in. Huyghenian, owing to its small diameter, which was just 1-10th of an inch, while the field-lens of the other was 7-32nds clear. The question of a perfect eyepiece is important to those of us who have no clockwork to keep an object in the centre of the field of view, and is also worthy the attention of our mathematical and practical correspondents.

F. T.

THE ELECTRIC LAUNCH.

[20651.]—Your correspondent (letter 20627), "E. F. N.," says he would like to hear what I have to say as to the machinery of the above vessel. I presume he means as to its comparative weight to that of a steam-engine.

In making such comparisons, *time* is an important element. A storage of electricity is analogous to a storage of any other article, the letting out or lowering down of which may be utilised to produce useful work.

If a weight of 1,000lb. is raised 33ft., the letting down of such a weight in one minute would represent one horse-power, and we should say our one horse-power weighed a little over 1,000lb. But if the weight were allowed to fall the 33ft. in 15 seconds, it would be at the rate of 1,000lb. weight to four horse-power, or 250lb. to one horse-power, although the total amount of power would only be as before, one horse.

This shows the difficulty of comparing the two motors, electricity and steam.

To make a fair comparison, we must take the weight of the electrical apparatus, time of run, and horse-power exerted at 33,000 foot-pounds per minute; and the weight of a steam-boiler, engine, water, and coals, to do the same amount of work in the same time.

If I put the electric launch in the most favourable light, and assume that the whole of the machinery and storage batteries weigh only 2,240lb., and the run at six hours, this compares very unfavourably with steam.

Assuming 20 horse-power to be exerted, it is easy to construct an engine and boiler at, say, 40lb. to the horse-power, 800lb. Then coals for a six hours' run, at 5lb. per I.H.P. = 600lb., total weight 1,400lb., compared to the 2,240lb. for the electric launch.

If the electricity is used in half the time, three hours, this would appear to reduce the relative weight: but the steam-engine might readily be designed to do the same thing, with a three hours' supply of coal, and greater pressure, or piston speed, &c.

I am closely watching the development of electro-motive power, and I think the above example is very creditable to all concerned; but it can scarcely be called a *light* motive power at present.

Sensational paragraph writers in daily papers do a great deal of damage to the cause of real scientific research, by unduly lauding electricity. The same unwise conduct took place when railways were young; we were continually being told that the locomotive would "annihilate time and space"! a feat which is yet in the far future.

Oct. 14. **Thomas Moy.**

ELECTRO-MAGNETIC UNIT OF POWER.

[20652.]—I think that "Milverton," letter 20573, p. 89, will find the information he requires in Prof. Everett's well-known "Units and Physical Constants." Dr. Siemens, in his address (I quote from the report in the *Electrical Review*), says—"A Watt then expresses the rate of an ampère multiplied by a volt, whilst a horse-power is 746 Watts, and a cheval-de-vapeur 735." Or, in other language, since the volt $= 10^8$, and the ampère $= 10^{-1}$, the Watt $= 10^8 \times 10^{-1} = 10^7$ .... (1).

Now, from Prof. Everett, p. 168, the horse-power = 7·46 erg-nines or $7{\cdot}46 \times 10^9$, or by shifting the point 746×10^7, and in the same way force-de-cheval $= 736 \times 10^7$, so that, since from equation (1), the Watt $= 10^7$, the horse-power = 746 Watts, and the force-de-cheval = 736 Watts.

Dr. Siemens calls the cheval-de-vapeur 735, while Prof. Everett calls the force-de-cheval 736. The latter number I have used (it will be noticed) in this calculation.

Frederick John Smith.

IMPROVED BICYCLE HEAD.

[20653.]—I think that one great fault of Mr. C. P. Archer's design for bicycle heads (letter 20617) lies in the fact of his proposing to have a vertical spring in the head, as this, having a downward tendency, will, in all likelihood, allow the backbone shutting on to the rubber tires when the small wheel springs forwards, and this will speedily bring the rider to *terra firma*, and in a manner not very pleasant or mildly—viz., "over the handles."

This, I think, will undoubtedly be the case if the socket G (as I understand it) is allowed to slide on A, the spindle attached to the forks.

A Bicycle Rider.

MIRRORS OF REFLECTING TELESCOPES.—TO "ORDERIC VITAL."

[20654.]—I confess to having read letter 20566 (p. 88) with considerable disappointment, as I had hoped that one who had shown himself so familiar with the mathematics of optics might have turned his attention to reflecting telescopes by way of completing the subject. I do not think Tulley's remark is so meaningless, for it was no doubt the result of years of practical experience during which, as he expressly states, he found that the same curve of the large mirror was *not* suited for the three varieties of reflecting telescopes.

I naturally hesitate in expressing an opinion on a matter of such difficulty, but I think "Orderic Vital" is wrong in assuming that the parabola is of necessity the proper curve for the Cassegrain and Gregorian, though it is, doubtless, essential for the Newtonian.

I look upon it in this way. In the Newtonian, the cone of rays proceeds *direct* to form the image, for of course the flat merely changes the direction of the rays as a whole, without interfering with their relationship one to another; but in the Gregorian and Cassegrain the case is quite different, as the rays are received first on a curved surface, and not on a plane.

Suppose for a moment the large mirror were a spherical curve, then the rays from the central zones would converge to a focus at a longer distance than those from the outer zones, producing, of course, a certain amount of longitudinal aberration, and it is clear that no *plane* surface could receive simultaneously all these different focal images; but it seems equally clear that a curved surface would do what the flat surface could not, and this is just the case in the Cassegrain and Gregorian constructions. If, for instance, there was a difference of, say, a fiftieth of an inch between the central and marginal focal length, I see no reason why this aberration should not be corrected by a curved surface, whose versed sine was equal to this difference, or, perhaps, I should rather say by a curved surface which varied to this extent from the curve of small mirror that would be suitable to receive the rays from a parabolic "large" mirror.

In reality as the small mirror is not situated *at* the focus of the large mirror, the amount of aberration to be dealt with by it would differ from what I have assumed to exist; but "Orderic Vital" will, I am sure, easily understand the principle for which I am contending, and will then, I hope, admit that Tulley's idea of *pairs of curves* is not the fallacy he assumes. Since the working of the small mirror to any other than a spherical seems to have necessitated the employment of this curve only, the question resolves itself into the best curve for the large mirror, and this must evidently *not* have been a parabola. Cannot "O. V." kindly tell us *what it was*, or *should* have been.

I have never come across an untouched "Short" speculum; but the result of a test by Mr. Wassell and myself of an old Tulley mirror belonging to a Cassegrain was to show that the curve was *not* a true parabola; but whether the variation was due to imperfect figuring, or was an *intentional* correction of the figure to such a spherical small mirror, we had no means of telling. **L. L. L.**

FITTING AND FORGING.

[20655.]—I notice that in No. 913 "Amateur Fitter" asks for some letters on Fitting, and "Oliver Twist" says he misses some of the more practical papers which used to appear in the earlier volumes. I, like many others, have often wished for something of the sort, that I might with more confidence begin to fit up a set of lathe-castings. Mr. Brown, at the conclusion of his papers on "Tools and Motive Power," spoke of giving, at some future time, some such papers on Fitting.

I was very glad to see "J. L.'s" paper last week; and, judging from the number of queries anent fans and blowers, think that a few letters on Smith's Work—how to make tongs, &c.—would be very welcome. **H. W. W.**

VEGETARIANISM.

[20656.]—May I be permitted to follow Mr. Stooke's letter (20597, p. 113) in the briefest possible manner, in reply to the vegetarian doctrines there laid down and vegetarian arguments propounded? And, in the first place, I will observe that no one denies the "facts respecting man's adaptation for vegetable diet," so that vegetarians in saying this do not militate against any "flesh-eater's" tenet or position.

But I would inquire of Mr. Stooke if he does not consider that man is "gregarious" by the operations of reason, rather than through any natural proclivities for "vegetarianism" or "frugivorousness"? What analogy, I would ask, is there between the metropolis of Great Britain and a gang of buffaloes, a herd of antelopes, and a colony of monkeys? If man belongs to the instinctively "gregarious animals," why does he not "herd it" in the frugiferous country, and glory in a frugivorous diet?

But I would ask Mr. Stooke to oblige me by promenading (or otherwise transporting himself) into the Ludgate-circus, and he will there witness the "analogy observable between man" and the lion, as well as between him and the ass. There is also to be seen the "analogy observable between" him and the ox; but I would inquire, has man the "cloven foot" of the "gregarious," "vegetarian," "frugivorous," and "herbivorus" ox? and does he want, like him, in his perfect state and condition, an artificial row of teeth for his upper jaw? On the other hand, is not the "analogy observable between man" and the lion more "observable" and more perfect? Why, Nature, down to the very extremities, operates in the same way in respect to both of these noble animals! In the one case she produces nails, and in the other claws—both by the same process, and both from identical secretions! Who will not, therefore, acknowledge that henceforth the British lion and the African ditto are "chums" and brothers?

The "analogy observable between man" and the "frugivorous" ape is, I suppose, too pronounced and, at the same time, too uncomplimentary to figure in the show-window above indicated. But many of the human species can, at any time, demonstrate *that* "analogy" by taking a sly glance at their looking-glasses. It was, without doubt, this spectrum of the speculum that hinted to the late Dr. Darwin his evolution theory, as many of the promenaders of Cheapside must have concluded, and I think *Punch* (will any kind reader tell me if I am right?) on one occasion reproduced the idea in a cartoon! But see the structural and anatomical difference "observable" between a human creature and the "frugivorous" ape; and what I should like to inquire is, if Mr. Stooke would have us to diet ourselves like monkeys?

But Mr. Stooke appeals to the "nutritive organs" for demonstration of our natural "frugivorousness." Now they are the very functionaries to which I appeal as challenging Mr. Stooke's position; for I don't know what *mine* would do if I debarred them of a mutton chop now and again!

Then, again, "carnivorous species possess teeth peculiarly formed for the tearing and masticating of flesh food"; and Mr. Stooke goes on to describe the "dentile apparatus" of the "carnivorous species," and his deductions are that "flesh food" needs greater mastication and mincing than vegetables and fruit, and that the "dentile apparatus" of the "carnivorous species" is specifically adapted to this undertaking. Now this is a singular jumble—and Nature controverts the truth of it, which adds to its ridiculousness! Specimens of the "carnivorous species" don't masticate at all, as can be proved at any time Mr. Stooke chooses to treat his dog with a skewer of cat's-meat; for no sooner does the dog fairly grasp the meat than down it "bolts," skewer and all; and this is a fair natural proof that "flesh food" is more easily digested and assimilated than a "vegetable diet," and consequently does not need a proportionate amount of mastication with fruit and vegetables; while nature further adds to this important proof. Flesh-food is but vegetable matter eliminated from its congenital dirt; and he who eats flesh eats vegetable *minus* the dirt—while he who eats vegetable only, partakes of the constituents of flesh with the earth and refuse of vegetable matter. Are we not taught to crush well the cells of an apple? And what animal is that that "ruminates," besides man? A "carnivorous animal" or a "vegetarian" one? It is the "vegetarian ox," who is obliged to "chew his cud" before he can pass the earth, filth, "muck," and rubbish he eats; while the large proportion of natural refuse from oxen plainly teaches us what a small proportion of vegetable matter is available to build up the fibres of the animal body, and how the digestive organs of "vegetarians" must be surcharged and encumbered with this rubbish in taking a sufficiency of vegetable matter to carry on the due processes of nature! I conclude, then, that flesh-food is sublimed vegetable matter in a state of semi-concoction; that it does not need so much chewing, and that it is more easily digested, and more adapted to the wants of human nature than any other kind of food.

But to return to the "dentile apparatus" of this dental subject. Does Mr. Stooke presume to postulate that unless we can show a mouth like a lion's, or jaw-bones like those of his diagram, that we have no natural warranty to partake of a mouthful of flesh food? How preposterous! Vegetarians seem to have created an intellectual world for themselves; but, like flies on the ocean, they also seem wholly unable to get beneath the superficies of their own creation! This "dentile apparatus"—what is it? It's an offensive and defensive weapon—it's an apparatus for gripping and holding its victim; it is a ditto for the slaughter of the victim, a ditto for tearing and cutting up the carcase; and, lastly, a "set of teeth" for giving a parting "nip" to each morsel before it leaves the mouth of the animal for its capacious stomach. It takes the place of our own jaws, our hands, our knives and forks, our mincing apparatus, our cookery, and what not. And who shall now say that, with all these accessories, we need the teeth of carnivorous animals to demonstrate our privilege and duty to partake of flesh food as a daily diet?

I am sure I do not know how Mr. Stooke himself may be off for a "dental show," but he is certainly aware of the fact that human teeth are designed both for "use and ornament"; and possessing as they do the variety of incisor, the canine, bicuspid, and molar, I think we may fairly conclude that, *inter alia*, man, in respect to food, at least, is discretionary in his liberties, and that an "omnivorous" table conforms more to his wants, his pleasures, his heathfulness, and longevity.

In respect to the length of intestine, Mr. Stooke's argument runs like this: that a long lane was made to perform a long journey in, and, therefore, it is not legitimate to perform a short one in it; the length of our intestine corresponding in a nearer proportion to that of the "herbivorous classes," which is greater in length than the intestine of the "carnivorous species," only goes to prove that man is eminently suited (in those regions at least) for an "omnivorous" regimen—for, certainly, length can accommodate shortness when shortness cannot accommodate length.

Mr. Stooke attempts to make a point of the fact that "we cannot eat animal food unless it is cooked." But how about his vegetables? Would he really have us to devour a raw steak as a boy would a gingerbread cake? It is our preparation of flesh by means of heat that will ever distinguish us from the true "carnivorous animal." The elements of flesh are changed by the chemistry of cooking, and it is literally no longer *raw flesh*, but *cooked meat*; and hence we are no more "carnivorous" than the "vegetarian" himself.

The advice to take a dish of boiled onions for supper would be all very well as sauce to a boiled rabbit or a roast shoulder of mutton; and as to the "vegetarian roast goose," I shall myself always prefer the "genuine article" until converted to their principles by the vegetarian brotherhood.

How much soever these estimable men may deserve our respect for their self-denial, they are yet much to be commiserated for their self-imposed fallacies and pernicious illusions. **G. B. T.**

MICROSCOPY—NELSON'S ADAPTER.

[20657.]—On p. 127 a description of this appliance is given which appears to me not wholly accurate. I therefore submit the following correction to the notice of your contributor:—

It is there stated that "The best position for insertion should be marked, as in the other two positions more than one-eighth of a turn will be required to fix or release the objective."

Having the device before me, I find, in fact, that unless the insertion of the objective in the nose-piece be made at the corresponding slots, which are each one-eighth of a turn from the final "screwed home" position, the one-eighth turn for screwing "home" cannot be effected at all except by such an exertion of force as would injure the screw-threads. Your contributor's reference to the two other positions requiring more than one-eighth of a turn is, therefore, imaginary: the insertion can, it is true, be made in either of *three* positions, but only in *one* position can the one-eighth turn for screwing "home" be effected. So far in correction.

Although the best application of the system probably involves sending one's microscope and objectives to an optician to have the screw-threads cut away suitably, yet a compromise may be effected, at least so far as sending the microscope is concerned. Messrs. Powell and Lealand, 170, Euston-road, undertake to cut away the screw-thread as required from the objectives and supply an *adapter nose-piece* that will screw on to the usual nose-piece of the microscope, thus permitting Mr. Nelson's rapid changing system to be put in operation at once.

One may emphasise the point that the application of Mr. Nelson's system to the objectives in no way injures them for use on microscopes having the usual nose-piece intact; and, similarly, the alteration of the nose-piece does not interfere with the use of any objective provided with the "Society" screw. Mr. Nelson's system requires simply that the thread of the "Society" screw on the objectives should be filed off, down to the face of the cylinder on which it is cut, in three equal and equidistant segments; the thread of the nose-piece of the microscope (or of the adapter nose-piece supplied by Messrs. Powell and Lealand) is cut to correspond. The process of applying the objective is then as follows:—The objective is pushed into the nose-piece in the position marked by a gauge-slot (care being used that the gauge-slots on the nose-piece and objective coincide), one-eighth of a turn to the right then screws it "home" precisely as it would be after the four or four and a half turns required with the normal "society" screw and nose-piece.

The problem of devising an efficient and rapid system of attaching objectives to the nose-piece of the microscope has had some attention in years past. As far back as 1862, Mr. Wenham canvassed amongst his friends a plan that would have required about one-third of a turn of the screw to fix or release an objective; but the time was not ripe. Within the past two years Messrs. Parkes of Birmingham, Alfred Nachet, of Paris, and Vérick, also of Paris, have brought out special devices for this purpose; but these devices have all involved too radical a change from our present system. Our position is not one of perfect freedom to start with the most efficient system of nose-piece. We are committed to the "Society" screw in thousands of microscopes and objectives. What we want, then, is a method of rapidly changing objectives without injuring our existing means. The feasible method must necessarily be ot the nature of a compromise. Viewed in this light, Mr. Nelson's suggestion appears to me to meet the case practically.

With regard to employing an adapter nose-piece, (*i.e.*, an *extra* nose-piece) for carrying out Mr. Nelson's plan, as above alluded to, it may be objected that the application of another nose-piece will necessarily cause an alteration of centring, and consequently any large collection of objects whose positions have been duly registered by means of finders, will require the whole of this tedious work to be done anew, which, at a glance, might seem a formidable task. The matter can, however, be reduced to the very simple process of ascertaining the difference between the new (adapter) centre and the former one; this difference being a fixed quantity, may be added to or subtracted from the former registered positions, as the case may require.

F.R.M.S.

DREAMS.

[20658.]—"Didaskalos," in query 48264, to which I take the liberty of replying at greater length in a letter, asks a very hard problem about dreams and unsound sleep. They are due to many different causes, and some of these so complex that we cannot always trace their origin. The correct posture for rest is on the right side; if we lie on the left side we tend to compress the heart, and so give rise to painful beating of it, which is distressing. Lying on the back is more harmful still, as the loaded bowels or distended bladder give rise to much uneasiness, nightmare, and erotic dreams. The night's rest depends in a great measure on the state of the body, that is healthy or diseased, and on the state of the mind. A person who is in indifferent health is more likely to dream than a person who is hearty and well, and who is tired with his daily work. Mind troubles are often the cause of restless nights; we carry the cares of the day to bed and continue them in our sleep, and get up next morning almost as tired as when we went to bed. Unusual mental or bodily excitement in the day may thus give rise to dreams at night. Heavy work before retiring is bad, as the system is too excited to allow of quiet slumber. Never read horrible tales before retiring if your mind is at all active, or you may be an actor in a like tragedy most part of the night. The great cause, though, of nightmare and alarming dreams are heavy suppers; such suppers consist of meat in some form—more especially pork or veal—fish, or cheese. The worst nightmare I ever had was from cheese and pickles at supper. If supper is taken at all, it should consist of some light farinaceous food, taken at least two hours before retiring. Some inform me that they cannot rest unless they have a good supper, but these people are never well; they dream much, are late risers, and headachy when they do get up, and most often have no relish for breakfast. Alcohol may give rise to sleep for two hours after being taken, but then it most often wakens one up, and you are an hour or two before you get another sleep. If a person is tired when he takes it, he sleeps then in spite of it. Thus, you see, we cannot recommend alcohol as a soporific. Want of exercise plays an important part in our night's rest; if we have done little in the day, we may not be tired enough for sound sleep, and so the brain runs riot. Tea and coffee, near bed-time, are more harmful in producing wakefulness than for inducing dreams. A distended bladder or constipated bowels also helps to produce dreams, so may slight pains in any part of the system. A quizzical person reading this may exclaim "Gracious me! everything seems to produce them," and he is very nearly right. Recollect that every sensation we receive is carried to the brain, and there we are made aware of it. Thus, if I am standing near a stove, the beat acting on the nerves of the hand communicates a sensation to the brain, which I recognise as that known as heat.

Thought is molecular motion, or the result of certain impressions conveyed to the brain-cells. Now, in sleep the controlling power of the brain is asleep; sensations are sent to the brain, and thence to the controlling power, but, as that is asleep, we are aware of the strangest mixture of impossibilities. Thus, I am in a London garden with the Queen, and I am looking at the swans on Windermere with some friends around me; these friends, say, are dead.

If I were awake, I should not be with the Queen in a London garden, nor should I be able to see Lake Windermere, nor yet see my dead friends. When awake these same ideas are sent to my brain, but they are sifted or examined by the controlling power and either rejected or are allowed to give rise to thought. When asleep all our sensations are carried to the brain, and instead of being checked off and found true or false, they are all set forth as real.

When we are awake and pain is felt, we can feel the part where the uneasiness is; but when asleep the pain-sensation is sent to brain-cells governing the part, and as they cannot be checked off, they give rise to irritation, which irritation gives rise to horrid dreams, and we are often awoke in consequence. If a person is dreaming, and a noise is being made at the same time, then the noise is brought into the dream and forms part of it; if we were awake we should know what the noise was due to.

Dreams are of two kinds, those which go on soon after retiring—of such are the nightmare kind; and those most common ones which come on after our first turn-over in the morning, and which vary in kind, being pleasant or otherwise. In a very short time one can dream of a very great deal; in ten minutes a person may live a fortnight, or even longer.

Cure.—It may be divided into the *direct* and *indirect*.

The *direct* cure is avoidance of meat, fish, or cheese at supper, and not to take supper of any kind just before going to bed. Do not read sensational tales last thing at night, and avoid great bodily fatigue at the close of the day. Also avoid much fluid towards bedtime. The *indirect* cure is to improve the tone of the system by daily sponging the body and limbs with lukewarm water, taking plain food at regular hours, having as much fresh air as possible, and taking a regular allowance of exercise to fatigue the body, and make sure of sleep. To the sedentary or those engaged in literary work, "after supper, stroll a while," is a very useful plan. If constipation exist, then use the wholemeal bread at meal-times, and take a regular supply of greenstuff, fruit, or nuts.

T. R. Allinson, L.R.C.P., &c.

Oct. 17.

"A. S. L.'s" HYDRO-DYNAMIC PARADOX.

[20659.]—There is no motion of this apparatus to investigate, it being incapable of making one revolution per second. If it performed at all, the momentum would carry the tubes past the "curved passage," and what mechanical power of the "system" could retrieve the overshot? But if the tubes made a perfunctory performance of their duty, there would be four awkward jerks in each revolution, and four rather long stoppages "to water" in. But the main "fallacy" of the supposition that one could get a continuous revolution (we won't mention the other words) out of this mechanical contrivance, lies in the patent fact that the bellows E would never be capable of sucking the water up out of the bellows. There would be a sufficiency of air within the tubes A and B to permit of the expansion of the bellows E, without trenching on the fluid in F for the supply. That fluid, of course, might rush into the abovementioned tubes to fill the void; but I doubt if you would get a driblet of it into the bellows E. "A. S. L.'s" reasons for the non-revolution of this apparatus, and the pulley and beam phenomenon are alike erroneous. The fluid in the one case does not act as a counterpoise to the weight E, seeing that it does not pass through the tube G, and in the other case the "companion weights," when equal, balance each other, and the opposite weight of the beam also. **G. B. T.**

Erratum.—I notice an error in the sketch of the stars surrounding M. 57 Lyræ, p. 136. The bright star on the line from "14" to "9" should be numbered "1" and not "2."—H. Sadler.

FACTS AND FIGURES.

Production of Lead in 1881.—The following is an estimate of the production of lead in Europe for 1881, which is as follows;—Spain, 120,000 metric tons; Germany, 90,000; England, 67,000; France, 15,000; Italy, 10,000; Greece, 9,600; Belgium, 8,000; Austria, 6,000; Russia, 1,500; total, 326,500. Herr Landsberg estimates the production of the United States at 110,000 tons. As the output of Mexico, South America, Canada, and Australia is small, it may be assumed that the world's production is about 440,000 tons of lead. This does not include China, which is a heavy consumer of lead, and is not unlikely a producer of some importance; nor does it include Japan, of whose output there are no figures.

Oil on the Troubled Waters.—Experiments with oil in Aberdeen Harbour were resumed on Monday last. The oil was pumped from three valves, 28ft. apart, extending across the Channel, inside the breakwater. Seventy gallons of oil were expended, and the effect at the time was very marked. Although a stiff south-easterly gale was blowing, the waves disappeared wherever the heavy belts of oil were traced.

Fluke in Sheep.—Readers who remember the discussion on the cause of fluke in sheep, in these columns some time back, may be glad to test the value of a remedy reported at the last meeting of the Devonshire Chamber of Agriculture by Mr. Heath, the county veterinary inspector. Mr. Heath obtained several sheep last autumn, and throughout last winter kept them on permanent pasture which had in all previous years been highly injurious to sheep. One-half of the flock he turned out loose, without taking any but ordinary precautions, but with the food of the remainder of the flock he mixed a quarter of an ounce of salt and half a pint of corn for each animal. He saw that they acquired a taste for their food with this mixture before they went out to pasture, and then when in the meadows the supply was given them daily. The result was that whilst the germs taken in with the food developed the "fluke" in the first half of the flock, the remainder, on which the salt and corn experiment was tried, entirely escaped, and were perfectly sound when killed. The experimental sheep realised a profit of 50s., and the corn and salt only cost 3s. for the winter.

Indiarubber Paste for Driving Belts.—Half a kilogram of finely-cut caoutchouc is melted with half a kilogram of oil of turpentine in a well-covered iron pot at a temperature of 50° C. When all is melted 400grm. colophony and afterwards 400grm. yellow wax are added to the mixture, which must be stirred now and then. In another pot 1·5 kilo. of whale oil and 0·5kilo. of tallow are heated till the latter is melted, and then the contents of the two pots are mixed while hot with continual stirring, which is continued till the mixture solidifies. The use of the paste is as follows: Old brittle belts are brushed over with it in the sun or in a warm room and allowed to dry. While being used the inner side of new as well as old straps is from time to time smeared with the paste, which renders them durable and causes them to adhere well to the pulleys. Instead of pure caoutchouc, indiarubber waste, which has previously been boiled with caustic soda solution for a quarter to half an hour, may be used; but instead of 500grm. about 625grm. should be taken.

The Standard Instantaneous Grip Vice.—The principal advantages of this vice, which is illustrated in our advertisement pages and is made by Mr. T. J. Syer, are:—(1) It grips and relaxes its hold instantly, in any distance up to 13¼in. (2) The action and working of it is so complete that a piece of ordinary writing-paper can be secured as firmly as a piece of timber. (3) It effects a saving of about 75 per cent. of the workman's time, by its easy action and the certainty of its grip. (4) If wood-facings are fitted to it, all possibility of indentation of the article placed in it is removed. (5) These vices can be fitted to any description of bench, new or old. The workman has simply to raise the lever (or handle) to a perpendicular position with the left hand and draw out (or close, as may be necessary) the front jaw the required distance, then place the piece of wood, or other material, between the jaws, after which he must press the front one nearly close to the wood, then press down the lever, when the wood will be held firm in the vice. To remove the piece of wood he must raise the lever as described above.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47239.]—**Deafness.**—If iodine did not affect the skin, I should advise a trial of blisters. Procure Burt's "Liquor vesicatorius." Two fluid drachms will last a long time. Paint it on behind the ear for a minute with a short stiffish brush, taking great care not to let it run down or get in the eyes, or on the fingers. This will give no pain after a minute or two, and will raise a blister in three or four hours. Repeat as soon as healed, and see if there is any improvement. Perforation of membrane, certainly not.—F.R.C.S.

[47327.]—**Colouring Steel without Heat.**—Will "Essar" please allow me, as one of many interested, to remind him of his promise to furnish our readers with the recipe to accomplish this result?—H. T. J.

[47733.] — **Coil for Lighting Gas.** — To "Sigma."—I now see what the querist wants, but I cannot give him details without myself inventing the process and apparatus, which I cannot spare time to do. But I will give him two plans on which he can himself work out the details, with the knowledge he already has. First a coil of fine platinum wire may be rendered white hot, and so light the gas, as is done by the little portable battery so fitted; an inch or so of wire worked in a close spiral, or zig-zag would do, but I doubt whether the gas would not destroy it, as it would have to remain in the flame. The other plan would be worked with a small induction coil, such as are made to go in the pocket, battery included, and are worked by a couple of mercury or silver chloride cells; therefore, two or three Leclanchés would answer. The secondary wire would be connected to the spark-producing wires. The primary would not be fitted with a break, but conductors from it be led to a commutator, making a contact and breaking it, when a spark would pass. This commutator could be a part of the gas stop-cock, which might have a projecting stud, or even the handle itself might act as such; this should touch a spring as it begins to be turned on, and break contact as soon as the gas is issuing, in order that current may not pass while the light is burning. This would give one good spark, but if a series of sparks were desired, the ordinary contact break could be used with the coil as well. An exactly similar commutator could be used to operate the first system of heated wire. A coil without secondary might probably answer, in which the spark would be due to extra current only; in this case one end of the spark-forming wire would be mounted on the spring and be moved into contact with the other end by the act of turning on the gas, as described. This would very probably give a spark of more body, but not so vivid, and I cannot say without experiment which system would answer best; but from the description given, I think it is the last which is used in the cases mentioned. I should think that an iron core of ¼in. diameter, 5in. long, made of No. 20 iron wires, and wound with five or six layers of No. 22 copper, the whole soaked in melted paraffin, would do the work with three Leclanché cells in series.—Sigma.

[47735.]—**The Use of Salt.**—"Murano" says he has noticed that persons who are fond of salt are generally unhealthy or half-developed. I always understood that salt was a very healthy condiment, on account of the muriatic acid it contains, it being the muriate of soda. Diluted muriatic acid is frequently prescribed for indigestion. I am in my 69th year, and am very fond of plenty of salt in my food, and enjoy good health, and don't think I am half-developed.—Ebenezer Jones.

[47884.]—**Removing Copal Varnish.**—The fact that it is not easily removed is just the very thing that renders it so valuable—in combination with its hardness, of course. You can waste any amount of spirit over it; but the quickest way will be to stick to the scraper and the glass-paper. —T. P.

[47887.]—**Hot-Air Engine.**—A small hot-air engine was illustrated on p. 129, Vol. XXXII.; and another on p. 369, Vol. XXXI.—Essar.

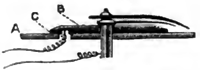
[47889.]—**Linen-Bleaching.**—If "In a Fix" will look in Ure's "Dictionary" under head of "Bleaching," he will find that the processes of linen-bleaching are rather too numerous to form the subject of a reply. In fact, the description would be as tedious as the process. Perhaps "In a Fix" has omitted to expose his linen to the action of the sunlight.—J. T. M.

[47900.]—**To Mr. Lancaster.**—Many thanks for noticing my query. My weather-glass would not work at all; the precipitate simply remained at the bottom of the tube. I have now made one as follows:—Camphor, 2dr.; potassium nitrate, 1½dr.; ammonium chloride, ½dr.; proof spirit, 2¼ fluid oz. I should be very glad if you could give me any indications.—J. C. B

[47914.] — **L.B. and S.C.R. Engines.** — To "Coridakus."—Nos. 245 Withdean, 255 Willingdon, 232 Buckhurst, are 4-coupled, wing-tank engines, known as the D class, and are not Terriers; 303 Milan and 304 Nice, are 4-coupled, tender-engines, known as D 2 class, and not Grosvenor class. No. 10 Banstead, 12 Wallington, 20 Carshalton, 32 Walworth and 34 Balham, are D class; 37 Southdown, 41, Piccadilly, 42 Tulsehill, 48 Leadenhall, 52 Surrey, 55 Stepney, 70 Poplar, 76 Hailsham, are Terriers. No. 99 Bordeaux, 100 Calvados, 106 Guernsey, are 6-coupled, side-tank goods, known as C class. No. 194 Glynde, 195 Portsmouth, are single expresses; 201 Belgravia and 204 Westminster, are 4-coupled tender-engines, coupled behind. No. 213 Norfolk is a 4-coupled tender-engine, coupled in front, wheels 6ft. 6in., and known as the D 3 class. No. 216 is an old 4-coupled side tank-engine. No. 232 is an old single tender-engine. No. 252 Buckhurst, 273 Dornden, 296 Osborne, 297 Bonchurch, are D class. No. 302 Turin and 305 Genoa, are D 2 class. 328 Sutherland, 344 Hurstmonceaux, and 350 Southbourne, are single express tender-engines of the Abergavenny class, and known as the G class. The number of the Horsham, which was 233, is now altered to 487.—Spike.

[47916.]—**M.R. Engines.**—126 and 128 were built at Derby, 1874; 123, rebuilt, 1878.—C. H.

[47927.]—**Electric Time Signals.**—In the figure A represents the dial of clock. A brass plate, B, is turned (and, if need be, ornamented with engraving, gilding, &c.) in the lathe, and cemented to the dial with marine glue C represents the layer of cement, which acts as an insulator to keep B electrically separate from A. See that the hole in centre of B is large enough to avoid contact between B and the tube carrying hour-hand. A wire, soldered beneath B, passes through a large hole in A without touching the latter, and is led to the outside of clock-case, being carefully insulated from all metallic connection with the clockwork. Short brass pins are fixed in B, so as to project 1-16in. or less above surface at the places corresponding to the hours at which your bell is to ring. A slip of platinum (brass would do almost as well, as there is rubbing contact) is soldered to hour-hand, so that, as it moves round dial, contact is made with these pins, and all you now have to do is to connect a wire to brass plate carrying the wheels, and cutting the wire joining an ordinary electric bell with its battery; join the two ends then made with the two ends respectively of the wires on clock, as you would join a "contact piece"—and there you are!—Glatton.



[47930.] — **Raising Water.** — Efficiency of hydraulic ram, under your conditions, would be about ·44 that of a Poncelet-wheel working a p.; that of a reciprocating-pump worked by a Poncelet undershot water-wheel, would be ·49; that of a reciprocating pump worked by turbine, about ·52. Neglecting friction, we find that:—Ram would raise 40 gallons per minute; Poncelet-wheel and pump, 44·6 gallons per minute; and turbine and pump, 47·62 gallons per minute.—Glatton.

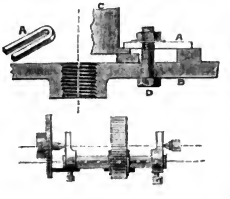
[47933.] — **Refrigerating Meat.**—"Anxious Inquirer" can have one of the cold-air producing machines, like that illustrated on p. 82. I am doubtful whether meat once frozen in that manner would cure well.—Essar.

[47935.]—**Ventilation of Room.**—Fix in two opposite corners of room a pair of wooden tubes, 4ft. 6in. or 5ft. high and about 6in. square; the lower ends to be connected with outer air-holes through floor; their upper ends fitted with a wooden throttle valve, so that the in-draught may be regulated. The outside may be painted or papered to suit the rest of room. No draught will be felt, and you will have plenty of fresh air. This is the first requisite. Now see that the hot air, after passing through ventilator in ceiling, can get away.—Glatton.

[47996.]—**Trammel Head.**—Your idea, I think, is a very good one. It is a pity that the engraver has shown a line dotted which ought to be full, thereby rendering it difficult, I should think, for those unused to mechanical drawings to understand. —Glatton.

[48023.]—**Fixing Cylinders and Eccentrics in the Lathe.**—To "Working Blacksmith."—Thanks for your reply to query 48023; it is a 3¼in. by 10in. cylinder that I wish to fit up; but I have no slide-rest to my lathe. Shall I be asking too much of you to know also how to turn the neck of crank, which will have to admit the connecting-rod brasses? The cylinder will be in the centre of bed, and the flywheel on end of crank-shaft, and bend pulley on the other. Any hints on the matter will greatly oblige.—Amateur Fitter.

[48023.]—**Fixing Cylinders and Eccentrics in the Lathe.**—Sketch shows usual method of chucking a cylinder; B is a face-plate on which cylinder is bolted by a number of clamps, like A, clearance being given for boring-tool by raising cylinder, &c., on packing pieces, as shown. Bore out eccentric, cut keyway and key on a mandrel, place a dog on each end of mandrel, mark centre on each at a distance from centre of mandrel = throw of eccentric, and mount between centres.—Glatton.



[48029.] — **Steam-power for Lathe.**—Why, certainly! The thing is done every day. Lag the pipe well with some good non-conductor—slag-wool for instance.—Glatton.

[48031 and 48162.]—**Transmitter, Bell's Receiver, and Simplex Telephone.**—A description of the Simplex telephone will answer both querists, and at the same time may be interesting to many others. Both the transmitter and receiver are adaptations of Mr. Strangeways' cup-and-ball microphone and electro-magnetic receiver, which have been fully described in this paper several times by that gentleman. The microphone is the most sensitive I know of (and I have made nearly every conceivable pattern), as it will transmit ordinary conversation carried on some yards from it, and for business purposes there are none better, the rationale of it being so excellent, every vibration of the diaphragm having a tendency to cause the ball to rotate, and thus prevent fresh contacts. The microphones are made as follows:—A square box 4in. by 4in. by 1¼in. made of ⅜in. wood. Inside the box diagonally on the bottom is screwed a strip of thin copper, on which are screwed three cups made of gas-carbon; the lid or front of the box is the vibrating diaphragm made of straight-grained white pine ⅛in. thick; on the back of this are glued 3 discs of carbon exactly facing the cups; 3 balls of carbon ⅛in. dia. are placed in the cups, and the whole screwed up. It will be necessary to mount the box to swing like a looking-glass, and when the right inclination is found secure it in that position. The lack of good results is in omitting this most important arrangement. One ball is the most sensitive when speaking at a distance, but 3 are best when speaking closer. The receiver is formed with three cylinders of wood, each 3in. diameter; the middle one 1in. thick, and the end ones ½in. thick. In a hole in the centre of the middle one is secured a reel, 1in. long and ¾in. diameter, with ¼in. hole through it, wound with silk-covered copper wire, size 30 to 36, and the hole filled with a bundle of soft iron wires filed even at the ends. The end cylinders have a recess turned in them, 2in. diameter and 1-16in. deep, and a hole in the centre, to take a brass tube which takes the flexible ear-tubes. A disc of ferrotype plate is screwed between the central cylinder and each end-piece. By this arrangement both poles of the core contribute to the reception of the sound. Of course, they have to be carefully adjusted before being screwed up. There is a great novelty in the method of switching in the box to insure a certainty of communication. When the ringing key is pushed to call the distant station the current is made to pass through the receiver of the sender, giving audible repetitions of the make and break of the armature of the distant bell. If this is not heard, the battery power must be increased till it is, and means taken to have the bell regulated. The length of this letter prevents me monopolising further space this week; but I shall be pleased to give a drawing of the switch if desired. Bell's receiver is not so good as Hickley's; but the latter was condemned in the last trial, and so can only be made, not bought. Bell's receiver, with the Simplex transmitter, is superior to any other combination, and is nearly all that could be desired by any one not quite deaf.—W. H.

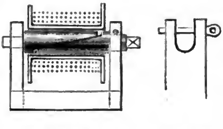
[48043.]—**Dead or Chemical Black on Steel.**—A brilliant black can, it is said, be produced on iron and steel by applying, with a fine hair-brush, a mixture of turpentine and sulphur boiled together. When the turpentine evaporates there remains on the metal a thin layer of sulphur, which unites closely with the iron when heated for a time over a spirit or gas-flame. This varnish protects the metal perfectly, and is quite durable.—Auld Reekie.

[48059.]—**Grape Wine.**—Make it by the same process as rhubarb wine, which process I described some six or seven weeks since. Burst the grapes at commencement. If they are not ripe from 10 to 15 per cent. more sugar will be required. Wine made from any English-grown fruit is not worth drinking, owing to the fruit being almost destitute of sugar. Almeira grapes would be much better, requiring the addition of but little cane or beet sugar. Raisin wine is the most wholesome that can be made in this country: requires no sugar, is therefore purely vinous, and will not grow acid by a reasonable age, if carefully made and stored.—Meliora.

[48064 and 48110.]—**Siphons.**—As generally used, siphons are very simple and effective: they can be started either by being fitted with foot-valves and filled with water, or by the air being exhausted by means of a pump fixed on the neck. Horizontal length of siphon but of little matter, provided there is a sufficient fall, and the vertical height not much over 28ft. "Aquarius" can give no further information unless supplied with details as to size of lake or reservoir, fall to be obtained, and time required to empty lake, &c. Under peculiar circumstances a personal survey might be required.—Aquarius.

[48065.] — **Counterpoise.** — The first weight would pull the point of attachment, the tack, to the lower side of wheel immediately beneath axis. Now, theoretically, an infinitely small weight will move it from this position a small distance. Probably this is what your friend meant. To counterbalance 10lb., 10lb. is needed.—Glatton.

[48071.] — **Coil - Winder.** — I send sketch, as requested. Spindle is made in two halves, the joint sloping so as to make them wedge-shape in side elevation. One bearing is round, the other forked, so as to admit of removal of spindle. A handle for turning to be fitted on squared end of shaft. A simpler plan is to fix core on coil and drive a thick iron wire in its centre at each end, bending over into a crank for turning, and making a hole in two opposite sides of any suitable bore to serve as bearings.—Glatton.



[48084.]—**Camera.**—I am sorry I cannot give you any practical directions as to camera-making, but should recommend you to make it square, as being the most generally useful form; and with regard to taking two portraits on the plate, you will require what is known as a "repeating-back," drawings of which are to be found in most dealers' catalogues.—W. Robinson, Jun.

[48096.]—**Photographic.**—The lens you have is a portrait combination, and is not well adapted for landscape purposes, though the employment of a smaller stop would somewhat improve matters. If, however, your camera is large enough, you will obtain a better result by removing the back combination altogether, and putting the front one in its place, with the flat or concave face outwards towards the view. If your lens has Waterhouse diaphragms, they will do for use with it; but if not, you can easily extemporise stops of blackened cardboard made to fit into the hood of the lens.—W. Robinson, Jun.

[48098.]—**South-Eastern Bogies.**—The numbers of these engines run somewhere between 150—160. There is also one, No. 19, to replace the old Cudworth No. 19. The principal dimensions are—Cylinders, 18in. by 26in.; driving-wheels, 6ft.; bogie-wheels, 3ft. 6in.; centre driving to' trailing-wheels, 8ft.; diam. boiler, 4ft. 4in.; centres of bogie-wheels, 5ft. 6in.; pressure on square inch, 140. The boiler of these engines is painted dark green, with black and white bands. There are two bands of paint round the driving-splasher, and between the two is painted black, and outside the painting it is darker green. The framing is green, with a white line on the edge. The cab is painted like the driving-splasher; the chimney and smokebox black, and all working parts bright; the injector top clack is of brass, with a stop-valve-wheel on top, and with a small pet-tap. The engines are fitted with a commodious cab, with steam-reversing gear, and vacuum brake. The common fault is that the regulator slide-valve sometimes slips off its working face. The design is very like that of the G.S.W.R. bogies, so that any reader possessing a picture of it would be able to form an idea of the S.E.R. bogie. In conclusion, I would recommend Mr. Bleasdale's photo. of this magnificent locomotive.—E. W.

[48105.]—**M.R. Engines.**—1323 and 1324 are four-wheeled, saddle-tanks, with outside cylinders, built by Manning, Wardle, and Co., 1873.—C. H.

[48106.] — **Waterproof Cloth.** — There are several methods of waterproofing cloth; one of the simplest is to rub the wrong side with a piece of good beeswax until wax just shows on cloth. Then take a hot iron in one hand, and a stiff clothes-brush in the other, and iron and brush the cloth all over (brush while still hot.)—Glatton.

[48108.]—**Spongy Iron Filters.**—My experience of these does not agree with "M. F. G." I often visit houses where they are used, and find the water pleasanter than out of the old kind. I lately cleaned one, and found the material coarse on the top, but it got finer towards the bottom. I have not heard that they are troublesome in the way of clogging up, although I should call that rather a proof of the badness of the water and fitness of the filter to do its work. I think it would be all the better if the Grand Junction Water Company's beds were clogged up a little oftener; they certainly pass plenty of soil through iron. I believe that the Antwerp Waterworks would have been an utter failure but for spongy iron. Most likely "M. F. G.'s" filter was a very old-fashioned one.—Dep.

[48111.]—**Abney's Shutter.**—This, as I understand it, is simply an ordinary drop-shutter, or only worked with an elastic band, but which, instead of being placed direct on the hood of the lens, is provided with a flexible hood of black velvet or other similar material which fits on to the lens, the shutter being held in the hand. The object is to prevent any vibration of the camera when the shutter is released.—W. Robinson, Jun.

[48112.]—**Photography.**—The following methods of preparing a fixing and toning bath without gold are given by Hardwich:—1, nitrate of silver, 3dr.; hypo., 4oz.; water, 8oz. Dissolve the silver in 2oz. of water, 2dr. of hypo. in 2oz. water, and the remainder in 4oz. water. Pour the silver solution into the 2oz. hypo. solution, stirring vigorously. In a short time the hypo-sulphite of silver formed will begin to decompose, passing from white to orange-yellow. When this begins to verge towards brown add the 4oz. solution of hypo., which will complete the decomposition, a part of the precipitate dissolving, and the remainder becoming perfectly black. Filter, and the solution is ready for use. 2. Strong solution of perchloride of iron, 6 fl. dr.; hypo., 4oz.; water, 7oz.; nitrate of silver, 30gr. water, 1oz. Pour the iron solution into the hypo., with constant stirring. A purple colour first forms, but soon disappears; when quite colourless add the silver solution, stirring briskly. This is said to give better results than No. 1, but it requires keeping 12 hours before use, and is more active at the end of a week.—W. Robinson, Jun.

[48124.]—**G.N. Engines.**—There are two misprints in my reply:—1. The cylinders of No. 8 are 18 by 28, and not 18 by 26, as stated. 2. Vol. IX. has been printed instead of Vol. XXX.—Metron.

[48126.]—**Cyanide of Potassium** in the cold will, sooner or later, seriously affect guttapercha: so also will a soluble salt of silver. I don't say that it will run through in a couple of days, because it won't; but it is not satisfactory to use: "By-Stander" may rest assured of that. I think it is used for electrotype moulds, and very successfully; but it is one thing to suspend a mould in the bath, and another to line said bath with it. Plating solution will work with a large amount of organic matter in it, if it is taken up slowly, and the bath is in constant use. As he has the cistern made, by all means use it; it will last a considerable time. If I wanted a large vat, I should have one of slate, properly cemented, or of hard wood, tongued and grooved; or, if a small one, a large bell glass, which can be bought to hold nearly 20 gallons. As to the Grove cells, I don't advise him to use them, as they are not the right kind of battery for ordinary electro-plating. The quantity of current should be large, and the electro-motive force low, in order to get a good adhesive coating with copper, silver, or gold. These conditions are best obtained in Daniell's battery. The fumes of nitric acid may deteriorate the solution, and are dangerous to health; it is more expensive than the sulphate of copper, and is entirely wasted when done with, whereas your copper cell gets thicker and thicker every day. The Grove's cells may be useful for coppering the ends of carbon rods and such like work. P.S. and N.B.—The English Mechanic is better than all the recipe-books ever published and put together. Most recipe-books are made for about the same purpose as cheap razors, and are worth about as much.—Os.

[48139.]—**M. S. & L. Engines.**—I wish to supplement "Meteor's" reply to this query, more particularly in reference to the engines with inside bearings. Mr. Sacré, the engineer, has clearly a preference for outside bearings, and although he has occasionally built engines with inside bearings only, no passenger-engines of that class have been built since 1869. My object is to show that in its early days, the M. S. and L. had a larger proportion of single bearings than at the present time. There were some long-boiler goods, Nos. 3, 30, 48, &c., by Sharp, Bros. and Co., 1847. "Sphinx" was of this class, referred to by "Carstairs" on p. 141. Its wheel-base was: leading to driving, 6ft. 11in.; driving to trailing, 5ft. 3in.; total, 12ft. 2in.; wheels (cast) 6ft. diameter, and cylinders 18 by 24. Nos. 75, 94, 95, &c., four-coupled passengers, brass dome, and in the same position as "Sphinx's," viz., close behind the chimney, 1847-9. Also, 35, with rather larger wheels, and dome on the centre of barrel. In 1859, the Company had four single engines from Fairbairn, Manchester, Nos. 1, 5, 8, and 52, 5ft. 3in. drivers, brass dome behind chimney, and four-wheeled tender. In 1868, these were altered to four-coupled; in No. 5, the trailing-wheels were taken from a sister-engine, and were coupled by means of outside-cranks put on the face of the boss—the axles having been lengthened for that purpose. Then there were four engines by Beyer, Peacock and Co. in 1865, Nos. 212-215, four-coupled, flush boiler, and a brass dome on the centre of barrel. The year after, came 268 and 269, by Kitson and Co., four-coupled leaders, 5ft. diameter, boiler like 35. In 1869 the Company made five engines, Nos. 64, 74, 75, 97, and 98, four-coupled trailers. The coupled wheels were made in Belgium, and have forged counterweights. I may here say the standard boiler of the M. S. and L. was then a raised firebox, with a valve encased in brass funnel on it, and the dome (painted) on the centre of the barrel. In 1872-3, however, all new engines had flush boilers, and about the same time Ramsbottom's valve was adopted. In 1874 the raised firebox was reverted to, and in 1877, as now, flush. No. 399 is an exception, being raised; it is also an exception in having outside cylinders, though the Company had one or more of that class many years ago. Nos. 78, 1, 19, &c. (1869-70), and also in 1870, Nos. 8, 42, 43, &c. (I think there were five); the latter were a peculiar looking engine, having flush boiler and two domes; these were all six-coupled; also in 1872-3, Nos. 281, 295, 308, &c., similar to 78, but flush. Of six-coupled tanks there is but one class, inside bearings, small wheels, saddle tank, and a cab of G.N. pattern, Nos. 271, 344, 413, &c., 1871, &c. Of the engines with outside bearings, "Meteor" has mentioned most of the coupled classes, but not the singles, of which there were several. The last built were the 101 class, 5ft. 10in. drivers, 1865. Some of the coupled engines ought to be mentioned as being the forerunners of the 180 class, used for express service. I refer to 76 (1863) and 146-151 (R. and W. Hawthorn), 1864. The wheels were about 5ft. 6in. diam.; the frames, including the stays, were cut out of the solid, and of course are very rigid. The 180-187 class (1865) differ externally in having 6ft. wheels. Nos. 311-320 (1873) are a still larger class, 6ft. 3in. wheels, and flush boiler. In 1874 more of the 6ft. wheels were built, and afterwards the bogie engines, coupled wheels 6ft. 3in., and bogie wheels 3ft. 3in. diam., and fitted with a cab. Tank-engines: there were some singles (73, 78, &c.), but they were replaced many years ago; while in four-coupled there is practically only one class. Nos. 23, 24, 9, 12, 208-211, &c. (1860-6) were "well"-tanks; but some, if not all, have been rebuilt as side tanks; and 449, 452, &c., are new engines of the same class. There are also other engines variously differing from the foregoing. "Meteor" has mixed some of the numbers and classes. Nos. 2 and 33 are pass. engines (1868); 216-235, S. S. and Co.; 236-255, B. P. and Co.—R. N. H.

[48140.]—**Coil.**—You will see, if you refer to p. 316 of the last volume, that there is no secondary wire.—Fred. Walker.

[48147.]—**Fixing Fretwork.**—Put it on with patent knotting.—Jack of All Trades.

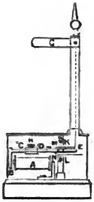
[48147.]—**Fixing Fretwork.**—1. Try shellac mixed with methylated spirit, to consistency of glue. 2. Add glacial acetic acid to your ordinary glue instead of water.—Glatton.

[48150.]—**Zinc Castings.**—Use sand; plaster holds so much water.—Jack of All Trades.

[48153.]—**Removing Black Stain from Marble Tablet.**—I am afraid you will not do it. I know of no remedy. If you had used shellac or patent knotting with your black, you would have been right. Use no composition with oil.—Jack of All Trades.

[48158.]—**Short Sight.**—I used glasses for short sight when working at engraving, &c., for twenty years, not continuous. For the last ten I dispensed with them, and can see to read the ordinary print in the "E. M." at a distance of 3ft.—Jack of All Trades.

[48162.]—**Indicator.**—I send drawing of semaphore, which I presume is the indicator "Gerald Harley" requires. The indicator arm is at danger in its normal position. But when a current is passed through the coil A, the armature B will be attracted, the lever D (which is centred at C) raised, and the arm depressed to the all-clear position. The springs, M N, and adjusting screws, K L, are for regulating the upward and downward movement of the lever D, and also for repeating back to the signalling station the position of the arm. The rod F is connected with the lever at E, and also eccentrically connected to the arm G.—Block.



[48172.]—**Opera-Glasses.**—The glasses in this case are, of course, too wide apart for the eyes.—F. R. C. S.

[48172.]—**Opera-Glasses.**—Probably tubes do not fit connecting-pieces properly, and have got out of line. If so, move them back again.—Glatton.

[48174.]—**Astronomy.**—J. Firth will find one of the diagrams in Lockyer's primer to have been placed upside down by the printer, as he will at once see by the letters N. and S. at the poles; the N. pole of the earth's axis always points (approximately) to the pole of the heavens.—C. R. T.

[48176.]—**Platinotype Printing.**—For particulars of this process see replies to queries 42133 and 42831, Vol. XXXII., pp. 427 and 596.—W. Robinson, Jun.

[48177.]—**French-Polishing.**—Yes, there is a method of stopping porous mahogany. Take fine plaster of Paris and red ochre, and mix with linseed oil to a stiff paste and the colour you desire, and apply with plenty of elbow-grease, and let the work stand for a day or two before polishing.—Jack of All Trades.

[48182.]—**Gold Bronze Powder.**—Gold-leaf is ground up with honey or sugar-candy, and washed; but bronze powder is not gold. See the London or Birmingham Directory. I believe Judson makes bronze powder, and Bessemer.—Jack of All Trades.

[48183.]—**Engine Queries.**—The thickness of your piston should be 2in., the diameter of the piston-rod 1in., the area of your steam-port 1¼ sq. in., and your exhaust-port 1¾ sq. in. The size of your slide-valve will, of course, be determined by the distance apart of your ports and capacity of the steam-chest; the former will also easily determine the stroke of the eccentric. You had better bolt your cylinder to the saddle of your lathe, and use a 2¼in. bar long enough for the travel, having a boring-head keyed on, with six grooves on its circumference: you should use three tools, each following the other. For the last cut use one tool, and fill the other slots with hard wood, so that it cuts its way in, and you will, therefore, have a smooth and true bore.—Fred. Walker.

[48184.]—**Leather Bellows for Camera.**—Thanks to Mr. Parkinson for his reply to my query, I can make a very passable bellows with two plies of material and shaped cardboard strips between; but I wished to know how to fold a single ply neat and square, into the form of a bellows like those of the best camera-makers, in which there are no card strips.—Midlothian.

[48185.]—**Electric Engine.**—The commutator I use is similar to the one described by "Conrad" on p. 72 of this volume; but I fit the ebonite or wood-plug to the shaft, so as to allow of adjustment. The reversal takes place just past the period when the armature poles are opposite the F.M. poles.—Fred. Walker.

[48187.]—**Glue or Paste for Skins.**—Use glue and treacle, with a strong decoction of nutgalls.—Jack of All Trades.

[48190.]—**Boiler.**—As "Boswell," on p. 145, wishes me to describe fractures, I will try and do so. They were not caused by excessive deposits in boiler. Twelve months ago there was a new plate of best Lowmoor iron put in the bottom of the boiler over the furnace, when the flange of the end plate was found to be in bad order, several of the rivet-holes broken out, and the plate cracked through at the bend. It was so bad that a light blow with the hammer would break it like cast metal. So the boiler-smith put on a patch about 20in. by 8in., made of the same iron as the plate, and fitting round outside of end and bottom plate, and riveted to both. Would it have been better inside? Now, the patch is cracked from bottom, rivets to angle where bent round end plate; the end is in two plates with a seam of rivets across the middle. There is very little heat on the patch, as the fire is along the boiler. Please explain cause and best remedy.—Leakage.

[48194.]—**Cleaning Brass Cartridge-Cases.**—Cleanse with hot soda-water, and well wash. Pickle them in nitric acid and water, well wash; then boil them in a strong solution of cream of tartar and tin shavings.—Jack of All Trades.

[48194.]—**Cleaning Brass Cartridge-Cases.**—If "J. C. L." will keep his brass cartridge-cases perfectly dry, he will find they will be free from verdigris. Rub them over with a greasy rag.—C. R. T.

[48198.]—**Small Brass Castings.**—Use powdered Bath-brick, instead of sand, made damp enough to work with salt-and-water, and dry your mould before pouring.—Jack of All Trades.

[48203.]—**Fishing-Tackle.**—Soften bone by dissolving out the earthy part in hydrochloric acid one part, water four parts. Better, however, use horn. Dissolve the shoemaker's wax in methylated spirit. Bronze ferrules—by cleaning perfectly from grease; make slightly hot, so that you can just hold them, then brush over with, or dip in a solution of, chloride of platinum.—F. R. C. S.

[48205.]—**Tricycles.**—A good size of driving-wheel for all-round work is 48in. running level, or for hilly country geared down to 46 or 44. I am about 5ft. 6in. height, my chief tricycling experience being with a Salvo, double-driver, front-steerer, wheels 50in. geared down to 46in. It was fairly fast, and good at hills. There is a decided advantage in double-drivers, which was, I think, discussed in these columns a year or two back. Double-steering, as in the Coventry rotary, is, perhaps, as valuable as double-driving. Ball bearings to all parts certainly reduce friction wonderfully.—Windsor.

[48205.]—**Tricycles.**—"Dick" does not state what class of machine he is going in for; but if, however, he is going in for an ordinary tricycle, a 48in. would probably suit him. Double-drivers are more useful for all-round work than single ones, as when going along a muddy road the driving-wheel is liable to slip, whereas, if the machine be a double driver, the wheels (which are in most cases driven through an axle) are not so liable to do so in consequence of the power being equally distributed to both wheels. Ball bearings are more handy than plain bearings, as they do not require so much adjustment and require less oil.—W. Scotland.

[48205.]—**Tricycles.**—These machines are becoming so deservedly popular, that a little practical advice will perhaps be of service. To recommend any particular tricycle would, in the face of the recent disclosures in the cycling papers on interested puffing, be rather a delicate task; and indeed, under any circumstances, it would be unfair to gratuitously advertise a maker just because his work happened to suit my fancy. Amateur recommendations, moreover, cannot always be depended upon, since it is an everyday occurrence for riders to "cry up" their own machines as being the best and fastest, when upon inquiry, it may be found that they have never given any other a fair trial. For practical purposes, tricycles may be divided into single or double drivers and front or rear steerers. Double drivers possess some advantages on greasy or rough roads, especially when—as in the rear-steering machines of the Meteor pattern—the backbone is so short that any attempt to get over the work is apt to lift the back wheel, thus creating a tendency of the single driver to turn in a circle with the free wheel as a centre, and of course causing a loss of steering power. I was once tumbled into a ditch through a collision from this cause, and have ever since taken care to give such machines a wide berth. With a longer backbone this defect is not nearly so prominent, and notwithstanding all that has been said against rear-steerers, I have found them very light and serviceable roadsters. A front-steering tricycle will allow the rider to get completely over the pedals, but when it is being ridden over soft ground the extra weight is thrown on the leading-wheel, and is the cause of a loss of power. The diameter of a driving-wheel depends entirely on the strength of the rider. For one not accustomed to the exercise, I should think 44 to 48in. well suited. I should like, however, to warn your correspondent that it is the rider rather than the tricycle which makes the pace; consequently, if he expects a high average speed, he is likely to be disappointed. To run a mile in five minutes is a very easy feat if the road be good, but to assume from that fact that twelve miles an hour may be kept up all day is a great mistake, and one calculated to make other (perhaps equally good) riders dissatisfied without cause. I have travelled some thousands of miles, and I find, for an average day's work, including stoppages, one-half of that speed, or 70 miles in 12 hours, is about as much as I should care to do. I have very little faith in ball-bearings, except that, as they are generally fitted to the better class machines, they are, on that account, likely to prove satisfactory.—Treasurer of the Liverpool Tricycle Club.

[48216.]—**Watch-case Polishing.**—You could of course polish it in the lathe, using rouge and water and a very soft piece of wash-leather; but the final touch is given with the smallest quantity of very fine rouge and the palm of the hand, and in some instances with the point of the finger.—Os.

[48225.] — **Rust from Gun-Barrels.** — Use a piece of flannel over the cleaning-rod dipped in oil, and sprinkled with fine emery-powder.—F. R. C. S.

[48226.]—**Truss.**—You do not say what kind of truss you wear—whether it is the spring over the pad, or a spring fitting round the body. I should advise you not to tamper with it, but return it to the maker, who is bound to fit you properly. If the truss shifts and the hernia protrudes, it will give you the feeling of undue pressure. If your truss is new, it is sure to cause discomfort for a few weeks. —T. M.

[48229.]—**Locomotives.**—The locomotive power for working the Cheshire Lines Committee's trains is supplied by the M. S. and L. Co. The engines on the London, Tilbury, and Southend line are four-coupled, ten-wheeled side-tanks by Sharp, Stewart, and Co.—R. N. H.

[48231.]—**Dulcimer.**—In reply to Mr. J. Marshall, I may say that brass wire is generally used for dulcimers; but steel wire is, of course, stronger, and may be used if preferred. It is a matter of choice more than anything else. The wire should be rather fine, and if the number of notes required are not very great, the same thickness of wire will do for all the notes. If any difference is made, it should be a shade thicker for the higher notes. You can obtain suitable wires from any respectable music-shop. The brass wire for dulcimer should be tempered, or hardened. Soft brass wire will not do. If you intend having steel wire, you will have no difficulty in obtaining it from a music-shop ready for use. The brass wire, sold at the ironmongers, is not sufficiently tempered as to be of any use for dulcimers.—G. Fryer.

[48235.] — **Carbonic Acid.** — Roscoe's and Schorlemmer's "Treatise on Chemistry," gives sp. gr. of CO_2 in the liquid state as 0·9951 at −10° 0·9470 at 0°, and 0·8266 at + 20°. — Wm. J. Scholes.

[48238.]—**Setting Slide-Valve.**—Does querist mean main slide? because the expansion slides are at the back of main valve, and adjustable while working by wheel and index outside to cut off at any part of stroke within the main slide range. If main slide, more particulars are required—that is traverse of valve, width of ports over-all, width of valve.—J. O. E.

[48241.]—**Preserved Potato.**—It is cut into slices or pieces, placed in a drying machine, which takes various forms, but which acts on the principle of passing a rapid current of hot dry air over the trays of potato-slices. Apples are dried in same manner.—Essar.

[48242.]—**Fishing-Rod and Tackle.**—Give your rod two coats of the best coachmaker's varnish, each coat to be thoroughly dried. I advise you to get the book entitled, "Angling, and How to Angle," by J. T. Burgess, price 1s. It contains full directions for making trout-flies.—T. S. H.

[48243.]—**Worm-eaten Violin**—is evidently a cheap one, made of inferior wood. Perhaps a solution of corrosive sublimate would answer. I never saw the label, and don't know the maker, although I am familiar with the names of most of the good ones; but even if the maker were well known, it would be no guarantee of the genuineness of the label. Spurious labels are put on all manner of rubbish to make it sell, and delude the unwary. You could fill the holes with wax or rosin. You should try to play more frequently, and wipe the violin carefully before putting it away—in a dry place.—T. M.

[48244.]—**Electro-Gilding.**—The solution of gold requires to be evaporated to expel the excess of acid. It should then be redissolved in water, and precipitated with the cyanide; but it is perfectly unnecessary to make gilding solution in this manner. Make a solution of cyanide of potassium, about ½oz. to the pint of water; suspend the gold anode from the positive pole of the battery (that is the copper), and from the negative or zinc pole suspend a piece of clean brass or copper, and as soon as the gold appears on this copper, the solution is ready for use. Better work cannot be done with any other solution, but a great deal more gold may be (and often is) wasted.—Os.

[48244.] — **Electro-Gilding.** — Has "An Old Subscriber" tried precipitating with hydrocyanic acid (prussic)? I have failed with the cyanide of potassium method, but now make my gold solutions by the battery process:—Dissolve cyanide of potassium in water (about 2½oz., 90 per cent.), keep hot, connect gold anode to copper of battery, and suspend in solution, and a platinum or gold plate to the zinc and suspend in liquid; and pass current through solution from two Smees or Daniells. In an hour or two sufficient gold will have been dissolved in, and is then ready for use. By this method caustic potash is set free in the solution, and afterwards absorbing carbonic acid from the air becomes carbonate of potash; this may be objected to, but it does no good. On the other hand, it does not do much harm, and you are sure of your metal.—Girdlestone Wright.

[48249.]—**Flywheel.**—You can do it by altering the eccentric. Put engine on centre, and notice the position of sheave relative to crank. If there is no rocking shaft the sheave always leads the crank a ¼ + lap and lead, but for your purpose, having noticed the position of sheave, move it on shaft from top to bottom, hold it with the screws, take your steam-chest cover off, and when crank is on centre the port should be 1-16 open.—J. O. E.

[48250.]—**Girder.**—Use two-rolled joist. Write for catalogue from Measures and Co., Southwark-street. Choose those about 17in. deep, and flanges 6in. wide; weight, 82lb. per foot. Two of them side by side, connected by three or four ¾in. bolts through the webs, will suit you. Give them 18in. bearing.—C. E.

[48252.]—**Insects in Fernery.**—If you have slugs in your fernery, Adiantums will never succeed; but you can easily exterminate them by the following method: Cut some thin slices of potato, spread on each slice a little of "Battle's Vermin Killer," and put them near the ferns they attack most. The slugs will eat the potato in preference to anything else, and by adding the poison, you may depend it will be their last meal. For the other insects use "Insect Powder." Sprinkle a little about the fernery, or even a little on the ferns occasionally, will do no harm whatever, but get rid of the pests. Be careful to have the right mould, as that is very important. Keep them sufficiently watered, and sprinkle the ferns all over as well as the mould, for they like to draw moisture through their fronds; I should do the latter every night. I have reared some fine specimens by following these simple plans, and can confidently recommend you to follow the same, and have no doubt of your ultimate success. I shall be very glad to give you any further suggestions.—Isle of Wight.

[48258.]—**Mercurial Gauge.**—As an old, and probably forgotten, friend of Mr. R. K. Jones, he will, I know, excuse me if I point out the extreme inconvenience of a column of mercury which should register 140lb. pressure. At the ordinary pressure of the atmosphere (about 15lb.), the height of the column would be 28in. or 30in. Now, $140 \div 15 = 9\frac{1}{3}$. This, at the lowest estimate, would give nearly 22ft. I should prefer to use a small boiler, which would only require a little water in it, and regulate the pressure by the heat, which latter would be indicated by a thermometer. He is doubtless aware that the amount of pressure corresponding to different degrees of heat is very well known. This latter device would be quite as cheap as his proposed mercurial gauge, and much more practicable. N.B.—Of course my figures are only approximate.—Os.

[48259.]—**Musical Bells.**—Bells act better in the treble with reed instruments, or pipes, with a piano action, but should not be struck on their edges so much as on their sides. So the saucer-shaped bells are centered one after the other on a metal rod, having a wood ring or washer, ¼in. thick, between each, and a binding-screw at ends of rod to hold tight. This metal rod must be bedded in a soft rubber at each end. The ordinary upright action will do if the dampers are bent forward to rest on the bells. The hammers need not be altered; but a strip of cloth, rubber, or leather interposed between hammer and bell will modify the tone; the three substances can be used alternately with a pedal action, or a stop could raise or depress the various lengths. It is right that the damper action should be lifted by a forte pedal, and the experiment might be tried of whirling or turning round the whole of the bells on their brass rod by means of a fly-wheel actuated by lever or spring. Strings should be used for the bass, but if there is no room for a soundboard, the best thing is to place a pipe or tube over each three of the bells, pipes to be made three or four times the length of their diameter.—Fiddler.

[48259.]—**Musical Bells.**—The hammers may be made of wood, and covered with one layer of calf or sheepskin, with the smooth or dressed side outwards. If treated in this way, the tone from the bells will neither be too dull, nor yet too clangy. The hammers should vary in size according to the bells. The formation of the various hammers is also of great importance in the production of good tone. They should be neither too wide nor yet too pointed where they strike the bells. It will be particularly noticed that in many pianofortes the tone produced by the treble notes is often dull. This is caused, in many instances, by the hammers being too wide, and also through their being too thickly covered with felt. On the other hand, if the hammers are too pointed, or too hard, the tone produced will be harsh and metallic. Experience, alone, will prove this. Now, with regard to the bells, the less material there is between them, the better. A small leather washer, sufficiently thick to allow free vibration between each bell, will suffice. If the washers are too large (I do not mean in thickness) they will tend to muffle or destroy the free vibration of the bells. All that is required between them, is something to prevent them from coming into colision with each other, and something, also, to keep them at a respectable distance apart, for the reasons I have stated above. The action should be free and light, in order to prevent a heavy touch to be required on the keys. Good and effective playing is always accompanied by a light and free touch on the keys. Therefore, if the touch is heavy and laboured, the effect produced is not so perfect as it otherwise would be.—G. Fryer.

[48260.] — **Telephones.** — I would advise "Cantab" to make a "Blake Transmitter," as it is decidedly the best, and only one contact is necessary. It is fully described (coil and all), in a back number of the "E.M." It is easy to have the bell and binding-screws outside if so desired, but Mr. Tolman's switch arrangement is better. You can ring the bell at other end by an ordinary push, as shown in Mr. Tolman's illustration, but it is absolutely necessary to break one contact—viz., to cut out your own bell, while you send a current through the line to ring the bell at the distant station. It makes no difference which way you wind the bobbins for the receivers. The soft iron core is usually put on the N. end of magnet, and it should be about ¼in. in diameter. It is advisable to have the contacts in switch-box tipped with platinum. It is not very difficult to make a Gower-Bell Telephone, but a "Blake Transmitter," bell receiver, and ordinary coil bell is about the best arrangement. I shall be happy to give "Cantab" further information if he will advertise his address, so that I may write him direct.—Amateur.

[48261.]—**Steam Heating.**—Does "Ontario" wish to make a boiler of wrought or cast iron as a steam-heater? I should strongly recommend a wrought iron vertical boiler with internal firebox, if he can get one made conveniently; sketch and particulars of which I shall be glad to send on knowing what the boiler has to do. A vertical steam-boiler would require little ground-space, and would be useful for many purposes, and would not be difficult to make; but it would be time wasted to give particulars if "Ontario" intends making one of cast iron in the form of a series of pipes, no form of which I could recommend; cast iron being quite unsuitable for steam-pressures. Will correspond if "Ontario" will advertise his address.—Boswell.

[48262.]—**Silver-Plating Solution.**—The best way to recover silver from spoilt solution:—Dilute your solution with water, add a little hydrochloric acid, which will precipitate the silver, allow it to settle, and pour off the liquor; dry the precipitate, and mix it with twice its weight of carbonate of potash, and fuse in a crucible.—B. J. G.

[48262.]—**Electro-Plating Solution.**—Throw down the cyanide of silver with sulphuric acid; then wash and re-dissolve with cyanide of potassium to make new solution.—Sigma.

[48262.] — **Electro-Plating Solution.** — Precipitate with hydrochloric acid, wash with water, and dry the chloride, and fuse with sodium carbonate. The operation is best conducted out of doors, because of the hydrocyanic acid given off. —Girdlestone Wright.

[48262.]—**Electro-Plating Solution.**—To recover the silver, add sulphuric acid to the solution till all effervescence has ceased. Allow the precipitate to subside; pour off and throw away the clear liquor from the top. Wash the precipitate with several changes of water; after which it can be collected and dried; then mixed with its own weight of well-dried washing soda, and fused in a crucible. If you don't like the trouble of fusing it you can dissolve the washed precipitate in cyanide of potassium, and proceed to use it.—Os.

[48262.] — **Electro-Plating Solution.** — To "R. M."—I have been in a similar position myself with my silver solution, which is about fourteen gallons. My solution was spoilt through lining my wood tank with coal-tar pitch. I went to some expense in having a strong teak-wood tank made by a carpenter; the boards were 1½in. thick, and dovetail jointed, and most carefully put together with red lead and screws; but, to my great surprise, in a month or two I found my solution leaking through the tank, and then I was advised to coal-tar pitch it inside, and the pitch spoilt my solution. I proceeded as follows to rectify it:—I got my bath out of doors into the open air and I proceeded to precipitate the silver, by pouring carefully into the solution sulphuric acid, and also stirring the same with a long stick; the quantity I poured in until no farther effervescence took place was three or four pounds weight. I then allowed the precipitate to subside, then poured off the clear liquor and threw it away; I then washed the precipitate that was left in the bottom of the tank with hot water, and then several times afterwards with cold water, and allowed the precipitate to subside each time; after the last washing I drained all the water from the precipitate as clear as I could; and I next redissolved the precipitate with potassium cyanide; I then filtered before adding bulk of water, and it now works as well as ever it did. The fumes must not be breathed that arise whilst the acid is being poured in, as they are highly injurious, and I may as well, at the same time, advise others concerned in electro-plating in a small way, who are troubled with leaky baths, to act as I did, and get a stone one made to size and form you require at Doulton's Lambeth Pottery. It is cheapest in the end.—Comet.

[48264.]—**Dreaming and Unsound Sleep.**—Let "Didaskalos" not try to avoid mental, social, and personal disturbance during the day, as he says he does, but let him take things as they arise in the usual run of life; let him tackle and combat each little disturbance as a man ought, and not be seeking to shirk his daily duty, as he must be doing if he acts as he represents. This will give his brain something to do in the day instead of during the night, when it will be glad to rest quiet, and let the owner of it sleep. Let him take a sharp walk of a couple of miles before going to bed, and let him smoke a mild cigar or pipe as he walks; and when he returns home, or before he starts if he likes, let him take a glass of whisky-and-water—real whisky, not public-house poison—and I will guarantee in less than a week he will sleep—"Like a Top."

[48265.]—**Ventilation of Workshop.**—It is not necessary to alter the blower if it accomplishes the extraction of the vitiated air. The difficulty appears to be the supplying of fresh air at a suitable level, and this could best be done by making inlets at the floor level, and conducting the air in oblong tubes fixed close to the wall to a height of about 2ft. The outer ends of the inlets should be formed with iron gratings, and the inner ends fitted with perforated zinc, so as to diffuse the air and prevent draughts. The positions, number, and size of these inlets must be determined by the size of the shop and the quantity of air required. If, then, the foul air is extracted from the top of the room by means of the fan, fresh air will flow in through the inlets, and efficient ventilation will thus be secured.—John C. Gill.

[48269.]—**Power of Engine.**—Taking piston speed as 400ft. per minute, multiply this by 254, the area of cylinder in inches; and this again by 60, which, perhaps, may be taken as the average steam pressure in pounds on the piston; then dividing this product by 33,000, will give 184¾ horse-power of the engine. The factor 60lb. on the piston is but a guess: it is impossible to tell what it is without taking an indicator diagram. As regards improvement, get some really competent person to take a diagram, and this will at once show you what power your engine is working to, and will also tell you if any alteration should be made.—Jonah.

[48271.]—**Boiler.**—If C. Weir will put a little gunpowder in paper and throw in the fire, and shut the door quick, that will blow the soot out of the tubes; having the blast on the same time will send it out of the funnel. But why make so much soot? Drill some holes in your firedoor, and let the air in, and burn the smoke; you will not be troubled with much soot; or, better still, use smokeless coal.—Brendo.

[48271.]—**Boiler.**—The tubes are certainly too small for boiler purposes, unless there is a strong blast or artificial draught, such as a good exhaust into chimney, such as is seen in locomotives; but to use fresh steam for the purpose would be a great waste of fuel. Have you tried good gas-coke? if not do so, and if you cannot work comfortably, then renew the tube-places, and put in a new smoke-tube about 8in. diameter, or of such a size as most convenient to work in with the present tube-plate. Could better advise if I saw a drawing with dimensions of crown-plates of firebox and shell.—Boswell.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47629.	Compensating Lever, p. 532.
47634.	Organ Stops, 532.
47635.	Home Study, 532.
47637.	Locomotive, 532.
47643.	Spiders, 532.
47645.	Measuring Railway Curves, 532.
47650.	Annual Loss of Life by Fire, 532.
47662.	Circulating Decimals, 533.
47666.	Construction of Maps, 533.
47676.	Magnetic Exploder, 533.
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47885.	Turbine Pit, p. 22.
47888.	French Locos., 22.
47890.	Lathe Flywheel, 22.
47894.	Steinheil's Eyepieces, 22.
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47922.	The Parker-Smith Brake, 23.
47924.	Electro-plating, 23.
47926.	Street Medical Coils, 23.

PRACTICAL RECIPES.

Testing Lubricating Oils.—A good test for oil is to place single drops in line upon a piece of plate-glass about 8in. wide and 24in. to 30in. long, one end being raised about 6in. to 8in. to form an inclined plane. The drops of oil start from the top of this inclined plane upon a race with each other. The first day sperm oil will be found in the rear, but after a while it will catch up and overtake the rest, and will even be found in motion after the other oils have dried up. An oil having a light body runs quickly and dries quickly, but an oil that has both a body and a free flow will readily be detected by this test. An oil may have a good body and yet have a tendency to gum badly, which quality will also be easily detected upon the glass. The oils should be covered from the dust while these tests are being made. A good test for the presence of acids is to put small quantities of oil in copper dishes which are easily made by depressing bits of sheet-copper with a round-face hammer. If acid is present it will attack the copper and extract the verdigris.

Cleaning Tubular Boilers.—One of the best ways to clean an upright tubular boiler, or one in which it is impossible to reach all parts of the internal surface to scrape them, and where the water used is liable to form much scale which adheres to the tubes, according to the *American Machinist*, is to put half a gallon or so of crude petroleum into it a few days before washing out. This will not cause the boiler to foam, but will effectually loosen the scale, which falls to the bottom. If this dirt is not removed, there is danger of burning the boiler. There is nothing in petroleum that will injure iron. The objection to using petroleum in boilers practically amounts to this: it reveals the fact that many of them are unsafe. Petroleum was never known to burn a crown sheet or boiler shell, neither has it corroded the seams or pitted the sheets, but, on the contrary, it will prevent many of these curious chemical actions that occur inside of boilers in using certain waters.

Cleaning Soiled Engravings.—For cleaning old and soiled engravings, Mr. W. Brooks, writing in the *Journal of Photography*, recommends the use of Holme's ozone bleach. The strength he prefers is one part of ozone bleach to ten of water, well shaken up before pouring into a dish. He immerses the engraving in the solution, face upward, avoiding bubbles. The only caution to be observed is that when the engraving is sodden with water it is somewhat rotten; so the less it is handled the better. Sometimes, if the engraving be only slightly stained, half an hour is quite sufficient, but when quite brown he has left them in for as long as four hours. After all the stains are removed, and the paper has regained its pure whiteness, pour the solution out of the dish into a bottle, as this can be used over and over again, until it becomes discoloured; then fill up the dish with water, changing frequently for about two hours, or, better still, place it in running water. When sufficiently washed it can be taken out and blotted off and then hung up to dry, and when perfectly dry, iron on the back with a warm flat-iron; but care must be taken not to have it too hot.

QUERIES.

[48274.] — **Watchmaking.** — Would any watchmaking subscriber kindly inform me the best way to drill and fit Geneva hairspring collets, as those I have are drilled very much too small for the spring? Also, what is the liquid watch-plates are put in to clean them, and whether an amateur is likely to succeed in fitting a new 'scape-wheel to a Geneva watch?—E. H. E.

[48275.]—**Gout.**—During the last two years I have been subject to gout, which I have inherited from my father. I am fifty years of age, and have had the complaint in my stomach four times, and I now have a feeling of uneasiness in the fingers of one hand. I have given up beer, but I should feel grateful if Dr. Edmunds would tell me what I may eat and drink, and what especially I must avoid.—Podagra.

[48276.]—**Experimental Physics.**—I made a calorimeter out of a small glass bottle by pushing stem of thermometer tube through cork, and surrounding bulb with a loose coil of iron wire, the ends of which were brought through cork and connected by thick copper wire to six cells of a Grove's battery. The iron coil was covered with alcohol. I plotted the rise of temperature on a piece of paper; dividing a horizontal line into equal parts, representing minutes' duration of experiment, and at the end of each minute making a dot over the corresponding division at such a height as to represent, by its position on a vertical scale, the temperature indicated at that instant by the thermometer. By joining these points I obtain a curve representing the apparent rise of temperature of the wire and alcohol. This is represented by the full line, Fig. 2. All the time the wire was heating the spirit, however, heat was escaping by radiation, &c., and to measure this I cut off the battery, and allowed the apparatus to cool, marking the temperature at intervals as before. I thus obtained the dotted curve. Now, how am I to combine the two so as to give, not the apparent, but the actual, heat generated in the wire by the current? I want to show the result in one curve.—Glatton.

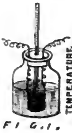


FIG. 1.

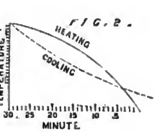


FIG. 2.

[48277.]—**Platinum and Copper Alloy.**—I am told that two parts platinum and one part copper make a very nice alloy, rich in colour and very suitable for finger-rings. Being anxious to make one, I should feel obliged for any information. I have a small plumbago crucible, and the use of a brassfounder's furnace, also a brazier's forge. Is it possible to cast the ring complete, or should I cast an ingot or bar and hammer up?—Richard Parker.

[48278.]—**Rainband Spectroscope.**—Can anyone give directions for constructing a simple form of spectroscope capable of showing the rainband?—G.

[48279.]—**Spirit Varnish.**—Will any kind reader tell me what is the cause of varnish looking rough after being laid on wood? I used a thin coat of glue to harden the wood before varnishing. I have tried this plan several times, but it always leaves a rough face, as though it had been laid on very fine sawdust or dust from sandpaper, and sometimes it looks as though some fine drops of rain had been falling on it.—Nelson.

[48280.]—**Steam-Crane.**—I wish to fit up a steam-crane to work in two positions, A and B, 35ft. apart. My difficulty is, how to get steam to the crane quickly in each position. Circumstances will not admit of my using a portable boiler and fire on the crane, so I must use the steam from works boilers. I propose to run my crane on rails from A to B; have a steam-pipe parallel with the rails, and connect up as required A and B. What I want is the quickest way of doing this. The ordinary way of making a flange-joint is too slow. I have seen the shunters make the connection between railway carriages for the vacuum brake, which they do instantaneously. This is the sort of thing I require, but it seems to require a flexible pipe. Will some of your able contributors help me, with sketch of this joint, and say if any kind of flexible tube is in use that will stand to convey 20 or 30lb. steam for any length of time; or if not, how am I to solve the problem?—Il Penseroso.

[48281.]—**Legal.**—Would one of your legal correspondents kindly answer the following?—In the act of unloading a wheel (weight 3½ cwt.) from R. T. Co.'s van, the rope belonging to the Company which the carman attached to the said wheel, suddenly broke, letting the wheel fall from tailboard of van on to my foot, which, in all probability, I shall always feel the inconvenience of. I was called by my employer from my work to assist him in steadying the wheel to prevent breakage, while the carman lowered it. The sole cause of accident was through rope breaking. Are the Company responsible, and can I claim compensation for loss of time and personal injury?—Bruised Mechanic.

[48282.]—**Legal.**—To Mr. Wetherfield.—Some few weeks ago I sent some optical apparatus to A. to be repaired. As they were not returned in due course, I made inquiries, and found that (I suppose, under pecuniary difficulties) A. has left the country, and the articles have come into the possession of one of his creditors, B., who refuses to give up the articles till his claims against A. are settled. Can B. lawfully retain possession of the articles, and if not, what would be the columns.)—One Anxious to Succeed. (Better use so thick a plate for some other purpose. See an article in this number.)—An Old Subscriber. (Your sketch will do as well as anything, but it is a peculiar "ornament" for a parlour window.)—Questioner. (Described some time ago. An electro-motor (or dynamo) under the carriages is supplied with current from another; the armature of the former is caused to revolve, and the motion is transmitted to the wheels in any suitable manner.)—C. W. W. (Answered many times. See the indices of recent volumes.)—R. F. (Several papers on the subject in back volumes. We know of no cheap book about it.)—W. V. S. (We believe any grocer's engineer supplies such machines, but the beans must have the fat extracted or be mixed with starch—in this connection called fecula.)—B. W. (Fulminate of silver or mercury will do. 2. The test is of too delicate a nature, and requires the technical skill of the chemist. 3. It means object-glass, usually.)—H. S. Smith. (Any in which animal charcoal, with a movable block, such as Atkins's, may be safely used. You are quite right in your objections to the others.)—W. Shaw. (You must first be sure that no one has anticipated your invention, and had better search yourself at the Patent Office. Are you familiar with Boyle's patent? That is one of the best we know of; and one or two parts of your letter lead us to fancy you may, quite unconsciously, be plagiarising. If it is not so, and you are quite sure of the novelty of your invention, you had better seek the aid of a capitalist to develop it.)—Victor. (Quite beyond our province to teach the "tricks of our own trade" in these pages.)—Country Barber. (We have done what you suggest. Show your appreciation by an occasional contribution.)—J. H. Huxley. (Let people who have nothing better to write about waste their time about Spiritualism. We think too much of you as a correspondent to encourage you in any such direction.)—Colonist. (We cannot advise.)

Mot.—R. W.—Ethoxo.—Your queries can only appear in the "Sixpenny Sale Column." Please read "Hints to Correspondents," and especially Hint No. 4.

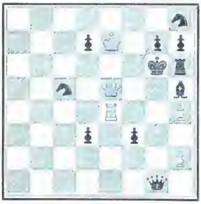
CHESS.

◆◆◆

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXCI.—By H. F. L. Meyer.

Black.



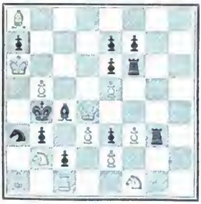
White.

White to play and mate in four moves.

PROBLEM DCCXCII.—By S. Loyd.

From "Chess Strategy."

Black.



White.

White to play and mate in three moves.

Problem 787.—This admits of a solution in two moves: 1. B to Q B 5. 2. Q or B mates.

Solution to 788.

White.	*Black.*
1. Kt to K 3	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solution to 781, 785, 786, 787, and 788, by "Celsus"; 787 and 788 by "Schmucke."

"Admirer" and "Schmucke."—We pointed out in the last number that a Black Pawn was accidentally omitted at Q Kt 5.

F. F. B.—Thanks for problem.

Mr. C. Selwyn has joined the Tourney, which is now closed. First prize, £2.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	2	6
Every additional eight words	0	6

Front Page Advertisements Five shillings for the first 40 words, afterwards 6d. per line. Paragraph Advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight words	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN

	s.	d.
Sixteen words	0	6
For every succeeding Eight Words	0	6

, It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however, preferably halfpenny stamps, may be sent where it is inconvenient to obtain P.O.O.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 5 p.m. on Wednesday to insure insertion in the following Friday's number.

Epps's Cocoa. Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctor's bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in Packets, labelled "James Epps and Co., Homœopathic Chemists, London." Also makers of Epps's Chocolate Essence.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, Post free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 3d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXX., XXXI., XXXII., XXXIII., and XXXIV., bound in cloth, 7s. each.

(Vol. XXXV. now ready, price 7s.)

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each, or post-free, 3½d. Cases for binding, 1s. 6d. each.

, Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the Post Office prevent their transmission through the Post.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Ointment and Pills.—All ulcerations, cuts, abscesses, bad legs, and skin diseases are best treated by these medicaments. The Ointment eradicates all noxious taints and makes every symptom assume a milder form, and this desirable result is made doubly certain by the purifying, regulating, and alterative powers of the Pills.

OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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Woodworking Planing and **Moulding Machine**, in good working order, worth £15. Will take Deal Timber in exchange.—T. G., 108, Pool-street, Wolverhampton.

Lathe, 4ft. gap bed, 4in. centre, in exchange for a second-hand Tricycle, in good order, or a set of Tricycle Fittings finished; or what offers?—J. Simpson, Beaconsfield Cottage, George-street, Syston, near Leicester.

Lathe, a bargain, equal to new, scarcely used, 4½in. centre, chucks, iron bed, table, and circular saw. Offers.—W. H., Seckford Villa, Woodbridge, Suffolk.

2½ centre **Bar Lathe**, and several volumes English Mechanic. Offers wanted. Lathe Heads, with fitted.—H. Sumner, Grange, Waterford.

Pair of **Lathe Heads**, nearly fitted up, back-gear, 4in. centre. Exchange for Portable Forge, or other tools.—[illegible], Lawrence, Sunderland.

Wanted, a good second-hand **Printing Press** and Type, to print about 9in. by 7in., in exchange.—James Stevens, Stonehouse, Gloucestershire.

"**English Mechanic**," Vols. XX., XXI., XXX. to XXXIII. Vol. XXX., XXXI., XXXIII. complete. Indices to all. What offers?—S. Watson, Mulgrave Lodge, near Whitby, Yorks.

Wanted, "**English Mechanic**," Vol. XXXIV. unbound, in good condition, in exchange for an electric bell or parts by Dale.—17, Mount Pleasant-road, Ladywell, Kent.

Wanted offers, anything, for "**English Mechanic**," from Jan. 7th, 1881, No. 824 to date, No. 910, No. 847—[illegible] missing.—T. M., Lakefield-street, Llanelly.

Amateur **Lithographic Press and Materials**, with Instruction Book, offered in exchange for Lancaster's Meniscus Apparatus, in good order.—John Lewis, Church-street, Tewkesbury, Gloucestershire.

Piccolo, Silver Watch, Dynamo Meter. Wanted, parallel vice, any tools, or offers in anything useful.—Apply J. B. [illegible], Matlock, Somerset.

Eyepiece and Object-glass of a small transit instrument, worth 30s. What offers?—R. H. Tennant, Paline-green, Limerick.

Old **Oak Carvings**, Jacobean panels and panel heads, fine condition. Wanted, fret machine, or "Rivington's Building Construction."—J. Smith, 63, Elwood-street, Highbury, N.

Lathe, 5in., chucks and tools. Exchange anything useful. Drilling machine preferred. Letters not answered.—15, Ann-street, Linton-street, Packington-street, Islington.

Achromatic **Telescope**, 3-draw, 3ft. focus, 2in. aperture, by Millikin and Lawley, cost three guineas; for inch Microscope Objective, English, or cash 20s.—C., 65, Cassland-road, London, E.

Accordion, Busson's, 3 octaves, 1 stop, with stand and box, complete; take violin, in case, part exchange.—Moore, 12, Great Crown-court, Haymarket, W.

I have about 100 Nos. of the "**Engineer**" and "Engineering," in from two to three months consecutive lots. I would exchange for a Lamplough and Brown's Suspension Tricycle saddle, with back rest (No. 2 preferred), or for Tube Expander (2 or 2½ inch), or for set of Pipe Wrenches.—T. J. Sherry, Morton, Dorset.

Set of 1½in. by 3in. Brass **Engine Castings**, part finished. For pair of geared Headstock Castings.—Smith, Lower-street, Tutbury, Staff.

Drilling Machine. Exchange for good 5½ or 6in. Slide Rest, or offers in lathe parts, or offers.—G. [illegible], Kerr-street, Warrington.

Model **Boiler Fittings**, Water Gauge, Feed Pump, Check Valve, Lubricator, and Taps, complete. Offers.—Macintosh, 35, Little Church-street, Edgware-road, London.

Tricycle wanted, single or double, in exchange best new 41-set Silver-plated Harness, or new 1 man power Boiler and Steam Engine.—C. Gillard, North Curry, Somerset.

Complete set of **Ironwork** for any size Bicycle, including Stanley head and neck, best steel spring, steel handle bar, hollow backbone, back and front forks, spoon brake, trouser guard, and step. Exchange for anything useful, or offers.—James Brown, Stafford-street, Longton.

"**Chemical News**," Vols. XXXVIII. to XLV. "Engineering," Vols. XXII., XXIII., XXIV., wanting one number; "Technical Educator," parts 1 to VI.; "Musical Times," January, 1879, to September, 1882; "Monthly Musical Record," 1878, 1879. All perfect, clean, and unbound. "Thomson's History of Chemistry," scarce, also Vol. I. of same. Cash or exchange offers requested for all or part. Wanted, especially, Vol. III. of Shaw's Edition of "Boyle's Philosophical Works," old Chemical or Alchemical Works, Scientific Apparatus, Music Stand.—A. L. Pearson, 26, Baker-street, W.

Chrome Alum for bound volumes English Mechanic, or offers. 1 lb. Sample free, 3 stamps.—R. Jones, 32, Aylesbury-street, Walworth, S.E.

Scotch Scenery. 100 steel engravings, about 7 by 5 inch. Exchange for English Mechanic, or offers. Sample and List, 3 stamps.—Address as above.

Night Telescope, by Berge, late Ramsden, London. 1½inch object glass, engraved "Capt. Carter, R.N." English Mechanic, or offers.—Address as above.

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THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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For Sale.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. List Twopence.

Electrical Depot and Manufactory.—Millar's, 126, Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Bells, 5s.; Batteries, 2s. Telescopes, Microscopes, Field Glasses, Spectacles. None better or cheaper.—Millar, as above.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 27, 1882.

ELECTRICAL MEASUREMENTS.—II.

By John T. Sprague ("Sigma.")

THE practical units employed by electricians, are those devised by a committee of the British Association some years ago. They were selected so that they should be of a convenient magnitude, and yet be decimal multiples of the absolute units of the metre or centimetre gramme second absolute system (described p. 125), and also approximate in value to units already in use; they have met with a gradual general acceptance, and at the conference in Paris in 1881, the system was adopted for universal use, with some changes in the names of the units, and, in future, all electrical work will be done, and all electrical writing will be expressed, in this system.

The VOLT is the unit of *electro-motive force*, and in the formulæ is symbolised by E; when of the nature of an opposed or *counter electro-motive force*, as in the case of a reversed cell, such as a voltameter, secondary battery, &c., it is written − *e*. The volt is, therefore, the unit of all the various expressions or actions, which are either consequences or parts of electro-motive force, or which are simply other names for the same thing. Therefore, "potential," "difference of potential," "tension," "electric pressure," "electric force," and so on, are all covered by this one unit, the "volt."

The volt represents a static force or pressure; there exists no standard of it at present, but it is purely a matter of calculation. It is of the value of 10^8 C.G.S. units (10^5 M.G.S.) This value was selected as being the nearest approximation to any existing available E.M.F., the Daniell cell, which is the most constant known. The E.M.F. of the Daniell is stated, by the best authorities, to be volt 1·079. That is to say, the volt is Daniell ·9268. But it is said that if a Daniell is charged with a solution of zinc sulphate, its E.M.F. is reduced to volt 1·02; but the actual force really varies with temperature, and there yet remains much uncertainty on the subject. As the E.M.F. developed in a thermo-electric battery is constant for a fixed range of temperature, and as the freezing and boiling points are easily producible, it is probable that a standard volt might be constructed by this means; but it would not be reproducible exactly, because any variation in the purity of metals alters the conditions; it could, however, be copied like the ohm.

The OHM is the unit of what electricians call *Resistance*, but which is not in any sense a resistance, and is merely a mathematical expression for the reciprocal of the conducting capacity. It is symbolised by R when general, but when it is subdivided into the several parts of the circuit it is written $r\ r^1$, &c. Its value is 10^9 C.G.S. units (10^7 M.G.S.), and this value was chosen because it was a near approximation to the Siemens mercury unit, which was largely in use. This unit, which is a column of mercury 1 metre long and 1 millimetre section, at the freezing-point of water, equals ·953 ohm. To give a definite idea of the ohm, it may be said to be equal to a wire of pure copper 100ft. long (99·1) and ·032 of an inch in diameter (about 22 gauge) weighing 21·68 grains per foot. Any other wire, of whatever material or size, or any electric circuit which would equally divide an electric current with this wire, would be 1 ohm in resistance.

The exact value of the standard ohm prepared by the B.A. committee is not known certainly. The following list of the different experimental determinations shows both the difficulty of these exact experiments, and the real uncertainty which still exists as to the data upon which mathematicians build up elaborate calculations.

1862.	Weber	1·088
1870.	F. Kolrausch	1·0196
1873.	Lorenz	·9797
1876.	Rowland	·9912
1877.	H. F. Weber	1·0020
1881.	Lord Rayleigh	·9895

As these differences are found by most skilful experimenters, aided by the most perfect and complete appliances, it is not a matter of surprise that the actual units obtainable vary considerably from each other. An international committee is appointed to settle this matter; and it is stated that a preliminary decision has been arrived at which is so injurious to future science as to call for urgent protests. It is resolved to construct a new standard and reproducible ohm, which is to agree in value with *the existing ohm, be that correct or not*. The reason given is, that to alter the standard would make all existing instruments incorrect, while the true value of the existing standard being ascertained, it will only be necessary to use a constant for correction in calculations. It is said that the fact that the practical ohm is not exactly 10^9 C.G.S. units is of no more moment than the fact that the metre is not exactly its theoretical proportion of the earth quadrant. But the cases are no way analogous: any unit of length may serve as the basis of a complete system. Its relation to the earth's quadrant is of no more consequence than its relation to the height of St. Paul's. But the ohm is part of a system closely related to its theoretical basis. All calculations of current, energy expended, and so on, are dependent upon this ratio. The question resolves itself into a choice of two evils:—

1. The existing standard is changed for one theoretically true.

Evils. Existing instruments become incorrect. But as it is, they are not really correct to the existing standard; they generally alter in course of time, and any change would only need a correction of results by a constant. This evil would, therefore, wear out in time.

2. The existing standard is retained.

Evil. For all future time no observations will be correct; every calculation will need a correction; the true relations of electric constants will always be obscured.

Can there be a doubt which is the lesser evil?

It is intended to make a reproducible ohm, which will be a great advantage; but the mode is open to question. The intention is to define what length of a column of pure mercury of 1 millimetre section is a true ohm. Mercury is far superior to any solid metal, because it is capable of easy precipitation, and is subject to no molecular changes; but how the column of mercury is to be produced is questionable, seeing that no glass tube can be drawn true; also a fractional length will be difficult of adjustment. The plan which I have suggested gets over this; let a V-groove be formed in ebonite or glass, exactly 1 metre long, or two such grooves side by side, half a metre long, and connected by massive copper at one end, so as to have the terminals side by side; this being placed exactly level, let so much mercury be put into the groove as shall exactly make the ohm: this would make its own section, and all that would then be necessary would be to ascertain exactly the weight of mercury required; weight and length, the two easiest measures to determine exactly, are all the data which would be required; a cover applied would complete the apparatus.

The AMPERE is the unit of *Current* per second, the one thing which has an actual value in nature, which value is not, however, taken into account in the system. The unit value of current is defined of necessity by the relations of Ohm's formula—

$$\frac{E}{R} = C. \quad \frac{\text{E.M.F.}}{\text{Resistance}} = \text{Current.} \quad \frac{\text{Volt}}{\text{Ohm}} = \text{Ampère.}$$

$$\frac{10^8}{10^9} = 10^{-1}\ \text{C.G.S, or}\ \frac{10^5}{10^7} = 10^{-2}\ \text{M.G S.}$$

The ampère was formerly called the veber. Its actual value is not yet ascertained satisfactorily, and the difference of values given is considerable. The value accepted until recently is that employed by myself, which makes the ampère a current which, doing work in electrolysis, releases ·00001022 gramme of hydrogen per second, or in grains ·000158, and the equivalent proportion of any other substance. M. Mascart has recently given as the value gramme ·000010415 of hydrogen, which is in grains ·000161.

A general formula for chemical work of a current is—

$$D = \frac{K\,a\,E\,t}{R}.$$

D is the deposit or work effected.
K a constant which the units value as above.
a the electric equivalent of any substance.
E the electromotive force in volts.
t time in seconds.
R resistance in ohms.

Knowing the number of vebers which can be measured or ascertained by E ÷ R, which values are then removed, the formula becomes

$$D = CKat$$

to which can be added a constant for conversion of the ampère unit into any other order of weight desired. To make this clear to those unfamiliar with formula, let us use it to answer the question. How many pounds of copper can be deposited on a square foot in 24 hours? A safe current is one of 1 ampère to about 6 square inches, or 25 ampères per foot. Then—

K = ·000156 grain	=	−4·1985571
a = 31·75 copper eqiv.	=	1·5017437
C = 25 ampères	=	1·3979400
t = 3600 × 24 time	=	4·9365137
Grains to lb. 1 ÷ 7000	=	−4·1549020
D lb. of copper 1·55	=	0·1897565

By simply taking the logarithms of the figures from a table and adding them together, we multiply the figures without trouble.

The COULOMB is the unit of "dynamic quantity"; it is not a necessity at all, for it is simply of the value of 1 ampère of current; that is, a current of 10 ampères would transmit in one second 10 coulombs of electric quantity; the coulomb is, therefore, C.G.S. 10^{-1}, and represents chemically grains of hydrogen ·000158, or such values as have just been described for the ampères.

The *Joule* or *Joulad* (name not yet accepted) is the unit of energy. It is the work expended by the ampères in 1 ohm., and its expression is $J = C^2 \times R$. This is the energy expended, the work done in passing the current through the circuit. *It is the true resistance*, and it is analogous to mechanical friction, and, like it, varies as the *square of the current*, as the formula E × C means exactly the same thing for any given circuit, only substituting a measured current for a measured resistance; this formula also gives us the result in what are called volt-ampères, which are the same thing as the Joule. This name has been recently proposed by Mr. Siemens, as a suitable recognition of Joule, the measurer of the actual co-relation of work and heat; but it has been in use for years (as the Joulad),

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proposed by D. G. Fitzgerald on the same ground.

The JOULAD covers all forms of energy, and includes W work in foot-pounds or other measures, and H heat in calories, &c. Therefore it needs a constant K to be added to the formula, which would represent the value in the desired terms. Thus the Joulad means:—

C. G. S (ergs.) .... 10^7
M. G. S., 1,000 .... $\cdot 10^8$
Foot-pounds .... ·737
Calory .... ·24065

The WATT is suggested as the unit of power (similar to horse-power); it holds much the same relation to the joulad as the coulomb does to the ampère. It is, in fact, the power to do a Joulad of work.

REVIEWS.

Memoir of Augustus de Morgan. By his Wife, SOPHIA ELIZABETH DE MORGAN. London: Longmans.

THIS life of De Morgan shows us the man directly, and only indirectly gives an estimate of the work he did. De Morgan's connection with University College, and his separation from it, must naturally form an important portion of any history of his life. We can do no more here than indicate what are the contents of the book, and promise those who will peruse it at least something that will interest them. The letters alone will do that. To take a specimen, writing to Sir John Herschel, De Morgan says: "I see your drift. But that *year* question set me off on equinoctial time. Why, the question is an ethnological, not an astronomical one. When the Portuguese and Spaniards met in the Philippines—*viâ* India the Portuguese, *viâ* S. America the Spaniards—they differed a day in their reckoning, kept their Sundays on different days, and cursed each other as only real Christians can curse. I never could learn how the Pope settled it." Further on in the same letter, he says: "I don't see how there could be three days current at once, unless some chaps had gone twice round the world, and never made a correction." Mrs. De Morgan supplies a list of her husband's most notable writings, including his contributions to the "Penny Cyclopædia," which, given on her authority, will be valuable.

The Remote Antiquity of Man Not Proven: Primeval Man not a Savage. By B. C. Y. London: Elliot Stock.

THE anonymous writer of this work says that it is an argument based on scientific facts, and supported by scientific opinions, in which the writer has endeavoured to prove that the appearance of man on the earth was not at a remote age in the past, and that primeval man was not a savage. Further on he says the facts on which this theory is based are often carious and incomplete. These sentences, which catch the eye in glancing through the preface, are not encouraging. for although we can understand that "scientific opinions" may mean the opinions of so-called scientific men, we can only wonder what are "scientific facts." The assertion, too, that a theory is based on facts which are often "carious," a word synonymous with "rotten," but applied only to the bones, is also peculiar. Still further on we find "true scientific facts," and then we begin to see the object of the writer, which is apparently not to prove the truth and hold it, but to upset "scientific facts" in order that he may support preconceived opinions. The book is obviously the work of a special pleader, and as such may be useful to those who wish to learn the value of "scientific facts."

Electro-Motors. By J. W. URQUHART. Manchester: W. T. Emmott; London: Trübner.

THIS work is intended for the use of engineers and others, and offers them an explanation in conveniently plain terms of the leading electrical and magnetic principles involved in the transmission of electrical energy and its subsequent conversion into motive power; but in his preface the author says:—"It appears necessary to explain that the construction of dynamo-electric machines is only cursorily treated, since it has already received attention in works devoted to electric lighting." The next sentence leads the reader to infer that the author has described the machines in some previous volume, especially as the frontispiece is partly occupied by the "author's electromotor," which, however, is not so fully described as "engineers and others," especially the others, would like. There is, however, much useful information in the book, for instance, the "list of insulated wires"; but that is given more fully in Mr. Sprague's work. Taken as a whole, it is, nevertheless, disappointing, for the fundamental principles did not require elucidating, whereas information of a practical kind is much desired by a large number of "engineers and others," and in that respect a great deal more might have been said.

The British Navy. By Sir THOMAS BRASSEY. London: Longmans.

THE third volume of Sir Thomas Brassey's work deals with opinions on the shipbuilding policy of the navy, collected from a variety of sources. Summing-up the opinions on heavy ironclads, the author says that they have the advantage in coal endurance, in armament, in capacity to carry large crews, from which detachments may be landed for military operations on shore. They also take the principal part in the engagements which determine the issue of a war; but they are excessively costly and very unhandy. The value of armour is generally acknowledged, but it is possible to carry it too far, while it is not impossible that the chief purpose which armour is intended to serve may be better attained by a more minute internal subdivision, especially as torpedoes will be the weapons mostly used against ironclads. The damage done to the ships at Alexandria was so little that not much is to be learned from that engagement; but the safest policy for this country is undoubtedly to have ships of all classes, from heavy ironclads to fast unarmoured but powerfully-armed cruisers. Thus we require floating citadels for coast defence, heavy ironclads to take the ocean and fight in line of battle, and fast-steaming vessels to scour the seas, some of which, at least, must be capable of engaging a powerful enemy, so far as weight of guns is concerned, if not in the matter of defensive armour. Opinions on these subjects are very varied, to say the least; but Sir Thomas Brassey has gathered together a useful selection, from which the student can obtain the arguments pro and con.

We have received the first number of *Longmans' Magazine*, containing 124 pages of readable matter. It commences with a novel by James Payn, and ends with a complete tale by F. Anstey, while amongst its contents are a paper by Prof. Tyndall on "Atoms, Molecules, and Ether Waves," another by Prof. Owen on "Our Origin as a Species," and the first instalment of one by Dr. Freeman on "Some Points in American Speech and Customs." That list does not exhaust the contents of a magazine which is certainly cheap at sixpence.——*An Essay on the Construction of Flutes*, by THEOBALD BOEHM, edited by W. S. Broadwood (Rudall, Carte, and Co.), is the first publication of a treatise written by Boehm in 1847 for Mr. Rudall. Mr. Broadwood says, "I imagine it will be read with no little pleasure by most flute-players, whether professional or amateur, giving us, as it does, a clear and succinct summary of those principles of acoustics which are applicable to the construction of all wind-instruments." Boehm died last November, at the age of 86, and many will thank Mr. Carte for giving Mr. Broadwood the opportunity of rescuing this history of the invention of the Boehm flute from oblivion.——*Elementary Chemical Arithmetic*. By SYDNEY LUPTON, M.A. (Macmillan), is an endeavour to put into concise and simple form, matter which is usually found only in the manuscript notes of teachers of chemistry. The value of numerical problems in teaching the facts of chemistry, has been recognised for some years; but, we believe, Mr. Lupton is the first to publish a book of problems. As the "answers" to the 1,100 questions are supplied, the work will be of great use to students unable to obtain the assistance of a teacher.——*A School Course on Heat*, by W. LARDEN, M.A. (Sampson Low and Co.), is an introduction to the science written to meet the wants of those who have no knowledge of physics.——*The Practical Steam Engineer's Guide*, by EMORY EDWARDS (Sampson Low and Co.), is an American work which may be found useful in this country by those who desire to learn something of American practice.——*Science in Short Chapters*, by W. MATTIEU WILLIAMS (Chatto and Windus), is a collection of papers on scientific subjects contributed by the author to various periodicals or to the Proceedings of learned societies.——*Practical Organ Building*, by W. E. DICKSON (Crosby Lockwood and Co.), is the second edition, revised and enlarged, of a practical manual which we noticed favourably when it originally appeared.——*The History of a Lump of Coal, from the Pit's Mouth to a Bonnet Ribbon*, by ALEX. WATT (A. Johnston), is sufficiently criticised by its title.——*Synopsis of Chemistry*, by THOS. DRINKWATER (Y. J. Pentland, Edinburgh), will be found useful to "students preparing for examination."——*A Treatise on Marine Surveying*, by the REV. J. L. ROBINSON, B.A. (Macmillan), is intended for the use of younger naval officers, and is in fact a textbook for the instruction of pupils. The questions and exercises have been taken mainly from the papers of the Royal Naval College.——*Euclid*, Books I., II., edited by CHAS. L. DODGSON, M.A. (Macmillan), is an attempt to show Euclid's method stripped of verbiage and repetition.——*Particulars of Dry Docks, &c., on the Thames*, compiled by CHAS. H. JORDAN (E. and F. N. Spon), is a table giving particulars of the various dry-docks, floating-docks, &c., on the Thames, with a map of that portion of the river in which they are situated.

We have also received *A History of Coal-Mining in Great Britain*, by ROBERT L. GALLOWAY (Macmillan), and *Textbook of Geology*, by ARCHIBALD GEIKIE, LL.D., F.R.S. (Macmillan), works which will be noticed at length.

ASTRONOMICAL NOTES FOR NOVEMBER, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 43 41·44 ,,	14 26 23	14 30 2	14 42 41·08
6	11 43 46·30 ,,	14 46 9	16 3 0	15 2 23·85
11	11 44 10·33 ,,	15 6 17	17 29 16	15 22 6·63
16	11 44 56·54 ,,	15 26 46	18 47 59	15 41 49·40
21	11 46 3·12 ,,	15 47 36	19 58 20	16 1 32·18
26	11 47 29·40 ,,	16 8 45	20 59 32	16 21 14·96

The Method of Finding the Sidereal Time at

Mean Noon for any other Station will be found on p. 390 of Vol. XXXIV.

The usual signs of Solar activity continue to manifest themselves.

There will be an

Eclipse of the Sun

on November 10th; but as it will be invisible in this country, the mere mention of it will suffice here.

The Moon

Enters her Last Quarter at 6h. 57·9m. on the evening of November 2nd, and is new at 11h. 19·6m. p.m. on the 10th. She will enter her First Quarter at 8h. 41·5m. a.m. on the 18th, and be Full at 2h. 2·5m. in the early morning of the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	20·2	4 44·1 a.m.
6	25·2	8 24·8 ,,
11	0·5	0 9·5 p.m.
16	5·5	1 33·0 ,,
21	10·5	8 52·3 ,,
26	15·5	*12 40·8 ,,

* After midnight on the 25th.

The Moon will be in conjunction with Mercury at 10 a.m. on the 9th; with Mars at 4 p.m. on the 11th; with Venus at 2 p.m. on the 13th; with Saturn at 9 a.m. on the 21th; and with Jupiter at midnight on the 26th.

Mercury

Is a Morning Star, attaining his greatest elongation West (18° 55′) at 1 a.m. on the 8th. His rapidly-increasing south declination places him more and more unfavourably for the observer, and his small angular diameter (8″ on the 1st) diminishing to 4″·8 by the end of the month, conspires with this to impair his interest as a telescopic object.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 26·8	7 17·8	10 41·4 a.m.
6	13 36·5	7 40·1	10 34·4 ,,
11	13 56·8	9 35·1	10 34·9 ,,
16	14 22·7	12 12·4	10 41·1 ,,
21	14 51·5	11 59·8	10 50·2 ,,
26	15 22·0	17 39·7	11 0·9 ,,

Starting thus from a point to the N.E. of Spica Virginis, Mercury will travel through that constellation, and across the whole width of Libra. On the 20th he will be a little more than 1° North of *α* Libræ; but this is the only star of any size to which he will at all approach so nearly.

Venus

Is an Evening Star during the entire month. She is at her greatest brilliancy on the 1st of November, and, but for her tremendous South Declination, might at this time be visible to the naked eye in daylight. As it is, she will, unfortunately, be immersed in the mists of the autumn horizon. Her angular diameter increases from 40″·6 on November 1st to 1′ 1″·4 at the end of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 7·4	28 0·2	2 24·3 p.m.
6	17 16·8	28 3·9	2 14·0 ,,
11	17 22·8	27 53·3	2 0·4 ,,
16	17 24·8	27 27·1	1 42·7 ,,
21	17 22·3	26 43·9	1 20·6 ,,
26	17 15·6	25 42·0	0 54·2 ,,

The path indicated in the above Ephemeris begins where the extreme southern part of Ophiuchus is conterminous with Scorpio, just enters Sagittarius, and returns to Ophiuchus again. It is described in a part of the sky very free from visible stars.

Mars

Is quite invisible.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
3	κ Cancri	5	1 31 a.m.	Bright	310	71	2 [illegible] a.m.	Dark	[illegible]	[illegible]
15	B.A.C. 6658	6	4 37 p.m.	Dark	64	73	[illegible] p.m.	Bright	[illegible]	348
25	ω¹ Tauri	6	1 51 a.m.	Bright	172	181	2 40 a.m.	Dark	217	252
25	B.A.C. 1563	5½	†11 48 p.m.	S.	4	349				
26	B.A.C. 1651	6½	6 51 a.m.	Bright	72	111	7 16 a.m.	Dark	277	315
26	χ¹ Orionis	6	6 46 p.m.	Bright	127	88	7 [illegible] p.m.	Dark	[illegible]	198
26	χ² Orionis	6	10 29 ,,	Bright	[illegible]	65	11 58 ,,	Dark	[illegible]	222
27	71 Orionis	5½	4 54 a.m.	Bright	[illegible]	88	[illegible] a.m.	Dark	287	328
29	A² Cancri	6	11 41 p.m.	Bright	81	41	12 [illegible] p.m.	Dark	[illegible]	[illegible]
30	60 Cancri	6	†5 59 a.m.	N.N.P.	186	179				

† Near approaches.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Sh I	5	51	A.M.	11	I	Tr I	9	37	P.M.	20	I	Tr E	8	4	P.M.
2	I	Ec D	3	4	30 ,,	11	I	Sh E	11	0	,,	21	II	Sh I	12	7	,,
2	*I*	*Oc R*	6	19	,,	11	I	Tr E	11	52	,,	22	II	Tr I	1	23	A.M.
2	I	Sh I	12	23	P.M.	12	III	Sh I	1	20	A.M.	22	II	Sh E	2	51	,,
3	I	Tr I	1	24	A.M.	12	III	Sh E	5	53	,,	22	II	Tr E	4	10	,,
3	I	Sh E	2	38	,,	12	*III*	*Tr I*	6	47	,,	22	III	Ec D	9	14	5 ,,
3	I	Tr E	3	39	,,	12	I	Oc R	8	59	P.M.	22	III	Ec R	11	39	40 ,,
3	I	Ec D	9	32	54 ,,	13	II	Ec D	3	21	16 ,,	22	III	Oc D	11	43	,,
3	I	Oc R	12	46	,,	13	*I*	*Tr E*	6	18	P.M.	23	III	Oc R	2	18	A.M.
4	II	Sh I	5	39	A.M.	14	II	Sh I	9	32	,,	23	II	Ec D	7	18	5 ,,
4	*I*	*Tr I*	7	50	P.M.	14	II	Tr I	11	9	,,	23	II	Oc R	11	13	,,
4	I	Sh E	9	6	,,	14	II	Sh E	12	15	,,	24	I	Sh I	6	5	A.M.
4	I	Tr E	10	5	,,	15	II	Tr E	1	52	A.M.	24	*I*	*Tr I*	6	41	,,
4	III	Sh I	11	21	,,	15	III	Ec R	7	39	26 ,,	25	I	Ec D	3	14	35 ,,
5	III	Sh E	1	43	A.M.	15	III	Oc D	8	21	,,	25	I	Oc R	6	8	,,
5	III	Tr I	4	38	,,	15	III	Oc R	10	55	,,	25	I	Sh I	12	33	P.M.
5	III	Tr E	5	53	,,	16	*I*	*Ec D*	6	52	7 ,,	26	I	Tr I	1	7	A.M.
5	*I*	*Oc R*	7	13	P.M.	16	II	Oc R	8	56	P.M.	26	I	Sh E	2	48	,,
5	II	Ec D	12	19	0 ,,	17	I	Sh I	4	11	A.M.	26	I	Tr E	3	22	,,
6	II	Oc R	5	27	A.M.	17	I	Tr I	4	56	,,	26	I	Ec D	9	43	10 ,,
7	*II*	*Sh I*	6	7	P.M.	17	I	Sh E	6	26	,,	26	I	Oc R	12	29	,,
7	II	Tr I	8	50	,,	17	*I*	*Tr E*	7	11	,,	27	I	Sh I	7	2	,,
7	II	Sh E	9	40	,,	18	I	Ec D	1	20	33 ,,	27	I	Tr I	7	33	,,
7	II	Tr E	11	31	,,	18	I	Oc R	4	18	,,	27	I	Sh E	9	17	,,
8	*III*	*Oc R*	7	29	,,	18	I	Sh I	10	39	P.M.	27	I	Tr E	9	48	,,
9	I	Ec D	4	58	15 ,,	18	I	Tr I	11	22	,,	28	I	Oc R	6	55	,,
9	*II*	*Oc R*	6	37	P.M.	18	I	Sh E	12	54	,,	29	II	Sh I	2	43	A.M.
10	I	Sh I	2	17	A.M.	19	I	Tr E	1	37	A.M.	29	II	Tr I	3	42	,,
10	I	Tr I	3	10	,,	19	*III*	*Sh I*	7	19	,,	29	II	Sh E	6	27	,,
10	I	Sh E	4	32	,,	19	I	Ec D	7	49	6 ,,	29	II	Tr E	6	25	,,
10	I	Tr E	5	25	,,	19	I	Oc R	10	41	,,	30	III	Ec D	1	13	,,
10	I	Ec D	11	26	10 ,,	20	II	Ec D	6	0	28 ,,	30	III	Oc R	5	37	,,
11	I	Oc R	2	32	A.M.	20	*I*	*Tr I*	5	48	P.M.	30	II	Ec D	9	53	43 ,,
11	I	Sh I	8	45	P.M.	20	I	Sh E	7	23	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Jupiter,

Although he does not south until the early morning, is visible all night long, as he rises before 7 p.m. at the beginning of November, and a minute or two after 5 o'clock in the afternoon at the end of it. His angular diameter increases from 41″·4 on the 1st of the month to 44″·2 on the 30th. He is well placed for the observer.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 5·1	23 0·1	3 23·8 a.m.
6	6 4·0	23 0·9	3 3·1 ,,
11	6 2·6	23 1·3	2 42·0 ,,
16	6 0·8	23 1·8	2 20·6 ,,
21	5 58·8	23 2·2	1 58·9 ,,
26	5 56·5	23 2·5	1 37·0 ,,

Hence it will be seen that Jupiter will describe a retrograde arc from a point a little to the West of *η* Geminorum, and will be found, at the end of the month, in the confines of Taurus.

Saturn

Comes into opposition to the Sun at 3 a.m. on November 15th, has considerable north declination, is visible all night long, and is, in fact, most favourably situated in every respect for the observer. His angular diameter remains constant at 18″·2 during the entire month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 27·9	16 [illegible]	12 43·2 p.m.
6	3 26·4	16 [illegible]	12 21·9 ,,
11	3 24·7	16 10·6	12 0·6 ,,
16	3 [illegible]	16 [illegible]	11 39·4 ,,
21	3 [illegible]	15 [illegible]	11 18·1 ,,
26	3 [illegible]	15 [illegible]	10 56·8 ,,

So that Saturn will describe a short retrograde path in that blank and barren region in Taurus to the south and west of the Pleiades.

Uranus

Continues practically invisible for the observer's purpose.

Neptune

Is now in an excellent position for observation, as he will be in opposition to the Sun at 5 a.m. on the 10th, and is, like Saturn, visible all night long.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	2·8	15	20·9	12	18·1	p.m.
6	3	2·3	15	18·6	11	58·0	,,
11	3	1·7	15	16·2	11	37·7	,,
16	3	1·2	15	13·9	11	17·4	,,
21	3	0·6	15	11·7	10	57·3	,,
26	3	0·1	15	9·5	10	37·1	,,

Our Ephemeris shows that the exceedingly short arc described by Neptune during November lies about 4° to the South, and very slightly to the West, of δ Arietis.

Shooting Stars

Should be watched for on the night of the 9th. It is almost needless to retell here the story of that well-known shower of the so-called "Leonides," the meteoric stream following in the track of Tempel's Comet of 1866. Suffice it to say, that the earth passes through this stream between November 11th and 15th, and that the maximum display occurs on the night of the 15th. We may reiterate a caution before given in these columns—that it is useless for the observer to begin his vigil until after midnight, when the radiant point of the shower appears above the eastern horizon. More than one distinct shower may be expected also about the night of the 27th; in fact, watch should be kept on each one from the 25th to the 28th inclusive.

Greenwich Mean Time of Southing of Twelve of the Principal Fixed Stars on the Night of November 1st, 1882.

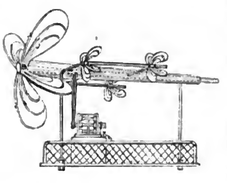
	Souths.			
Star.	h.	m.	s.	
α² Capricorni	5	27	58·72	p.m.
α Cygni	5	53	47·79	,,
α Cephei	6	32	2·69	,,
α Aquarii	7	15	52·31	,,
Fomalhaut	8	7	10·63	,,
Markab..	8	14	54·63	,,
α Andromedæ	9	18	9·23	,,
α Cassiopeiæ	9	49	37·21	,,
Polaris	10	32	34·76	,,
α Arietis	11	16	4·34	,,
α Ceti	12	11	30·10	,,
α Persei..	12	31	16·53	,,

The Method of ascertaining the Greenwich Mean Time of Southing of either of the Stars in the above List, on any other night in November, as also that of determining the Local Instant of its Transit at any other Station, will be found on p. 392 of Vol. XXXIV. We must reiterate the caution, however, that the rules there given are not rigidly accurate when applied to Polaris or any other close circumpolar star.

FANNING-WHEELS FOR NAVIGATING THE AIR.

MOST of those enthusiasts who have proposed to navigate the air depend upon modifications of the screw propeller to obtain motion, but if we may judge from a recent patent obtained in this country on behalf of Mr. T. Hyatt of New York, a rotating-wing, capable of creating air is the one thing needful. As the invention can also it seems be used as a substitute for wind-engines, windmills, fanblowers, and even for preventing vessels from sinking, it is obviously worth the cost of protecting it. According to the patentee, the invention, so far as regards navigating the air, is based on his discovery of the law in virtue of which flying creatures though heavier than air, are able to rise and float in it; viz., the lifting and supporting power of wind or air in motion; flotation being the condition precedent to flight. The apparatus is a winged wheel or propeller; the wings, three or more in number, constituting as a whole, a rotating wing or fanning-wheel, the primary object of which is to produce a tendency to vacuum by rapid revolution; the wing-surface for this purpose being relatively small, but, like the wings of such insects as dragon flies, bees, and wasps, worked at a high rate of speed. The inventor holds that the failure of mankind through all past ages, in their attempts to fly, has arisen from their imitation of bird-flying where the birds sail upon natural winds: whereas the essence of true flying consists in upholding one's self in the air (as the bee does) by the wind of one's own creation. The wings of all flying creatures, in their specific gravity, approach the specific gravity of the atmosphere as nearly as possible; the object of their movement being to produce resistance; the amount of resistance being in proportion to the inability of the wing to cut through the air. Imitating nature, the inventor constructs his fanning-wheel or rotary-wing of materials having, for their strength, the least specific gravity. This fanning-wheel he proposes to employ as a substitute for "wind engines" and "windmills"—and for all purposes where wind-power or an air-blast, or an exhaust is needed, for ventilation or for supplying air to fires.

The invention, as to water, is based on his discovery of the true law of propulsion through that element—viz., the sliding pressures of inclined planes varied automatically in obedience to the combined speed and momentum of the body moved by them. Water animals are created somewhat heavier than the fluid to be able to cleave it readily. Were they materially heavier or lighter they would need greater motive force than they possess. The specific gravity of water-inhabitants has reference to the conducting power of the water in which they are immersed: their motive force is small, and they need but little for locomotion. Whales though "warm blooded" move through the water usually at the rate of only four to five miles an hour; birds, on the contrary, move through the air at the rate of from 20 to 40 miles an hour; and birds in addition to their non-conducting clothing of feathers are immersed in air which of itself is a good non-conductor. Bees and creatures similarly constructed are able to float themselves in still air upon winds made by the rapid beating of their own wings; but birds in general, because of their relatively great weight in comparison to their motive force, are under the necessity of relying mainly upon the natural winds of the firmament; the flotation of heavy birds in still air is obtained by occasional vigorous flapping combined with gliding. The gliding of a bird through the air is flotation produced by the weight of the creature acting as projectile force; were the air to move under the bird with the same velocity, the bird might stand still; for the velocity of air in motion is equivalent to density: wind is therefore the first necessity for aërial locomotion, as it practically increases the density of the atmosphere and makes the flotation of heavy bodies possible in it.



The invention of an apparatus for navigating the air is therefore such an arrangement of wings or fans as enables the inventor to produce the greatest amount of wind at the least expenditure of power. Wings or fans made of metal can only be supposed to be adapted to an atmosphere at least of the practical density of water, or greater: that is to say, air made practically dense by reason of the velocity of its movement; consequently where this practical density of the atmosphere is required to be produced by the fanning action of wings, such wings, if made of metal, would require to be moved at a rate of speed far beyond what would be required of wings made of light materials in imitation of nature: and such increased rate of speed for the metallic wings or fans means increase of power and consequent cost: hence the invention of the fanning-wheel as a substitute for "fan blowers" is the substitution of an economical for a wasteful apparatus. And inasmuch as water is a fluid equally with air, the apparatus effects in the water as a substitute for "screw propellers," an equal economy for the navigation of vessels through that fluid: the action of the fanning-wheel in the water being practically of the same character as in the air. The illustration represents in side view the inventor's idea as it would be applied to a vessel for navigating the air. The fanning-wheel located at the front of the machine is designed to produce flotation, and for this reason is of larger diameter than the four smaller wheels behind it, placed two on each side of the body. These side wheels are designed to revolve in opposite directions. By this arrangement an equal number of fans or wings are constantly pressing downward as inclined planes against the air upon each side of the vessel simultaneously; the more powerful wheel at the front of the machine furnishing to the smaller ones in the rear an atmosphere of greater density for them to act in as propellers, than would be the case but for this disposition of the wheels.

In constructing the fanning-wheel, the frame pieces, in imitation of the bones and quills of birds' wings, are made of hardened rubber and hollow; in shape resembling reeds, largest at the butt and tapering to fine ends. These tapering tubes may all spring from the hub, or the largest one of the set may be made to carry the others. For a membranous covering silk is preferred, and the wings are attached to the hub in such wise that upon the shaft revolving each wing surface shall automatically adapt itself to the air-pressure created by the revolution of the wheel, and thus press against the air at an incline proportioned always to the power applied as affected by the momentum of the travelling body impelled. The hub to which the wings are attached may also be made of hardened rubber, and may also the hollow body. The patentee shows an electro-motor, driving the fanning-wheel; but he does not describe it, nor by what means motion is imparted to the small propelling wheels.

PRACTICAL NOTES ON PLUMBING.—XLVIII.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 151.)

Inside Work—Water Supply.

IN the remotest of ages of antiquity, the men in the East considered the construction of wells, fountains, and cisterns to be one of the greatest acts of benevolence they could perform towards their fellow-creatures. In fact, rich men considered it a moral duty to devote a certain portion of their wealth to the digging of wells and the building of cisterns for the supply of the thirsty traveller.

We will now proceed to the description and illustration of some of the most ancient wells, many of which date nearly three thousand years before the Christian era. We may commence with the oldest of which we have any record—namely, those dug by Abraham, at Beersheba, 4,458 years ago. Of course, thousands of years passed before man was equipped with the necessary tools for digging such wells as at Beersheba. The next in point of antiquity, although of much more importance, is Jacob's well, a description of which should interest all connected with this subject, more especially on account of its great antiquity, it having been made at least 3,600 years ago, and of its wonderfully perfect state of preservation. This well is situated at Sychar, on the road to Jerusalem, and is 105ft. deep, and 9ft. in diameter, sunk into the solid rock. Its standing depth of water is about 15ft. Next we come to Joseph's well at Cairo. It is of an oblong shape, and sunk through the solid rock, and measures 18ft. by 24ft. The depth of the first well is 165ft. At this point there is a large chamber cut in a lateral direction. This is for the horses, mules, or asses to work the lower well-buckets. The second well is 130ft. by 9ft. The total depth of the well from its surface to the gravel bottom is 297ft.

Many of my junior readers may ask why it is that some wells are so much deeper than others, whilst others may ask for a short account of the theory of springs. The latter question, when answered, will fully explain the former. The origin of springs is as follows:—The rain, snow,

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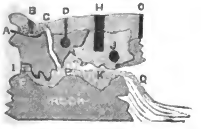
&c., which fall on the surface of the earth, penetrate the ground, sand, gravel, and other porus substances, until they meet with some solid substance as rock, or some plastic substance as clay, or other impervious materials, and if not impounded or confined, the fluid will glide in a lateral direction until it finds some kind of pervious material, or some opening, such as a fissure or cleft in a rock, when it travels through the earth, often for scores of miles, until it finds a lower level. For an illustration of this, I will refer you to Fig. 270. At B, G, D, H, O, is the land whereupon the rain falls. Suppose it to be ordinary meadow-land, as at A, below which is rock. From A to opposite G it is of convex shape. Here a certain amount of the rain-water will be held, and if a shaft, as at B, is sunk to this water level, we at once come across the spring, and the deeper you dig into this basin of course the more copious will the supply be.

FIG. 270.

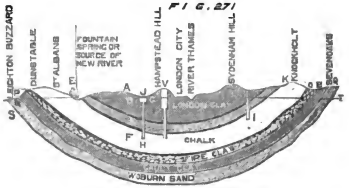


Now examine the shaft at H: this is sunk into the pebbles, having no clay or rock between it and the top of the chasm K. Here no water can be obtained, because it all filters, and drops into the chasm. By digging further you would, in the course of time, meet with what is not at all unknown to the well-sinker—"the drop," sometimes to his certain destruction, and other times to his great joy. This was the case with the boring rods of M. Arago, when boring for the celebrated well of Grenelle in the Paris basin. After boring for over 1750 feet, at last the boring rods and tools made a sudden drop of several yards, as from the bottom of the shaft H to the bottom of the chasm K, Fig. 270. But in the case of this well, nearly all materials above were impervious, and the water was impounded in such a manner, that on tapping it the water rose to a considerable height above the surface. In Fig. 270, at J may be seen a water channel or passage; this is frequently met with in mines, quarries, &c. Into this channel the water drops or percolates from above, and empties itself at the nearest opening, such as the side of a bank, and often into a chasm. From P to G may be seen the cleft of the rock which allows the water from the basin A to overflow into the chasm P, K. At D may be seen a shaft sunk through the earth to the top of the rock and a little way into it, where it is then hollowed out at the bottom or dark spot, to form a kind of reservoir. This is often done where the spring is constant but feeble in its supply.

I will now give you some idea of our London Artesian wells.

For this purpose refer to Fig. 271. A represents the surface of the earth, B the London clay, the top of which is according to the district, E is the plastic clay, F the chalk from whence we get our best water. It will be seen that these strata are of a curved form, their ends coming up to the surface, the plastic clay at E, and the chalk at St. Albans and Knockholt. The rain-water falls upon the ends of the chalk at Dunstable, Knockholt, &c. &c., and is collected in the bed of the chalk at F, H. It cannot get away by reason of the impermeable strata of fire clay and gault clay, which in this case answer the same purpose as the rock in Fig. 270. The rain-water is accumulated in the joints and crevices of the chalk, and will overflow at E on the line S, T. which is one of the sources of the water supplied by the New River Company. The deeper the well, of course the better the supply. If you want a better supply than your neighbours, you must bore and sink deeper. For instance, suppose the bottom of the sunk well J, G to be 10 feet below the water line S, T, here, if not otherwise interfered with, you will get 10 feet of water. But suppose the well V to be sunk 30 feet deep, and the pumps kept at work which would keep the water level in well V below the bottom of the well J, then J will have to be sunk lower, more especially in some parts of the chalk, because these do not supply sufficient for the two wells; whilst in other parts you may sink two wells close together and then get a full supply of water. I may here remark that the mere boring of a hole into the earth is not at all times sufficient to ensure a good chalk water supply, for in many places you may bore a well, and have to pass through sand, shingles, &c., which will require some kind of pipes to keep the hole clear from the sand, &c. In London well digging work is done by the well sinker, but in many parts of the country the plumber has the management of such work, and the present work being on plumbing, I think I have said sufficient to enlighten the young plumber, and to awaken his curiosity as to the water supply, of which of course he should have some slight knowledge. I shall now proceed with my pump work.

FIG. 271



(To be continued.)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman.

Associate of the College of Organists, London.

uu· NO. 5½ *Treatment.*—The foregoing Treatment is, as has just been said, one possessing great advantages. It will, however, at the same time have been seen that even it contains some few defects. The object of the present scheme—of the writer's—is to remedy these, so far as is practicable, and thus, while retaining the Device of the Clear Coupler, to prevent the latter from being accompanied by anything which at all detracts from its value; and so it is hoped to provide a Model that shall be as nearly as possible a perfect one for all ordinary Organs of the present scope.

The *General* Arrangement of the Instrument, as regards the posit of its Wind-chests, and of their Pipe-Order and Pull-points, and of other similar matters involved, is assumed to be exactly the same as in the preceding Treatment. That which has been said (at *r*, ante, 5th parag.) with respect to there existing no legitimate way of avoiding the *Crossing* of the Manual Actions, also holds good in the present case. The Manual Sections, likewise, are as before,—*Great*, and *Swell*; and their distance apart as regards Key Levels preferably remains as the 2½ inches,—though this is not binding.

The Great-Organ Keys are to be of any convenient length, not too short,—say a trifle longer than in the foregoing Treatment (see here also at 89, *r*, *Bis.*), and are again quite straight on Plan: the upper corner of the tail end of each is notched away, so as to leave the actual tail quite thin on Elevation; and through such thin part is pierced, vertically, a Hole suitable for receiving a Thread Button Wire of the usual size (see *p*, ante, 4th parag.). The Swell-Org. Keys, instead of overhanging those of the Great, are now made not to extend quite so far backward as do these latter, the amount of the difference being about ½ an inch: on *plan*, however, such [Swell] Keys are just as before,—viz., perfectly straight, and so laterally correspondent with the Manual beneath them. The Tail of each of those [Swell] Keys which are connectable with the Pedals is Forked in the way already described (at 89, *o*) for the reception of the Action Square-Nose which leads from such Tail: the Tails of the remaining [Swell] Keys are Notched away at their upper corner so as to leave a Tongue exactly resembling the lower prong of the just named Forking,—by which form of Notching the entire set of these Swell-Org. Squares will be kept at one same level. There is no other cutting or notching of the Keys of this Manual than has been now stated. See at this point what has been said (at *j*, ante, 1st parag.) with reference to the employment of the *Button-Clip* instead of the Forking: in the present case such Clips also would of course be applied only to the said Keys connectable with the Pedals. For the treatment of the Keys of both the Manuals with respect to the Contact and Regulation of the *Coupler* which unites them, see the proper Head (next parag. but three).

The Great-Organ Action commences with a short Tracker, formed entirely of Screw-Button Wire, running perpendicularly, from the Tail-Piercing already described, to a similar vertical Piercing in the fore end of the proper (first) Backfall. Each one of this set of Backfalls runs straight from such Wire Tracker to a line vertically beneath the Great-Organ Pulls (as before), and is posited at such a level that its fore Nose (that through which passes the Wire Tracker) just rests on the rear Nose (see next parag. but three) of the lowermost of the two sets of Coupling-Backfalls which are placed beneath the Manual,—such placing being assumed to be at the *usual* levels. The said Great-Organ Backfalls all receive the Half Semitonal Key-tail side Skew, so as to bring their rear Noses directly under the *spaces* between the Swell-Organ Trackers. (The whole of this portion is, on Plan, exactly as in the last Treatment; see therefore as with that, at *r*, ante, 8th. parag.). The said Wire Tracker will have a Stopping Eye and Button at its lower end; at about its middle will be a suitable Cranking (see *s*, ante) to permit it to pass properly between the rear ends of the Backfalls of Swell-to-Pedale; and its top End will be Tapped with the usual Button Thread, the upward extension of such end being always made sufficient for the Button which it receives—and which of course rests upon the thinned Tail also already described (at *uu*, ante, 3rd. parag.)—to serve as a Regulating Button if necessary, and the downward extension of such Thread being always carried low enough to receive a second Button set just under (and clear of) the same Tail. The object of this under or *Catch* Button is simply to prevent the Wire from falling down out through the Backfall Eye whenever the upper Button is removed for the taking out of the Key. It is to be noted that such Catch-Button is here desirable *although* the Wire Tracker is Cranked, because this Cranking ought to be of such form as to allow of unthreading such Tracker from the Backfall, and therefore the former might be quite capable of dropping of itself through the latter: of course the said Cranking will prevent the Wire Tracker from turning round during the process of Regulation, and thus the *Side-Horn* be rendered here unnecessary. On all these last points see fully in *Departments* COUPLING-ACTION and KEY-ACTION. It will be found farther on (at *u u u*, next, 5th parag.) that Regulation at the Great-Org. Key-tail is never, by the writer, *recommended* in the present case.

The Swell-Organ Action commences, as it does in all the six preceding Treatments, with a Square having a down extending portion or arm which draws a horizontal Tracker (see *d*, ante, 4th parag.). This Square is of the same form as that of the last given Design in so far as that the rear Arm is absent (see *r*, ante, 9th parag.), and the reason for such absence is also the same,—viz., the fact of the Coupler Manual to Manual's being of a kind which does not employ the assistance of such Square; but the latter is now again of the form used in Treatments Nos. 2, 4, and 4½, in that its Nose is in actual contact with the Key Tail,—such Tail being Forked where necessary. But there are now two new modifications introduced. The first of these is that it is only the Bass half of the Set of aforesaid Squares which have their Noses fitting and entering into Key Tail-forks (see here the description of latter, at *u u*, ante, 3rd parag.), because the Participation of these Keys with the Keys of the *other Manual* is secured by the type of the Coupler just mentioned (see proper description in next parag. but one). The second modification is that the Stickers of the Coupler Swell-to-Pedale are required to be placed at an increased distance back from the extreme fore-ends of the Noses of these same Squares, —against the under surface of which Noses, remember, such Stickers do act; and as a consequence of this, such Noses, and therefore the entire radial size of each of the Squares, is compelled to be extended accordingly (see *h*, ante, 9th parag.). The reason for such placing backward of the Stickers is simply that, as the Tail of each Great Organ Key now carries a Screwing Button, it is desirable that there be no portion of such Key existent over—so as to hide—such Button, and that therefore the lower contact of the Man.-to-Man. Coupler is necessarily thrown a little more forward towards the Playing part of the Key, and this naturally brings about a corresponding forward extension of the Swell-Action Square-Nose,—in order that the Contact of the latter shall not be in the rear of the Manual-to-Manual Contact, which would cause a risk of fore-lifting the Coupled Key (see 89, *l* and *m*). Note; the downward extension of the aforesaid Square, even though probably a trifle greater than in even the earliest of the Treatments given (see *d* and *h*, ante) will not interfere with the Great-Organ [first] Backfall, although the latter (as in the preceding Scheme) is below such Square, the reason being that such Backfall is now, instead of being at about the level of the Great Organ Keys, lowered out of the way of the said Square (see again the connecting short Wire Tracker, at commencement of preceding paragraph).

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At this point also glance at what is stated at a little on (at *u u u*, next, 5th parag.), with respect to the possible, though not recommended, employment here of a Front-Regulating Button and a Clip (just mentioned at *u u*, ante, 3rd parag.), instead of the aforesaid Tail Forkings.

The Coupler Swell to Great also will be constructed exactly as in the last given Treatment (see *r*, ante, 10th parag.), excepting that now there are no Wedge-Blocks on the *lower* (the Great-Org.) Keys, but that there are such Blocks on the *upper* (the Swell-Org.) ones, set and treated in the proper way for forming part of the *Button* method of Regulation. See here the Description of this latter, already furnished (at 88, *w*). It is essential that the Button itself be set as far back as is possible,—its Screw passing through the Key at the actual [fore] termination of the Tail Fork or Notch; the object of this being that the Coupling impulse shall be given at a point as little as possible in advance of the point of Square-Nose contact,—as has just been explained in the last paragraph but one.

The Coupler Great to Pedale will have been already partly understood by what has been said on other portions of the Design (see at *u u*, ante, 4th parag.). Its Coupling Backfalls are the lowermost of the two sets of such Backfalls that are beneath the Manuals. The rear end of each of those Great-to-Ped. Backfalls comes directly under, and in such a way as to carry, the fore Nose of the Great-Organ regular Backfalls,—these Noses being prevented from slipping sidewise off the Coupling Backfall Noses by the furnishing of each of the latter with two small upward-projecting Horns of Wire, between which Horns each Great-Org. Backfall Nose lies. The bringing into and out of Action of this Coupler is by the rising and falling of its Backfall Beam.

The Coupler Swell to Pedale has, as already implied, its Backfalls and their Beam placed between the Backfalls of the Great-to-Pedale and the Keys of the lowermost Manual. Each such [Swell-to-Ped.] Backfall runs backward for such a distance as not only to extend beyond the rear end of the Backfall of Great-to-Ped., but to pass between and beyond the Great-Org. Key-tail Trackers. These extreme ends of the Swell-to-Ped. Backfalls carry, each, a plain Wood Sticker, which thus runs up just beyond the Great-Org. Key-tail itself, and is wired at its foot into the usual vertical piercing made in such extreme end, and at its top into the base of the Swell Action-Square Nose already described. Such Noses will of course have been shaped in conformity with these requirements (see *uu*, ante, 5th parag.), and the Wire Trackers suitably Cranked (see *uu*, ante, 4th parag.). The Into and Out of Action of this Coupler is, as in the last named one, by the rising and falling of its Beam.

(*To be continued.*)

BELTS.*

(*Continued from p.* 131.)

PERMIT me to take a few exceptions to the statements concerning belt driving (see p. 86): 1. The surface left by a broad, flat tool is not so good for most belts as one made by cross-grinding with a stone or an emery wheel, so as to give marks parallel with the shaft instead of round the pulley face. 2. Brightly burnished pulleys drive better with some belts and under some conditions than roughened ones. 3. The driving power does not vary as the square of the arc of contact. So far from this being the case, doubling the arc of contact can under hardly any circumstances be made to give as much as double the drive. 4. A belt two inches wide will hardly ever drive twice as much as two belts, each one inch wide, and having the same tension per inch width. 5. The table giving the least diameter of pulley desirable for various widths of belt, would if correct for one arc of contact and tension, be incorrect for any other. 6. On vertical belts, that is, those connecting horizontal shafts one above the other, the heavier the belt the less the driving power, because it sags from the lower pulley. 7. If the driving power of a belt is calculated from the smaller pulley alone, simply because it is the smaller, the result will not be correct. The arc of contact, and the lineal contact, and many other things, come forcibly into play, and this is especially so on elevator pulleys, where one shaft is nearly directly above the other.

The writer of the statements to which I referred is so widely and so favourably known that I regret to contradict him, but in this particular direction I have the results of a very wide personal experience, and the written and oral expressions of many others embracing the most varied and trying practice in transmission of power. The records of many tests, giving results directly contradictory to the statements of your correspondent, have been published by me during the past two years in various technical journals in this country and Europe, and most of them can be easily repeated. I also offer the following reasons and authorities for my statements: 1. Leather belts (especially if thick under small pulleys) wrinkle and ridge crosswise on the under side when going over the pulley, and these crosswise corrugations engage better with grindstone marks running across the pulley face than with circumferential lathe tool marks. 2. A gum-rubber belt with a smooth elastic surface beds well down to a polished surface, and will drive better on that if the pulley is large, than on a rough surface. This is not true of leather, nor of canvas belts. 3. Briggs and Towne quote the driving power as varying in the following proportion with the arc of contact:

Angle.	lb.	Angle.	lb.
90°	32·83	150°	44·64
100°	34·80	180°	49·01
110°	37·07	210°	52·52
120°	39·18	240°	55·53
135°	42·06	270°	57·58

As $90^2 = 8100$, and $270^2 = 72{,}900$, which numbers are as 1 to 9, we would expect, if the grips varied as the square of the arc of contact, that if 90° gave 32·83, 270° would give $32·83 \times 9 = 295·47$lb. whereas it gives only 57·58lb. Doubling the arc gives

$$\frac{49·01}{32·83} = \text{nearly } 1·5 \text{ times}$$

the grip, not four times.

The first figures I lay my hands on among my own test records, are of a 4in. 4-ply cotton belt on an 18in. turned cast pulley, with 100lb. tension = 25lb. per inch of width. The grip was 244lb. with 90° arc, and 394lb. with 180°; the ratio being as 1 to

$$\frac{394}{244} = \text{about } 1·6$$

The next is a 12in. 4-ply rubber belt on the same pulley, with 400lb. tension. With 90° arc, the grip was 244lb.; with 180°, 418lb.; the ratio being as 1 to

$$\frac{418}{244} = \text{about } 1·7$$

4. Two 1 in. belts will bed more readily, especially on a small pulley, and if the belts are thick, than one 2in, having the same total tension. In fact, I know where a 3in. belt has run a machine better than a 6in.

I find on my records the following memoranda of a 6in. 3-ply and a 3in. 3-ply rubber belt on a 36in. cast iron pulley:

		6in.	3in.
90°	195lb. ten.	206lb. grip	210lb. grip
arc	400 „ „	405 „ „	316 „ „
180°	195 „ „	426 „ „	440 „ „
arc	400 „ „	721 „ „	682 „ „

The above figures are worth studying, as they tell something about tension as well as about belt width, for if we divide each of the results with the 6in. belt and 400lb. tension by two, we shall not get as much as with the 3in. belt and 195lb. tension, (which is rather less than half of 400lb.). In other words, with 90° arc, two 3in. belts each with 195lb. tension would have a grip of 420lb. while the 6in. had only 405lb. with 400lb. tension. With 180° arc, two 3in. belts, each with 195lb. tension, had a grip of 880lb., and the 6in. belt with 400lb. therein had only 721lb. grip.

5. The driving power of a belt depending on so many elements—pulley diameter, material and condition and amount of crown, arc of contact, and belt material, width and thickness and tension—any table taking note only of belt width will be of no use.

WINTER PHOTOGRAPHY.*

IT is by common consent admitted, I believe, that collodio-bromide will give as fine results as any process whereby lantern slides are usually produced. I certainly think it is much superior to wet collodion "bath" plates. With collodio-bromide plates, whether moist or dry, there is none of that building up of the shadows to which wet plates have such a tendency; for the "blacks" are not piled on by the reduction of free silver by an iron developer, but are formed by a "conversion" of the particles of bromide of silver already in the film, to which nothing is added. I think it must, therefore, be evident that the image is constituted in a much more scientific manner than by wet plates. The pictures are sharper and crisper, and even in the deepest shadows there is a degree of detail which is completely blocked up in wet collodion work.

I prefer a collodio-bromide emulsion made with excess of silver and restrained with a mineral acid. Rapidity is not of such importance as extreme cleanness in working, together with absence of texture and the facility to obtain any reasonable density. I have experimented with a large number of formulæ for collodion emulsions, and I have succeeded several times in compounding them so as to obtain most vigorous images, together with an exceedingly good colour when developed with alkaline pyro.. A small percentage of a chloride in collodio-bromide emulsions favours richness of colour of the developed image. The way I proceed to make collodio-bromide positives by *contact* is thus briefly described:—I get the glasses cut out of thin glass—preferably patent plate—3¼ × 3¼. I clean them thoroughly on both sides, and finish one side by polishing with French chalk. I then take my bottle of filtered emulsion and coat each plate bang up to the edges and corners, draining off into a clean bottle. I can coat three or four dozen such plates in an hour, and as fast as coated I place them to dry at a temperature of between 70° and 80° in a very simple and inexpensive arrangement of tin, wherein they dry off without any markings in a few minutes. Next night I go to work and print from my negatives. If the negatives are quarter-plate I place one in one of the dark slides of my little camera, and then lay one of the prepared collodio-bromide dry plates 3¼ × 3¼ down so that film faces film of negative. Place a soft pad of flannel or velvet over all, and close the dark slide. Then go to a gas or paraffin lamp; draw the shutter at (say) one foot from the light, and count as many seconds as you deem requisite. Close the shutter and go and develop. One or two trials will soon indicate the correct exposure. If the negatives are larger than quarter-plate then we must place our 3¼ × 3¼ prepared glasses down upon such a portion as shall best please us, and from large negatives it is possible to get several separate views.

Now, for reducing the size of (say) half-plate negatives down to 3¼ × 3¼ positives: I fall back upon my little camera, and I almost invariably employ the emulsion whilst moist, because the trouble of drying and re-moistening is thereby saved; and, as the light in the camera is very much reduced as compared with contact printing, and collodion emulsions are usually more sensitive when moist than when dry, I think it will be found easiest to work with the plates moist.

There is now another field open to the photographer, thanks to gelatine! Photomicrographs or microphotographs (I never know which is the correct term) are now quite easily produced at night by artificial light, with no more elaborate apparatus than the average amateur photographer and microscopist possesses. By employing an ordinary single microscope, with (say) a one-third of an inch power, we can with any of the recognised makes of commercial gelatine plates produced negatives of opaque objects illuminated from above by the light from a common paraffin lamp. Of course the exposure will vary according to the object, the light, the plates, and the focus of the "power" employed. From two to three minutes will usually suffice. Whilst transparent objects are comparatively easy, opaque objects present much greater difficulties than might be supposed; but such is the sensitiveness of gelatine plates that, if due care be given to the proper illumination, success is certain. What a power is thus placed in the hands of the photographer—even the amateur!

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* By Robt. Grimshaw, in the *American Machinist.*

* Extracted from an article by a "Country Lanternist" in the *British Journal of Photography.*

From my own experience a word of caution may prove invaluable. In following micro-photography nothing conduces so much to sharpness and bold definition as care to see that the whole apparatus is placed on a stone or brick floor. Whereas the tremor of a wooden floor is fatal to sharpness, this default is entirely overcome by placing the whole affair on *terra firma*.

THE EARTH A GREAT MAGNET.

THE first lecture of the session was delivered on Tuesday evening at the Birmingham Midland Institute, by Professor Silvanus P. Thompson, B.A., D.Sc., on "The Earth a great Magnet." The lecturer commenced by tracing the properties of the loadstone as far as they were known, and by the means of diagrams and experiments showed the existence of magnetic induction—i.e., that a piece or iron in contact with a magnet became itself a temporary magnet. This fact was known to Lucretius, yet it remained for Athanasius Kirchor, early in the 17th century, to discover that this induction did not demand contact, but that it could be exerted through substances such as glass, which were themselves incapable of magnetism. Speaking of the "dip" of the magnet and its variation over the earth's surface, he said that when there was an aurora borealis, all the magnetic needles were agitated, turning first one way and then another, and this was a very mysterious and important fact. If the matter was investigated it would be found that every eleven years we had the aurora borealis, magnetic storms, and sun-spots; and, as some people asserted, Indian famines and commercial crises followed these periods. In 1866 and 1877 this occurred, and if he was not much mistaken, we should in 1888 have magnetic storms, sun-spots, an aurora borealis, and possibly an Indian famine, and a depression in trade; and, to crown all, he should not be surprised if we had another Conservative Government. The lecturer, in offering a theory to account for the magnetism of the earth, said it had been shown by Faraday that a magnet revolving inside a coil or more ring of wire induced a current in the wire. He (Professor Thompson) assumed that the converse of this would hold, and that the magnetism of the earth would be sufficiently accounted for if it could be shown that there were currents of electricity circulating round it. An examination of a physical map of the world showed that the lines of equal temperature are very nearly coincident with the lines of equal magnetic force, and, in particular, that the greatest cold is probably to be found, not at the North Pole of the earth, but between it and the magnetic North Pole. Granting this, the convection currents in the atmosphere caused by the sun's heat would flow up from the earth at the magnetic equator, and pass northwards and southwards to the neighbourhood of the magnetic poles, where they would sink to the earth. But at the magnetic equator their rising would be accompanied with evaporation of the moisture contained in them, and it had been shown that evaporation always produced electrification. The moisture rising at the equator would journey towards the poles in an electrified condition, and assuming that electricity thus conveyed was equivalent to a current of electricity, all that was required was that there should be the requisite relative rotation of the current round the earth. The source of this rotation was to be found in the atmospheric tides, due, like the tides of the ocean, to the attraction of the moon. These tides would give the currents of air the relative rotation sufficient to produce and to maintain the magnetism of the earth.

SMOKY CHIMNEYS.

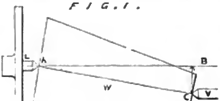
CHIMNEYS in an outside wall are more liable to smoke than those built in an inside wall, and the back of a chimney so built should not be less than 14in. thick. All chimneys should be carried 6 or 7ft. above the ridge of roof. Short chimneys should be smaller than the usual size, and the fire-place should be kept low. Chimneys sometimes smoke in consequence of a descending current existing or being produced in the chimney. If the fire-place is too open, contract the size of the fire-place, or use a contracted grate. If the chimney is very short, use a contracted grate with a blower; reduce the height of the fire-place and the size of the chimney; lengthen the chimney; reduce the opening into the chimney at top and bottom. Some chimneys smoke in consequence of a descent of wind. If the top of a chimney is below a pitched roof, heighten the flue that its top may be above the source of obstruction. If the top of a chimney is situated near to a tower, or a similar source of obstruction to the wind, use a simple protection to cover the top of flue.

TURNING TAPERS.*

IN turning tapers it is essential that the tool point be set to the exact height of the work axis; or, in other words, level with the line of centre. If this is not the case the taper will have a curved outline along its length. Furthermore, it may be shown that if a straight taper be turned and the tool be afterwards either raised or lowered, the degree of taper will be diminished, as well as the length being turned to a curve.

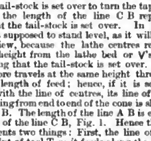
Figs. 1 and 2 demonstrate that the degree of taper will be changed by any alteration in the height of the tool. In Fig. 1, A represents the line of centres of the spindle of a lathe, or, in other words, the axis of the work W, when the lathe is set to turn parallel. C represents the axis of the work or cone when the lathe tail-stock is set over to turn the taper or cone; hence the length of the line C B represents the amount the tail-stock is set over. In Fig. 2 the cone is supposed to stand level, as it will do in the end view, because the lathe centres remain at an equal height from the lathe bed or V's, notwithstanding that the tail-stock is set over. The tool therefore travels at the same height throughout its whole length of feed; hence, if it is set, as at T, level with the line of centres, its line of feed while travelling from end to end of the cone is shown by the line A B. The length of the line A B is equal to the length of the line C B, Fig. 1. Hence the line A B represents two things: First, the line of motion of the point of tool T as it feeds along the cone; and, second, the amount the work axis is out of parallel with the axis A (Fig. 1) of the spindle. Now, suppose that the tool be lowered to the position shown at I; its line of motion, as it feeds, will be the line C D, which is equal in length to the line A B. It is obvious, therefore, that though the tool be set to the diameter of the small end, it will turn at the large end, as represented by the dotted circle H. The result is precisely the same if the taper is turned by a taper-turning attachment, so that the tail-stock does not require to be set out of line.

F I G. 1.



Top View of a Piece of Work in a Lathe, the Tail-Stock Set Over to Turn a Taper.

F I G. 2.



End View.

The demonstration is more simple when made with reference to such an attachment as the one just mentioned. The line A B represents the line of tool-feed along the work, and its length represents the amount the attachment causes the tool to recede from the work axis. Now, this amount, depending upon the set-over of the attachment, will be governed by the degree of that set-over; and is, therefore, with any given degree the same, whatever the length of the tool may be. All that is required, then, to find the result of placing the tool in any particular position, as at I in the end view, is to draw from the tool point a line parallel to A B and equal in length to it, as C D. The two ends of that line will represent in their distances from the work axis the radius the work will be turned to at each end with the tool in that position. Thus, at one end of the line C D is the circle K, representing the diameter the tool I would turn the cone at the small end, while at the other end the dotted circle H gives the diameter at the large end that the tool would turn to when at the end of its traverse. But if the tool be placed at A B, it will turn the same diameter K at the small end, and the diameter of the circle P at the large end.

We have here taken account of the diameters at the ends only of the work, without reference to the result given at any intermediate point along the cone surface; but this we may now proceed to do, in order to prove that a curved, instead of a straight, taper is produced if the tool be placed either above or below the line of lathe centres. In Fig. 3, D, E, F, C represent the sides or outline of a straight taper, whose diameter at the ends is represented in the end view by the circles. Now, a line from A to B will represent the axis of the work, and also the line of tool point motion or traverse, if that point is set level with the axis. The line I K in the end view corresponds to the line A B in the side view, in so far that it represents the line of tool traverse when the tool point is set level with the line of centres. Now, suppose the tool point to be raised to stand at H, instead of at I K, and its line of feed traverse be along the line G H, whose length is equal to that of I K. If we divide the length of G H into six equal divisions, as marked from 1 to 6, and also divide the length of the cone in the side view into six equal divisons (*a* to *f*), we shall have the length of line G H in the first division in the end view; that is, the length from H to 1, representing the same amount of tool traverse as from the end B of the cone to the line *a* in the side view. Now, suppose the tool point has arrived at 1. The diameter of work it will turn when in that position is evidently given by the arc or half-circle *h*, which meets the point 1 on G H. To mark that diameter on the side view, all that is required is to draw a line, as *h p*, just touching the top of *h*; a perpendicular dropped from it cutting the line A, gives the radius of work transferred from the end view to the side view. When the tool point has arrived at 2 on G H in the end view, its position will be shown in the side view at the line *b*, and the diameter of work it will turn is shown in the end view by the half-circle *k*. To transfer this diameter to the side view we draw the line *k g*, and where it cuts the line *b* in the side view is the radius of the work diameter when the tool is at the point *b* in the side view. Continuing this process, we mark half-circles, as *l*, *m*, *n*, *o*, and the lines *lr*, *ms*, *nt*, *ou*, by means of which we find in the side view the work radius when the tool has arrived at *c*, *d*, *e*, and *f*, respectively. All that remains to be done is to draw on the side view a line, as *u* E, that shall pass through the points. This line *u* E will represent the outline of the work turned by the tool when its height is that denoted by H. Now, the line *u* E is shown to be a curve, hence it is proved that with the tool at the height H a curved, and not a straight, taper will be turned.

It may now be proved that if the tool point is placed level with the line of centres, a straight taper will be turned. Thus its line of traverse will be denoted by A B in the side view and the line I K in the end view; hence we may divide I K into six equal divisions and A B into six equal divisions (as *a*, *b*, *c*, &c.). From the points of divisions I K, we may draw half-circles as before, and from these half-circles horizontal lines, and where the lines meet, the lines of division in the side view will be points in the outline of the work, as before. Through these points we draw a line, as before, and this line C F being straight, it is proven that with the tool point level with the work axis, it will turn a straight taper.

It may now be shown that it is possible to turn a piece of work to a curve of equal curvature on each side of the middle of the work length. Suppose, for example, that the cutting tool stands on top of the work, as in the end view in Fig. 4, and that while the tool is feeding along the work it also has a certain amount of motion in a direction at right angles to the work axis, so that its line of motion is denoted by the line B B in the top view. The outline of the work turned will be a curve, as is shown in Fig. 5, in which the line of tool traverse is the line C D. Now, the amount of tool motion that occurs during this traverse in a direction at right angles to the work axis is represented by the line F E, because the upper end is opposite to the upper end of C D, while the lower end is opposite the lower end of C D. We may then divide one-half of the length of F E into the divisions marked from 1 to 6. Now, as we have taken half the length of F E, we must also take half the length of the work and divide it into six equal divisions, marked from A to *f*. Now, suppose the tool point to stand in the line F S in the end view, its position in the top view will be at C. When it is at 1 on the end view it will have arrived at *p* in the top view. The radius of work it will then turn is shown in the end view by the length of line running from 1 to the work centre. Take this length, and from *a* in the work axis set it off on the line *a h*, and make the length equal the height of 1 S. In like manner, when the tool point has arrived at 2, the radius it will cut the work is shown by the length of line *i*; hence from 2 on the work axis we may set off the length of 2 S, making 2 S and *b i* of equal length. Continuing this process, we make the length of *c k* equal that of 3 S, the length of *d l* equal 4 S, and so on. All that remains then is to draw a line, *o g*, that shall meet the tops of these lines. This line will show the curve to which that half of the work length will be turned to. The other half of the work length will obviously be turned to the same curvature.

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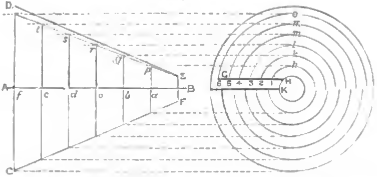
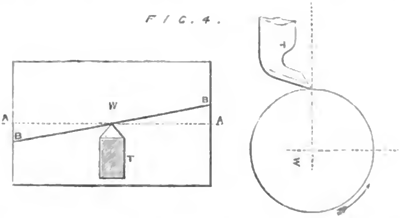
* By Joshua Rose, in *Mechanics*.

FIG. 3.



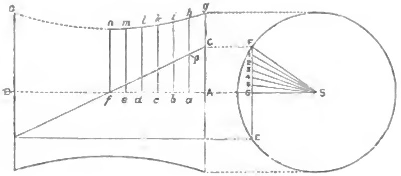
Side and End View of a Straight Taper, showing the Effect of Different Positions for the Tool.

FIG. 4.



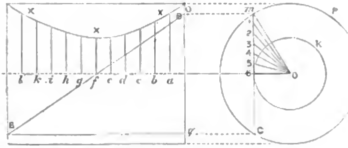
Top and End View of Work, introduced to Show that Equal Curvature can be Produced Each Side of the Middle of the Work.

FIG. 5.



Shape of Work Produced under Conditions shown in preceding Cut.

FIG. 6.



Further Example, showing Application of the Same Principle.

It is obvious that the curvature of the work outline will be determined by the proportion existing between the length of the work and the amount of tool motion in a direction at right angles to the work axis; or, in other words, between the length of the work and that of the line F E. It is evident, also, that with a given amount of tool motion across the work, the curvature of outline turned will be less in proportion as the work length is greater. Now, suppose that the smaller and larger diameter of the work, together with its length, are given, and it is required to find how much curvature the tool must have. We may find this and work out the curve it will cut by the construction shown in Fig. 6, in which the circle K is the smallest and the circle P the largest diameter. The line *m* C is drawn to just touch the perimeter of K, and this at once gives the amount of cross-motion for the tool. Hence, we may draw the lines O B, and from their extremities draw the line B *g*, representing the path of traverse of the tool point. We may then obtain the full curve on one side of the work by dividing one-half the length of *m* C into six equal divisions, and proceeding as before, except that we add the lines of division in the second half. It will be observed that the centre of the curve is at the point where the tool point crosses the axis of the work; hence, by giving to the tool more traverse on one side than on the other of the work axis, the location of the smallest point of work diameter may be made to fall on one side of the middle of the work length.

HOUSEHOLD HINTS.

Nail-Stains in Oak.—Nail-stains may be removed from oak by disolving half-pint of oxalic acid in a quart of boiling water, and scrub the wood with it.

Tar Stains.—Removing stains of tar from the hands is readily accomplished by rubbing with the outside of fresh orange or lemon-peel.

Cleaning Mirrors.—Clean your mirrors with soft paper, instead of cloth. This advice is not new, and yet cloth is constantly used, with its usual accompanient of lint and trouble.

Wooden Floors.—The following will be found useful in cleaning and restoring colour to wooden floors:—One part calcinated soda allowed to stand three quarters of an hour in one part slack lime, then add fifteen parts water, and boil. Spread the solution, thus obtained, upon the floor with a rag, and after drying, rub with hard brush and fine sand and water. A solution of one part concentrated sulphuric acid and eight parts water will enliven the wood after above application. When dry, wash and wax the floor.

Sir Garnet Wolseley's Irish Stew.—In the "Soldier's Pocket-Book," by Sir Garnet Wolseley, the following recipe is given for an Irish stew:—16½lb. meat, 16lb. potatoes, 4lb. onions, 6oz. salt, 1oz. pepper, ½lb. flour. Cut away the meat from the bone, and then into pieces of ½lb. each, the loin and neck of mutton into chops, disjoint the shoulder, and cut the blade-bone into four pieces (if leg, cut into slices) ½in. thick, rub them with the salt, pepper, and flour, and place the meat in the boiler, with some fat, brown it on both sides, then add the onions whole, and then the potatoes, and enough water to cover the potatoes, stew gently for two hours, keep the fire down, and well covered during the cooling.

A paper on the "Extraction of Selenium from a Waste Product of the Alkali Manufacture," by P. Kienlen, has appeared in the "Chem. Cent. Blatt." According to the *Journal* of the Society of Chemical Industry, the author finds that the deposit which occurs in the muriatic acid condensers of alkali works contains a large quantity of selenium, derived from the pyrites used in making the sulphuric acid. In a Glover acid of 1·6 specific gravity, he found 28·3mgrm. selenium per litre, and in a second sample of specific gravity 1·53, 34·2mgrm. It distils with the first portions of muriatic acid. A sample of the latter of specific gravity 1·16 yielded 25mgrm. per litre. The percentage of selenium in the deposit varies between 41 and 45. The following process of extraction is recommended. The substance is suspended in water and treated with a stream of chlorine. Selenium tetrachloride is formed and decomposed by the water into selenious acid, a portion of which is oxidised to selenic acid. The liquid is filtered and boiled with excess of hydrochloric acid. On addition of acid sodium sulphite, the selenium is precipitated in the form of deep red flocks, which are aggregated on passing steam, into spongy masses of a steel grey colour, which are then dried and fused.

SCIENTIFIC NEWS.

APPARENTLY, no other elements of the great comet have been calculated than those already published in this column, so that it remains a question whether it is coming back in a few months, or is going away for ever. We have the *Science Observer* Circular, No. 27, giving full details of the elements telegraphed to Lord Crawford (see p. 133). From this we learn that Messrs. Chandler and Wendell's comparison of the orbit with the observations available substantially confirms the periodical character of the comet. The period they give is 3,116 days. The observations made at the Cape at the time of perihelion show that this comet must have an intense brilliancy, as it was seen to disappear behind the sun's disc. We have received a number of letters stating that the comet has been seen in the south-east at a little after 4 a.m. One from Mr. J. L. Stothert, writing from Biarritz, is accompanied by sketches showing the position of the comet on three mornings at 4.45. They arrived too late for engraving. The estimate of the length of the tail is "equal to distance between β Geminorum and α Canis minoris." Prof. Ricco gives the dimensions of the tail as 17° in length, with a width of 2° 48'—at the widest part, we presume. He found the sodium lines, and many others, present in the spectrum of the nucleus.

Last week, Mr. Thos. Coats, of Ferguslie, handed over to the Paisley Philosophical Institute a new observatory, which he has built on Oakshaw Hill. It is fully equipped, and is endowed with £2,000 for its support.

Letters from Montreal state that the City Council has been officially notified by the Secretary of State that the British Association will meet there in 1884.

Mr. W. Lant Carpenter, referring to the statements made by Commander Bartlett, writes that the investigations of the *Challenger* fully confirm Dr. Carpenter's theory of oceanic circulation supplying the deficiency of warm water. The researches of Commander Bartlett fill a gap in some of the *Challenger's* observations, and confirm them in the most satisfactory manner.

The winter session of the Manchester Scientific Students' Association was opened last week by a microscopical *conversazione*. Mr. J. Angell, one of the vice presidents, delivered the opening address.

Flour-manufacture has been added to the subjects of the technological examinations of the City and Guilds Institute for the current session. Remembering Prof. Graham's complaint about the candidates in bread-making, it may be hoped that the examination in flour-making will attract a better class of students. There is a paucity of good technical teachers, and any of the science teachers who can give evidence of having acquired practical knowledge in the workshop or factory may now be registered as teachers of technology.

A paragraph "going the rounds," announces that Mr. Mallett, the son of the American consul at Florence, has invented a method of dispensing with "all chimneys, and the prevention of any smoke whatever." The "Control Combustion Company," has been incorporated in New Jersey, to equip locomotive, marine, and stationary boilers with the apparatus patented by Mr. E. J. Mallett, jun. The "invention" consists in producing a draught by means of an exhaust fan, a less pressure in the furnace, and the consequent admission of just so much air as is required and no more. The products of combustion are moistened by a water-spray, and then passed through an "athermous superheater," whence they reach the fan, and are ejected at a low heat. Smoke is not yet abolished, we are afraid.

Mr. Tate, of Bradford, has patented an electrical stop-valve for steam-engines. The apparatus is simple. There is a Leclanché battery, an electro-magnet, and wires leading wherever they are required. The circuit being completed, the electro-magnet is made to open a small tap which admits steam to a cylinder the piston of which is connected to the stop-valve. The apparatus, if kept in order, will be of considerable use in factories, as a ready means of stopping the engine can be thus placed on every floor.

The researches of MM. Schloesing and Müntz have proved that nitrification, in the ground and in organic liquids, is due to development of small organisms. MM. Gayon and Dupetit having been led by some facts to think that the opposite process, viz., reduction of nitrates, is also a physiological phenomenon, have investigated the matter experimentally, and found a microbe which attacks nitrates in presence of organic matters (chicken-bouillon, e.g.), which latter cause the products of fermentation of the nitrate to enter into new combinations. Pure nitrogen is liberated, representing a large proportion of that of the nitrate; the rest forming ammonia, and perhaps amidised derivatives of the organic matter. It is noteworthy, that carbolic acid and salicylic acid, in ordinary antiseptic doses, or even larger quantity, not only do not prevent the life of the reducing microbe, but they disappear completely with the nitrate, in the same way as sugar or propylic alcohol.

In 1866-67 (according to the *Deutsche Ind. Zeitung*), there were in Germany, not including Austria, 177 postage-stamps in 18 different States, &c. After 1st January, 1868, the North German stamps became prevalent; only Bavaria, Würtemburg, and Baden kept their own stamps. Since the formation of the German Empire and introduction of the new currency, the number of postage-stamps has again diminished, and besides the Empire, only Wurtemburg and Bavaria have now special stamps.

At the circus in the Champs Elysées, an electric orchestra has been lately set in action. The Brothers Bozza conceived the idea of suspending all round the circus a variety of instruments, and working them from the centre by means of electricity. The instruments selected are naturally drums, cymbals, multiple-bells, Ader fanfares, *cahiers chantants*, &c., all apparatuses which have been actuated by electricity before, or are easily so adapted. The performers play a piece of music on four large trumpets in the middle of the circus, and from time to time one of them works a sort of electric manipulator on a table near him. Thus he introduces into the piece now a drum-beat or clash of cymbals, now the jingle of a tambourine, a play of bells, or a bird's song. Sometimes detonating bodies are exploded or blue lights fired. The whole arrangement requires a large number of wires. M. du Moncel fears the effect produced does not correspond to the trouble taken. "Will not the public prefer the ordinary musical eccentricities of clowns, to all this electric complication, of which it cannot understand much?"

The central telephone offices of Cologne and Elberfeld, about 37 miles apart, have been connected by means of the subterranean cable between those towns; and, it is said, speech is thus transmitted with great distinctness. The town of Darmstadt, after long trial of various fire-alarm apparatus, has decided on the exclusive use of telephones for this purpose. The Bell Blake system is considered best. A telegraph network embracing the whole town will be constructed, the arrangement being such that from a central station it will be possible to communicate with each of the other stations individually, and with all at once.

In a recent letter to the President of the French Society of Public Medicine, the Director of the Municipal Laboratory of Chemistry in Paris, M. Girard, says that while the too-simple practice of adding water to milk has mostly ceased, under the vigilance of the law, a more ingenious operation is now performed—viz., stimulation of the milk-yielding powers of cows by feeding them with malt-refuse, &c.: they become phthisical and die in a few months, but for a certain time they give much more milk than normally. But what milk! It is watery, unnutritious, and unwholesome. As the cow's food is cheap, and the yield of milk (sold at the same price as good milk), is large, the owner recoups himself for loss of the cow. M. Girard considers the new system worse than the old, because in the latter the addition of water to good milk simply made it less good, but the milk in the other case is positively pernicious. M. Barral, in his *Journal d'Agriculture*, says he has read M. Girard's letter with "profound astonishment," and he criticises it severely. Feeding cows with malt refuse has been long recognised as a means of getting excellent milk, and without inconvenience. He promises a series of articles dealing with the subject in all its details.

It is proposed to make a tunnel under the Elbe, at Hamburg. The length would be about 800 metres, and the cost 25 million francs.

For some time past, at Bordeaux especially, "plastered" wines in general, and preferably those containing more than 2 grammes per litre of sulphate of potassium, have been submitted to a process known as "deplastering" (*déplâtrage*), the object of which is to remove the excess of sulphate. The ingredient used for this purpose is chloride of barium, which has the effect of substituting chloride of potassium for the sulphate of potassium existing in plastered wine. A committee has recently reported on the hygienic aspect of this practice to the Society of Public Hygiene of Bordeaux. The conclusion come to is, that if plastering of wines is a bad thing as regards the public health, deplastering is still more so—(1) because the deplastered wine may contain poisonous salts of baryta; and (2) because it may contain a foreign salt, chloride of potassium, which cannot be taken in a continuous manner with impunity.

The question as to increase of the number of apothecaries' shops in Berlin has been lately under consideration. In 1867, there were 49, or one to every 14,403 of the inhabitants; in 1880, the city, with a population of 1,122,385, had only 69 apothecaries' shops, or one to 16,266 of the population. Now, in Königsberg, there is one apothecary to 9,438, in Breslau to 12,423, in Hanover to 8,207, in Cologne to 7,964, in Munich to 7,586, in Leipzic to 10,001, and in Stuttgart to 7,151; so that Berlin is considerably behind in this respect.

At a recent meeting of a polytechnical society in Berlin, Herr Frischen, head engineer of the house of Siemens and Halske, reported on the first attempt to employ the electric railway for industrial purposes—viz., in a mine near Dresden. The line is 260 metres underground, and 20 waggons laden with coal travel on it. The rails are T-shaped. Herr Frischen illustrated the arrangement with several photographs, and warmly recommended the system for such purposes. An inquiry as to whether electricity had been applied successfully to working agricultural machines was answered in the negative.

In a paper on Myopia, recently read to the New York County Medical Society, Dr. Mittendorf told of a fine horse in Berlin that became intractable, and on examination proved to be suffering from nearsightedness. The owner had a pair of spectacles made for it, and it became as tractable as ever.

At a hospital in Philadelphia, lately, two cases of rupture of the drum of the ear caused by diving, have been reported. In both cases, the hearing was seriously impaired, but the wound healed in 10 or 15 days. To prevent rupture when diving (Dr. Wilson points out), the pressure on the membrane from without should be compensated by an equal resisting pressure from within. To accomplish this, a full inspiration should be taken prior to diving, the mouth kept shut, and to prevent escape by the nose, the posterior nares should be closed by elevating the soft palate. This is done almost involuntarily, and retains the inhaled air in the lungs, and cheek and ear cavities, its compression being produced by the contractions of the chest and cheek muscles. The act of swallowing will force sufficient air through the eustachian tube into the middle ear to resist the pressure from without. Dr. Wilson believes the accidents in question to be more common than is suspected.

Double-staining of Nucleated Blood Corpuscles.—Dr. Allen Y. Moore gives, in *The Microscope*, a valuable explanation of the method of differential staining by which his fine slides of blood corpuscles are produced. The blood is spread upon the slide by the usual method, drawing a drop across one slide by means of the edge of another slide. When the film of corpuscles, thus evenly spread, is thoroughly dry, the slide is flooded for three (3) minutes with a solution of rosin five grains, in distilled water and alcohol, four drachms each. The slide is then washed by passing it gently through clean water, and before drying is flooded for two (2) minutes with a solution of methyl aniline green five grains, in distilled water one ounce. It is then washed again, as before, and set aside to dry, and finally mounted in Canada balsam warmed just sufficiently to spread properly. Corpuscles prepared in this way will be found to be stained red, while the nuclei and leucocytes will be a bluish-green, and will show with great sharpness and brilliancy under the microscope.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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DOUBLE STARS.

[20660.]—ALL double-star observers will feel under obligation to Mr. Perry, for his interesting letter on this subject (letter 20540, page 65), and the accompanying measures of a class of stars rarely observed. Such observations, for this reason, have a special value now, and in the near future, when the relative changes have become more marked, they will be still more important.

With reference to the earlier stars in my several catalogues, I trust the micrometrical work of that greatest of all observers in this field, Baron Dembowski, will soon be given to the public. Nearly all of the first three or four hundred stars found by me were systematically measured by Dembowski, on three or more nights each, thus giving a position of the highest attainable accuracy. Only a few of these observations were published by the author during his lifetime. Some others I have given, from the mean results sent me by Dembowski, in selected lists of stars furnished to various astronomical publications. As the observations of these new stars comprise, altogether, not less than two thousand measures, the importance of this publication will be obvious. It has been understood that the long series of double-star measures made by this observer during the last twenty years, and printed from time to time, principally in the *Astronomische Nachrichten*, would be collected and arranged under the supervision of Schiaparelli, of the Royal Observatory of Milan. It is to be hoped this publication will not be much longer delayed. Other measures of stars, selected from the same catalogues, have been made by O. Struve, and will, doubtless, be given in the next volume of the Pulkowa observations.

Of some of the pairs observed by Mr. Perry, I am able to give other measures, which are probably not generally known:—

		°	″				
β	68	153·1	1·79	1875·21	De	1	night.
β	74	319·5	1·43	1876·09	De	5	"
β	75	34·3	1·20	1875·41	Do	4	"
β	159	317·0	1·37	1878·69	De	1	"
β	277	199·3	0·59	1879·46	β	1	"
β	381	230·6	1·48	1877·04	De	3	"
β	382	210·1	1·09	1881·70	β	3	"
		353·8	27·01	1881·70	β	3	"
OΣ	533	329·2	10·59	1878·18	β	4	"
		325·9	10·93	1880·43	β	5	"
		324·2	11·27	1881·44	β	3	"

The early observations, 1872-76, of some of the stars mentioned by Mr. Perry, and credited to me, β 68, 69, 74, 75, &c., are only estimates of the angles and distances, and not measures.

If "F.R.C.S." (letter 20542, p. 66), will turn to the *Washington Observations*, Vol. XXIV., 1877, p. 128, he will find careful micrometrical measures, by Prof. Hall, of all the stars near the annular nebula in Lyra, within the reach of the 26in. refractor. From these measures an accurate diagram can be easily plotted in a few minutes.

The last pair but one mentioned by M. Gaudibert (letter 20490, p. 37), is evidently identical with a pair discovered by Bird, though the distance is much underrated. Mr. George Hunt has given a complete history of this pair in the *Observatory* for August, 1881.

Chicago, Oct. 5th. **S. W. Burnham.**

JUPITER "SQUARE-SHOULDERED."

[20661.]—IT may interest "F.R.A.S." to hear that I saw Jupiter distinctly square-shouldered on the 21st, for half an hour, about 9 o'clock p.m. I was watching for the re-appearance of Sat. I. when I observed the irregularity of shape. Strange to say, on rising, the planet was the ordinary shape, but on getting up higher was the shape mentioned. Looking at it again after an interval of about half an hour, it had assumed its ordinary appearance. The flatness was not parallel nor at right angles to the horizon, but with the axis of revolution. I have never seen the abnormal shape before, although often observed Jupiter at as low an altitude. Can it be an atmospheric effect? If so, why is the flatness not parallel to the horizon? Sat. I. was neatly dichotomised by Jupiter as it reappeared from occultation. Power 88 on my fine 2in. Stewart refractor; definition good.

Ventnor. **C. J. R.**

SATURN'S SATELLITES.

[20662.]—As we have not been favoured this season with a continuation of Mr. Marth's admirable ephemerides of Saturn's satellites, I have calculated for myself their probable longitudes, using the data supplied by Mr. Marth's tables; and as no one has as yet furnished a reply to Mr. Smart (letter 20497), I send extracts from my list of longitudes for his guidance. They are calculated for 10 o'clock p.m., and have hitherto been found closely correct.

	Enc.	Te.	Di.	Rh.
1882.				
Sept. 3	146°·3	359°·7	156°·5	160°·35
Oct. 3	107·3	319·5	141·4	30·0
Nov. 2	68·3	279·3	126·3	259·65
Dec. 1	29·3	239·1	111·2	129·3
1883.				
Jan. 1	350·3	198·9	96·1	358·95

The positions for intermediate days may be found by adding the daily heliocentric motions—

En.	Te.	Di.	Rh.
262°·7	190°·66	131°·5	79°·66

The hourly motions are, respectively—

10°·9	7°·9	5°·5	3°·3

The following are the major and minor axes of the apparent ellipses in terms of Saturn's equatorial diameter—

	Major.	Minor.
Ring	2·3	1·0
Mimas..........	3·13	1·35
Enceladus	4·02	1·75
Tethys..........	4·98	2·16
Dione	6·37	2·77
Rhea	8·90	3·88

I observed all these four satellites last night in their determined places. Enceladus was very faint; it was, however, well placed near western elongation. **W. L.**

Hatherley Villa, Woodbridge, Oct. 21.

SOLAR PHYSICS.

[20663.]—So much has been said and written lately respecting solar physics, that I am tempted to offer you views on the subject which I have entertained for several years, on the physics of the universe.

They may be deemed crude by some, and perhaps they are; nevertheless, they appear to me simpler and more reasonable than theories which have been recently enunciated, and I think no harm can be done by ventilating them.

Well, then, in my opinion, space, interplanetary and interstellar, is occupied by highly-attenuated gases and watery vapour—exactly of the same composition as the earth's atmosphere; and I think it is fairly reasonable to think that it is so, inasmuch as it is generally accepted that the earth's atmosphere gradually thins out in the higher regions until lost in space.

I further think that the atmosphere of our earth is so much interplanetary gases (or ether) heaped up around it by displacement—that is, the earth, in its motion through space around the sun, displaces so much interplanetary gases (or ether) constituting our atmosphere.

If the whole of our atmosphere could be made to occupy the space filled by the earth, and equally diffused throughout it, it would be attenuated more than 250 times.

Again, a large portion of the interplanetary gases (or ether), by the motion of the earth, is pushed spaceward, and only a small portion of each individual displacement is heaped up on the surface of the earth.

From this cause, and the exceedingly slow motion of the earth *per se*, which is not eight times its own diameter per hour, it would take some time to heap up so much interplanetary gases as to be equal to the bulk of our atmosphere.

From this it will appear that the earth's atmosphere is continually but slowly being renewed, portions flying off, and fresh portions added to it by the earth's progress through space.

Of course, the same process is going on in the other planets of the solar system, and as in them, so also in the stellar system of the universe.

If we take the earth's atmosphere as a standard of pressure, which is 14·7lb. per square inch, we can easily determine the pressure of the atmosphere of the different planetary bodies in the solar system; as examples, I will take the moon and the sun.

Taking the relative sizes of the moon and the earth, we shall find the moon will have an atmosphere with a pressure of 4 ounces on the square inch, while the immense size of the sun will give it an atmosphere having a pressure of 30,000lb. upon every square inch of its surface, a pressure sufficient to produce the most intense heat and light. It would follow from this that the immense size of the sun and its motion through space, slow though it be *per se*, are the two great factors in the production of its heat and light; so that as fast as the sun radiates its heat and light into space, it is acquiring it equally as rapidly, in consequence of its immense size and motion through space.

The planets in the solar system, the sun, and all the stellar bodies are doubtless radiometers, set in motion by the action of light emanating from their various centres. **B. C. S.**

THE SIMPLEST WAY OF USING AN EQUATOREAL.

[20664.]—JUST a few words about the method of "A. S. L." in using an equatoreal. If the observer were stationed at the centre of the earth, it would be right enough; but when applied at the surface it fails altogether. Suppose the telescope to be used for the purpose of finding an otherwise invisible object, and suppose by this means it is placed in the centre of the field. In a very short time it disappears, owing to the earth's rotation: and what is to be done then? Recourse must then be had to the known star, and the same sort of process repeated for every other object. It appears to me this would be exceedingly tedious. The earth's rotation is uniform, and the hour-angle increases at the same rate as an ordinary watch goes, within ten seconds an hour. Therefore, following the watch, we keep the star in position. This, then, is an infinitely simpler and safer plan which Mr. Pearson advocates.

Oct. 17th. **An Amateur.**

NEWTONIAN FLATS.—TO MR. BRASHEAR.

[20665.]—I AM very glad to see that Mr. Brashear has given us another of his very interesting letters (20623), and I can assure Mr. B. that I am not at all displeased with his straightforward criticism. He is so much a worker and so great an enthusiast that I should like to shake hands with him.

Now, with regard to my irreverence in calling the colour-test mechanical, Mr. Brashear rather mistakes me: the *test* is, to my mind, mechanical; the beautiful phenomenon, known as Newton's rings, is another matter. I should, indeed, be a veritable Goth to call that wonderful effect anything but optical. But that its use as a test for flat surfaces is any advantage over the purely *optical* test I use, I am not yet able to admit. I have refrained from singling out any particular firms in all my correspondence, and am sorry Mr. B. should *name any*. "Good wine needs no bush." I will here state that firms with whom I have been engaged have a reputation equal to any on the other side of the Atlantic; and as to prism surfaces, I have had that department in especial charge, and have, for years, given almost undivided attention to flat work, and have personally developed a system that for results is yet unsurpassed. In fact, a battery of prisms with 4·5in. surfaces, lately constructed by my own hands throughout, has been pronounced by one of the most eminent spectroscopists as "the finest in the world." Do not let us puff: let us write without our readers having a chance of calling us interested—the world is so censorious.

A word about rock-salt lenses and prisms. I feel sure that the success of the Messrs. Clark is, in some measure—nay, in great measure—due to the climate enjoyed by our cousins "across the pond." A surface on rock-salt will not stand many days in our climate with the greatest care, owing to humidity, which soon eats into the salt. Thus, I do not blame the "eminent London optician" for declining a job that would certainly spoil before it reached its journey's end. I think Mr. Brashear will admit that the system he describes of smoothing and polishing his flats is not quite new: it is as old as the Dollonds, and no worse for that.

The condemnatory remarks Mr. Brashear makes use of, about working a disc and cutting it in half, as I have described for the benefit of the amateur, I feel sure will be modified considerably when that gentleman forgives my irreverence and tries the method. I am aware that if glass is used too thin, there is a danger of springing it in cutting up, but that is only when great pressure is used in breaking off. I give a smart blow on the back of the disc, in line with the diamond-cut, and can assure Mr. B. that a 10in. disc *can* be cut—nay, is cut, without disturbing the surface at all. Will Mr. B. assert that greater strain is put on in separating a disc, than is used in chipping his octagonal pieces into shape with the shanks; which, I take it he does, or gives himself a lot of unnecessary trouble to grind them into shape. Again, I assert that two parts of the same disc, worked to stand the colour-test—i.e., to show, if small, one colour all over, and if large, the parallel bands he describes, would, and does, prove, a flat good enough for anything, as far as the colour-test can. Our friend, too, has ignored the statement in my letter, that "I should then try the flat with a *good* o.g." (We *can* make *good* o.g.'s in England too.) This is out of the reach of most amateurs, or I question whether they would bother about specula. Thus, I gave what I know to be as good a system as can be placed in the amateur worker's hands, according to my light. I hope Mr. B. will give us a better, and that he will describe his "flat edging," when he writes again. I am sure he will take my criticism in the same spirit as I do his, and I am sure the efforts of both, and all of us, will be advantageous to the whole of us.

Prismatique.

THE SPECTROSCOPE, AND ITS APPLICATION TO CELESTIAL AND TERRESTRIAL OBJECTS.

[20666.]—IT may be as well to place on record what has been achieved with this instrument by an amateur, whose only information on the subject has been derived from current literature, but who has learnt more by practice than could possibly have been taught in theory. The instrument employed is a 5-prism direct-vision spectroscope, supplied by Cooke and Sons, of York, and adapted to a 4in. aperture telescope, also of their construction. And first for the sun. The focal length of the object-glass being 54in., the slit of the spectroscope is placed very approximately at that distance from it. A small telescope with a diagonal eyepiece, for convenience of posture, is employed, and a small mirror is attached outside the telescope to reflect the sun's image on the slit, so as to have the advantage of seeing this image in reference to its position as regards the slit. On looking through the telescope there are seen two spectra—one bright, and caused directly by the sun; the other faint, and caused by the bright atmosphere which surrounds it. These are separated by a straight line, and it is of the essence of the method that this line be *most accurately focussed*. The three vivid lines brought into existence by the various prominences in the sun's chromosphere are then plainly discernible—one at C, another near D, and another at F—both when the slit is placed as a tangent, and also when it is placed as a radius to the round image of the sun.

If the slit be suddenly opened, the forms of these prominences become visible; or rather, a section of them, caused by the two parallel lines.

Next for the stars. We now have to remove the slit, and to use a cylindrical lens. To find where it is to be placed, let the telescope, with this lens inserted, be directed to the sun, and focussed until the oblong image thereof attains its maximum brightness and definition on a card placed in the position of the slit. It will be found that the axis of the lens is now parallel to the axis of the slit before it was removed, the brass tube, having been marked, in order that everything may be reproduced. On applying the whole to a first-magnitude star, its spectrum can be now perceived through the small attached telescope. In this way Sirius and Vega can be seen to have three black lines, and Betelgeux a series of beautifully-fluted markings in their spectra.

Lastly, for terrestrial flames. These may be varied indefinitely by introducing a platinum spoon containing the materials into a common gas-burner and viewing the spectra by direct vision.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Oct. 17.

ELECTRICAL MEASUREMENTS.

[20667.]—Mr. SPRAGUE shows by his article on p. 125 so great an advance on the position he took up when he and I discussed his articles on "Electromotive Force, Resistance, and Current," in Vols. XXIX. and XXX., that it is really a great pity that he should repeat some of the erroneous statements I then contested, and lessen the value of his teaching by the looseness and inaccuracy of his wording. I know from experience how obscurely the system of absolute measurement is explained even by the best authorities; but, surely, if anything should be precise and accurate, it should be the explanation of the system of measurement, which is the basis of the modern science of electricity. "Milverton's" letters, which I reply to separately, and "J. D.'s" query on page 171, are sufficient evidence of the waste of time caused by the want of lucidity and accuracy of which I complain.

The first thing I have to note in Mr. Sprague's article is the loose manner in which the force of gravity is dealt with. He appears to consider g impartially to be now the force of gravity, and now the velocity imparted by the force. The fact is, g is an expression neither for a force nor for a velocity, but for the *acceleration* (velocity imparted per second) due to the force of gravity. Secondly, Mr. Sprague speaks of the force of gravity as an invariable force, and even says that in England it is equal to 981 dynes. True, he states that it varies according to the distance from the centre of the mass of the earth; but he nowhere mentions the fact that even at the same point it varies strictly in the direct ratio of the mass on which it acts. In fact, the force of gravity is proportional to both the mass acted on and the acceleration produced therein, and it is measured as equal to their product—that is, to mg. Thus, the force of gravity acting on one gramme (mass) will be 981 dynes, but the force acting on 100 grammes will be 98,100 dynes. It is just this very proportionality of the force of gravity to the mass it acts on which causes the acceleration g to be identical whatever be the mass. Hence, we may look on g as being the "intensity of the force of gravity per mass acted on, or per unit mass"; but in no case is g an expression either for the force itself or for a velocity.

Another loose statement is the one which has puzzled "J. D.," query 48336, page 171. The uncertainty is in the "ditto," as "J. D." supposes. It really refers to an intermediate unit, that of acceleration, LT^{-2}, which "Sigma" has left out. The erg, the unit of energy and work, would then read thus:—"The energy acquired, in moving through one centimetre, by one gramme (mass) acted on by a force adding one centimetre per second velocity in each second." But the second explanation of the erg, in "Sigma's" article, which satisfies "J. D.," is scarcely more fortunate, for in the first place the "13,825 centigramme metres" is evidently a slip of the pen for 13,825 centimetre grammes; and, in the second place, neither the one unit nor the other belongs to the C.G.S. system at all, but is just as much a gravitation unit as the gramme-metre itself. In all these units the gramme is taken as a weight; but as explained elsewhere to "Milverton," the C.G.S. system includes only those units which are based on the gramme as the unit of mass, on the centimetre, and on the second.

The next erroneous statement of Mr. Sprague's I feel somewhat hopeless about, having contested it before, and as it now appears, without any success. The statement I refer to is that "energy or work varies as the square of the force." It really is incomprehensible to me how "Sigma" can make a statement like this, utterly contrary to received ideas, and make no attempt to prove it. Possibly it arises from an imperfect differentiation in his mind between the ideas of force and velocity, such as I have already noticed in the case of gravitation. But the very peculiarity in the absolute system of measurement when passing from one set of fundamental units to another, to explain which he now again makes the statement, will itself supply the refutation. For, though one M.G.S. unit of energy is equal to 10,000 C.G.S. units of energy, while one M.G.S. unit of force is only equal to 100 C.G.S. units of force; the actual physical force and the actual physical energy remain exactly the same as they were, however we may express their quantity or degree. And as energy is equal to force by length, if we take the same force, and the *same length*, our energy will be just the same, in whatever way it may be expressed: thus,

1 M.G.S. force-unit × 1 metre = 1 M.G.S. energy-unit;

and

100 C.G.S. ditto × 100 centimetres = 10,000 C.G.S. ditto.

But, if we take the C.G.S. units themselves,

1 C.G.S. force-unit × 1 centimetre = 1 C.G.S. energy-unit.

And as 1 M.G.S. force-unit equals 100 C.G.S. force-units, while 1 M.G.S. energy-unit equals 10,000 G.C.S. energy-units, I suppose "Sigma" would say that the last equation proves his case. Is it possible that he overlooks that, of the two factors of the energy, he has reduced not only the force 100-fold, but also the distance 100-fold as well? Of course, if we reduce *both* factors 100-fold we shall reduce their product 10,000-fold, but that is no justification for stating that energy varies as the square of the force! A moment's consideration will show that if we take n times the force, acting through the *same distance*, we shall simply get n times the energy and not n^2 times, as "Sigma" would have us believe.

There are other debateable points in Mr. Sprague's article, but I only wish to contest those which might do positive harm if left unnoticed, and I hope that his next article will show that I have not written this in vain.

H. G. Moberly.

THE ELECTRO-DYNAMIC UNIT OF POWER.

[20668.]—"MILVERTON" (letter 20628, p. 139) is still so befogged that to thoroughly explain his difficulties would take up more space than I can venture to ask for. I can only hope that an indication of the chief points where he has gone astray, and further study of my letter, p. 114, of "Ll.B.A.'s," p. 139, and of Mr. Sprague's timely article, p. 125, may assist "Milverton."

In the first place, C.G. does not mean one gramme raised one centimetre, nor does C.G.S. mean one gramme raised one centimetre in one second. The term C.G. does not exist, and the term C.G.S. is far more general in its application than "Milverton" fancies. It is a generic term applying equally to all the distinct units belonging to the system which is based on the centimetre, gramme (mass), and second, as the fundamental units of length, mass, and time respectively. Thus a surface of one square centimetre, a velocity of one centimetre per second, the momentum of a gramme (mass) possessing that velocity, the force which produces that momentum in one second, &c., &c., are all C.G.S. units.

"Milverton's" gramme raised one centimetre, and gramme raised one centimetre in one second, are not C.G.S. units at all, and they are neither systematic nor absolute, for his gramme is the gramme weight, variable even at different points of the earth's surface, and depending wholly on the relative position of two or more masses.

In paragraphs 3 and 4 of his letter (where, by the way, 10^4 is evidently a misprint for 10^7, as 107 in "Ll. B. A.'s" letter is for the same) "Milverton's" equations represent the value of gravitational units on the left, in C.G.S. units on the right, and if he will retrace his steps, recollecting that g is 9·81 metres per second of velocity added per second, he will find that the unit in the value found for the French horse-power is a C.G.S. unit; that is, that it is derived from the fundamental units one centimetre, one gramme (mass), and one second.

The value so found would cease to be expressed in C.G.S. units if it meant what "Milverton" supposes. In fact, his ideas just want reversing. The pound or gramme in the gravitational set of units is the dynamical weight, but the pound or gramme in the C.G.S. set of units is the statical mass. "Milverton" appears to suppose that a foot-pound of energy is one pound (mass) raised one foot. Would the energy be the same if that pound (mass) were raised one-foot on the surface of the moon? On the contrary, one foot-pound means one pound weight raised one foot, or in other words, one pound mass raised one foot *against the force of gravity*.

I hope that these explanations will put "Milverton" on the right track, but that if he wants any further explanation he will not hesitate to say so.

H. G. Moberly.

THE ELECTRIC LAUNCH.

[20669.]—IT seems somewhat premature to judge the merits of the *Electricity* from the single experiment quoted by your correspondent "E. F. N.," letter 20627, and, indeed, the chief disadvantage mentioned by Mr. Moy seems to be the great weight of the storage cells. Now I find that the 45 Sellon-Volckmar cells measure 7½in. high, by 9½ by 8½in. each, and the total weight is about 2,700lb., which may outweigh a boiler and coal bunkers of the vessel's calibre; but then the cells have the advantage of easy stowage, being of small size, and it being of no consequence where they are situated in the vessel, being in this case stowed under the seats; whereas a boiler, with its attendant bunkers, and necessary room to swing a shovel, must occupy one fixed place.

Now that Mr. Reckenzaun, who originated and carried out this system of electric propulsion, has gone so far successfully, there is no doubt that the scientific men of the day, who are intent upon the most economical storage of electricity, will make lightness and portability a special object, as well as general efficiency. It is evident that lead will have to be discarded in the construction of such a cell, however.

I learn that a "special propeller is being constructed to be driven direct from the motors at a high speed." Should this answer, there will be no necessity for the counter-shaft and belting that exists at present, and the whole apparatus be under the cabin-floor, comparing favourably with the steam-engine of the usual launch type in this respect, and also that it does not require the attention of the latter, and therefore the centre of the boat above the motors could be used as a cabin, and no sign of a propelling power visible, save the lever of "Addymair's friction clutch," the ampère metres, commutator handle, and reversing gear.

Another advantage that this method of propulsion possesses over the ordinary steam launch, is that the power is always there when the cells are charged, no matter when it is wanted; there is no banking up of fires, soot, and smoke, nor danger of explosion from carelessness of attendant.

Taking the tugs that ply up and down the river, for an example, they are full of machinery and coal, yet have to carry ballast, and as the coal is consumed, and the vessel lightened, her towing power decreases also, whereas the storage battery could take the place of ballast and coal, the extra weight compensating for the former, and having the advantage of the latter in being constant, whether charged or exhausted. If ever (and I don't see why they should not) electric tugs replace the steam ones, the companies owning them will have power stations on the river bank, with buoyed cables for transmission of current, and I have no doubt that it would be cheaper to maintain a large engine in such a station to transmit its energy, even though the loss be 30 per cent. in storage, than the present system of towing, which necessitates long periods of waiting, during which steam must be kept up, employing labour and using coal, while the electricity, according to Mr. Reckenzaun's system, remains latent in the cells. **Fred. Walker.**

NOTES ON DYNAMO-MACHINES.

[20670.]—In letter 20645 Mr. Evershed opens up a question which for some time I have been on the point of noticing myself, my delay being owing to a desire I had not to trench upon anything "E." might have to say further on this point.

The remarks I have to make refer more particularly to the Gramme machine than to the Siemens.

In determining the characteristic curve of the Gramme machine, it will be found that the curve is not one of rapid rise at first, followed by a slower rise, continued indefinitely; but consists of a rapid rise to a maximum, after which it commences to fall off.

Fig. I shows this graphically. A D B is the theoretical curve, A D C is what is practically obtained. Now this result has nothing to do with the delay in magnetising the iron ring, neither is it due to the other cause of retardation, which Mr. Evershed omits to mention—viz., the self-induction of the coils. In proof of this, I give the fact that this falling off is independent of the speed, and occurs in the curves of all speeds; it can be caused by nothing but the field due to the coils carrying the current. Let us trace the action.

FIG. 1.

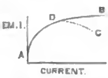


FIG. 2.

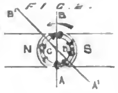


Fig. 2 gives a diagrammatic view of the two field-magnets, N S: the ring, C D: and let us take a single coil and trace it round. Let us forget all about the field-magnets, and consider the two poles in the ring. (I may remark that this method of treatment gives precisely similar results to considering the field due to the two magnets.) As the ring leaves the N pole at D, a current will be induced in the direction shown by the arrows, till it comes to the neutral line A B. Here the direction will reverse, and during all the motion from A to B will be as shown; at A the second reversal takes place. Thus it will be seen, on consideration, that all the currents flowing off at the brushes at A B will produce poles N_1 at B, and S_1 at A.

Now, the true neutral point of the machine, due to these two sets of poles, if they are of equal strength, is $B^1 A^1$.

The right position, then, for the brushes, depends on the relative strengths of the poles N S and N_1 S_1. When the current becomes large, the poles N_1 S_1 at A B become, perhaps, nearly as strong as N S at C D, so that although for a weak current little lead is required to be given to the brushes, when the current is increased, more lead must be given; otherwise the effect of the machine is weakened, as shown in Fig. 1, by the curve A D C. The very fact of giving the brushes more lead will take the poles at A B further round still; but a point will be reached when these effects are balanced.

Instead of thus treating the subject, I might have given sketches somewhat like those given by S. Evershed, showing the displacement of the field; but I believe the former is somewhat simpler in considering the Gramme machine.

With regard to the lead given to the brushes, we must be careful not to be deceived by the position on the machine from a superficial observation; for in some machines the position of the commutator does not correspond to that of the coils, the commutator being turned bodily through a certain angle. This, I believe, is the case with the Siemens, and certainly is with the Edison.

I shall be glad to hear what others have to say on this subject. **Ll.B.A.**

"LOOPED FIGURES BY GEARING."

[20671.]—When working one day at a lathe I then had fitted as described, a Cambridge wrangler called and suggested that a true cusp would not be formed; but as he watched he saw the loop develop under his eyes. I offered to lend a few engravings of blocks, and will, with pleasure, send "F. A. M." some with loops not at centre. I quite see the point referred to—viz., that out of the two motions, rocking and circular waves alone would result; but does not something depend on the position of the fixed tool, whether on the near side of centre, at the centre, or beyond it? The fact of loops being produced is undeniable, as "F. A. M." will see. I wish I could repeat the blocks; but, luckily, I have engravings of several. I can guarantee that only the geared rose-engine was used in producing these. **O. J. L.**

HOME AND GARDEN CARPENTERING.
II.

[20672.]—Now it is required to build a shed for bicycle, tricycle, garden-tool house, or for donkey, goat, rabbits, or fowls, &c., &c. The scantling is very similar to the garden fencing before given, and my idea is to do with as little labour and timber as possible, and as few tools. The following will be absolutely necessary, however: hammer, saw, screw-driver, gimlet, bradawl, and a spokeshave. These, if not at hand, will not be a very expensive kit, and with instructions how to make, one little tool will be all that is required. An axe or wood-chopper certainly would be handy; no plane is required—it is labour in vain. Wood takes the preserving medium better, and stands the weather better rough from the saw than if planed. The rectangular figure Fig. 1, with the lumps in the angle, we will suppose to be the ground-plan for a shed for stowing away a bicycle and tricycle 16ft. long, 6ft. wide, 6ft. 6in. high in front, 7ft. 6in. at back,—that is, a lean-to with a fall of 1 in 6 for the roof to throw off the wet. First, you will require 8 piles of yellow deal, pine, or white stuff, section 4½in. by 3in., 2ft. 6in. long; four of them will want a cheek taken off one long side and one short side for 6in. down, so that it leaves a ½in. shoulder (see A and A×). The other four will require a shoulder similar on the broad side, and a mortise right across (see B and B×). These are the piles, that are to be made hot and treated to a coat of tar, and when you have chosen a rising ground, upon which you should build if possible, line it out, and put your piles in, the shoulders level with the ground. For one I constructed I drove a long stake in first, and wriggled it about, and then drove my piles in, marked them off level, and cut the shoulders when in the ground—rather awkward I admit, but better than digging ground up and putting them in, as they are not so apt to settle down. If you do dig holes for them do not point them, but prepare some elm 1in. thick, 6in. wide, and 12in. long, and central on the butt-end at the bottom with a couple or three of 4in. spike nails, which will answer all purposes. C, which relates to all four corners (the uprights) is made of inch stuff, one board cut diagonal, as recommended in the letter on garden fence making, the corner posts L shape. D is made the same, with one board and the piece nailed down upon the centre, making these four posts T-shaped, and, instead of mortising, pieces are notched out before nailing them up; and when put together a mortise is formed for the rails to nail your weather boarding to (see posts 1 and 2); 3 and 4 are sections of the same; 6, 7, 8, 9, 10, and 11 show the holes, pieces notched out, which, when put together, form the same mortise. When the rails are put through it forms a bond top and bottom. If for a workshop it forms a fillet that carries the floor, or, more properly speaking, a joist outside and in, and a sleeper shown at E carries two more joists, and it may be boarded transversely; and when the floor is once laid it may be taken up in one piece and relaid, that is, if you want to cart it away. The sleeper is shown again at 5. A mortise is cut at each end, so that it fits upon the web of the post and rests upon the piles. There are notches cut in these again, and the joist being inch stuff 6in. deep, is joggled into them for about 2in. This, you will understand, is taking the length from 16ft. battens. The affair would stand very well 6ft. between uprights: the sleepers, 2½in. by 3in. Fig. 2 is, to a certain extent, a section and elevation in the centre bay, as we may term it; 1 and 2 are the posts or uprights; 3 is the rafters, 1in. by 5in. deep; 4, 5, and 6, battens for roof boarding, shown at 7; 8 shows how the rafters and bond-rail is joggled into the posts; 10 is a batten, which is shown at 4, with a strengthening wale nailed on, but a piece can be sprung in and nailed as shown at 10; 11 is the way to lay the boarding upon the battens, the fillets upon the joints are only nailed upon one side, the other is left for shrinking; 12 is the way the window-sill is put in; 13 is the window-eave or drip-board; 14 is section of sash-bars, only vertical. The glass is put in jump joint. The joints can first be payed over with white-lead and oil. 9 shows the way other bars are mortised in the top and notched into the bottom, driven in tight and skew-nailed; 15 is the erection with a batten door hung to open out, hung with cross Garnett hinges. The rafters are cut to an angle in the front to form a backing to carry a V-gutter, which can be fixed with nails through the back of the same into rafters. When you get the frame up and the roof on, you can fill in the sides by nailing light boarding upon the battens, or bonds, from top to bottom. This is a building that you may readily strike and cart away with you or make firewood of. You can knock it off the piles, and re-erect it in a very little time. One I erected for a workshop, I have been given to understand, has had the roof removed and been converted into a greenhouse. Screws are very cheap, and you will require very few. If put in with lard, you may draw them from posts, boards, &c., &c., and from the foot of posts and piles, which will make it better for removal. Spruce batten is the cheapest material, and very durable if it is well dressed when put together. I thinned my compost with paraffin oil, as it was cheaper and went farther. The battens or fillets upon the joints of roof should be put on with a strip of old calico sheeting or canvas, as when it overlaps the other end the tar composition is absorbed by it like a sponge and makes it tight. The stuff for uprights should be 8in. by 2in., one-cut deep; the same for bond, joist, rafters, and battens for roof. If to be floored, sleepers' stuff 6in. by 2½in.; one flat floor, boards 8in. by 2½in., two cuts deep. Use rose nails, 1½in. by 2½in.; and for roof, 1in., cut clasp, will do. If you dispense with the piles, and make the posts as I have done in some instances 18in. longer, and nail a foot on them as shown at Fig. 4 and Fig. 5, the T-post a piece of 1in. elm, 12in. by 6in., and the corner post, L-shape, a piece 1in. elm, 8in. square, you will require some 3in. or 3½in. rose nails—not many, as three in the T will do, and four in the L; the roof stuff, 8in. by 21in., three cuts deep. The other portions, &c., I must defer until next letter.

Jack of All Trades.

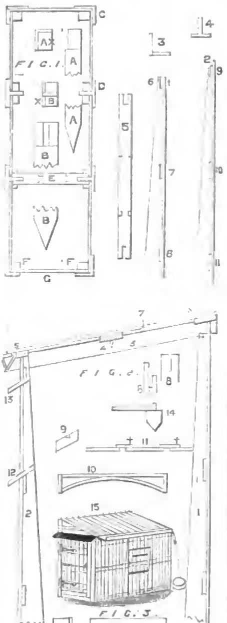


FIG. 4.

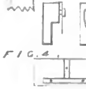
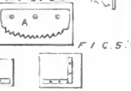


FIG. 5.



SPECTACLES.

[20673.]—I have recently been going in for the subject of spectacles, and find many little things which, although very important, are neglected in the application of this simple optical contrivance.

Now, I should like to see something from "Prismatique," or any other practical optician, as to what is done in the following cases:—Suppose an eye in which the cornea is thicker in the centre than around the edge; also an eye in which the cornea is thicker around the edge than the centre. In both these cases, what devices have opticians for ascertaining that such is the case; and how do they remedy them?

Again, suppose the right eye is weaker than the left, or *vice versâ*, would the optician give the patient an ordinary pair of spectacles? If not, what steps does he take to discover such defects, and remedy them?

I am afraid sufficient care is not given to the subject of adapting spectacles to the eye; and that on this score there are many practices which are not only objectionable, but condemnable.

London, W., Oct. 11. **Henry Stooke.**

VEGETARIANISM.

[20674.]—Mr. Stooke and "G. B. T." have both addressed you long and valuable letters on this subject. So far as the question itself is concerned, I am certainly of the opinion of the latter, and regret the more that he leaves one fallacy unchallenged—nay, even confirms it.

Both correspondents contend that animal food *can* not be eaten raw.

Now, I can eat a piece of perfectly-fresh steak of really good quality raw, and enjoy it; I learnt to eat it so from a lady as fastidious with respect to food as any.

I know, moreover, of a case in my own family where a man having long suffered much from a disease of the stomach, was ordered by the late Professor Oppolzer, of the Vienna University (dead now some 15 years), to eat raw meat, especially veal and venison, bruised in a mortar.

Moreover, millions of people delight in oysters, which are generally eaten raw. Raw eggs are also an article of diet which many consider a dainty.

Upton Park, October 22. **Polyglott.**

BICYCLE HEAD.

[20675.]—Many years ago, when first bicycles were introduced, we made a large number with a steel spring let into the head. This was in the age of wooden wheels, and the object aimed at was to lessen the vibration, and we were quite satisfied with the results, as also were the riders.

Thos. M. Bear.

Britannia Works, Colchester.

STEAM TRICYCLES.

[20676.]—Tricycles and bicycles have now been brought to such a state of perfection, that there seems almost nothing left to be desired. But some restless spirits want very much to alter this settled problem without reconstruction of the whole machine.

These beautiful machines, as adapted to manual power, are quite inadaptable for steam-power. If steam-power is to be applied to common roads, an entirely new mode of construction is necessary. In Blackburn's patent, No. 3838, '77, this fact was judiciously recognised. When I wrote to you on this subject three years ago, the edition of blue books were quickly sold off, and it has ever since been out of print. But the patent is well worth perusing at the Patent Office library, as it contains some very ingenious ideas, which were well carried out. The condenser appeared to act very well indeed, and the coil-boiler seemed to be the only weak point about it, as I told Mr. Blackburn at the time. I presume this proved to be the case, as the patent became void at the end of three years, on nonpayment of the £50 duty. This vehicle weighed eleven hundredweight, and carried two persons comfortably; the driving-gear was variable, and the liquid fuel arrangements were very efficient. The history of the steam tricycle in your last issue (page 152) may be interesting to your readers.

In 1871 I invented a new mode of applying ⊃ tubes to steam generators (No. 2762, '71) and further improvements (see patents Nos. 2977, '75 and 1406, '77). The latter patent contains forms of boilers almost identical with those shown on page 153, the difference being the formation of the upper part, which is the idea of Mr. Storey, the designer and maker of the tricycle shown in the diagram.

The method of burning liquid fuel is the invention of Mr. Kidd, who planned for me the arrangement shown, about the year 1875, when I was trying a great many experiments in aëronautics, &c., with Mr. Storey's assistance.

Mr. Storey applied for a patent for his boiler in 1880 (No. 5236), but did not proceed with it. He, however, continues to manufacture them. Mr. Kidd's plan of burning liquid fuel was described 5 years afterwards in a provisional specification, No. 2076, '80, and again with Storey's boiler in No. 4799, '80, and thereby, of course, rendering both the latter illegal and invalid. The mode of condensing by means of a water tank is very inferior to Blackburn's. If this tank is filled with 60lb. of water at 60°, and the evaporation equal to 2lb. of water in 3 minutes, the water in the tank would be raised (by the latent heat of the steam) to boiling point in less than 10 minutes, after which the tank would be useless, whereas Blackburn's condenser is continuous and much lighter.

I would advise any of your readers who may contemplate putting steam to tricycles to abandon all idea of extreme lightness, as a few pounds are of no consequence when steam has to do the work, and strength is of great importance. Compressed air, springs, and electricity are not worth a moment's thought for motors, the necessary arrangements for compressing, winding up, and replenishing being impracticable. Steam requires no reservoirs of power, and can be got up anywhere by means of fuel and water.

21st Oct. **Thomas Moy.**

THE JERKS IN RAILWAY TRAINS CAUSED BY CONTINUOUS BRAKES—TO "S. J."

[20677.]—To make this subject clear to your correspondent, I will divide the "jerks" felt by passengers into two classes—1st. That which takes place when a train is running and the brakes are applied; 2nd. That which is felt at the moment when the train is coming, or has actually come, to rest.

An instantaneously-acting automatic brake has a store of power upon each vehicle ready for use at any moment. It therefore follows that if the whole of this power be applied at the same instant, all the carriages will be brought to rest simultaneously without any jerking between each other, and without any compression of the buffers or dragging of the couplings. Passengers will hear the brake-blocks grinding upon the wheels, and feel that the speed of the train is being very quickly reduced, but without any inconvenience to themselves.

We will now consider a slowly-acting non-automatic brake: it has no store of power upon each vehicle ready for action, but the power has to be conveyed to each carriage from generally the engine, but in some systems from the van. Here we have slowness of application in consequence of time lost in transmitting the power, an inferior "stop" as regards distance, and also violent jerks caused by the brakes being *full on* upon some vehicles and *full off* upon others.

Take, as an example, an express train fitted with a brake under the control of the driver, and worked from the engine. The driver creates a vacuum or other power: the effect is, that instead of simultaneous action throughout the train, the brake is first applied to the engine-wheels, then to the tender, next to the carriages one after another, until at last, after many seconds (the time, of course, varying with the length of the train), the brakes are applied upon the rear van. A train running at 60 miles an hour passes over 88ft. per second, and the energy in such a train would be no less than 120 foot-tons for each ton of the total weight of the train; hence it follows that when the brake is applied, the speed of the front portion of the train is suddenly reduced to about 50 or 55 miles an hour, at the same time that the rear portion is moving on at the original speed of 60 miles an hour. This action compresses all the buffer-springs, and in a long train the compression amounts to a total of many feet.

Now when the brake begins to act on the rear vehicles one by one, the buffers rebound and cause a violent jerk, which is not only disagreeable to the passengers, but sometimes causes draw-bars and couplings to be broken, in which case a non-automatic brake is at once rendered useless, and a collision between the two portions of the train is very likely to follow.

Referring to the "jerk" which is felt at the moment when the train stops, the following is the explanation desired by your correspondent. When a train is running, and brakes are applied, each carriage is subjected to a strain caused by inertia, equal to the weight of the carriage multiplied by the rate of retardation of the train. This strain equals in practice about one-tenth of the total weight; it acts as a forward push applied to the centre of gravity of the vehicle, and changes the distribution of the weight on the wheels, the front pair being more loaded than usual, and the rear pair correspondingly less.

Now it will be seen that this alteration in distribution of weight must also affect the position of the vehicle: instead of running forward *horizontally*, it will be found that the front end of each carriage is much *lower*, and the rear end *higher* than its usual level. As soon as the train actually, or very nearly stops, the *vis-viva* of the carriage body is destroyed, in fact ceases to exist, and the vehicle at once assumes its normal position with equal weight upon the wheels. The sensation caused to passengers by carriages "righting themselves," as it is technically termed, is very unpleasant. It can, however, be entirely avoided by arranging the brake-gear in such a way as to create a vertical force counteracting the extra load thrown upon the front wheels by giving more pressure on the inside brake-blocks than upon the outside ones, and drivers should always release the brakes at the last revolution of the wheels, in order to give the carriages time to assume their normal position gradually and imperceptibly, without any jump or jerk at the moment of stopping. Your correspondent mentions that this "jerk is very marked" upon lines he names at Manchester; but if he were to travel in some of the stopping trains upon the Midland Railway fitted with modifications of the Sanders and Bolitho vacuum brake, he would find that the jerks caused by it are much more severe than those given by Smith's vacuum brake upon the Manchester, Sheffield, and Lincolnshire Company's trains. "S. J." tells us that, as a director of an Insurance Company, he finds that railway companies *invariably say* that the passenger got out of the train before it stopped.

It is, unfortunately, a fact that many persons *will* get into, and out of, trains when in motion, but still much of the loss of life which follows can easily be prevented by the companies providing the carriages with continuous footboards, and having platforms of a proper height. It is, of course, well known that the companies "do invariably state that the passenger got out when the train was in motion."

After an accident to a passenger, it is usual for a company's official to see the porters and other servants who were present, the result being that the servants well understand that they must all give the same account as that drawn up by their superior officer.

Some time ago a case was brought under my notice in which a train had actually stopped, and a passenger in the act of getting out of a carriage was thrown down by the rebounding of the buffers in consequence of their having been compressed. The passenger was at once threatened with legal proceedings "for getting out of a train in motion." He, however, knowing that he was in the right, and supported by the statements of fellow-passengers, determined to take the necessary steps to defend himself. After considerable investigation the truth was obtained, that the train had actually stopped, and that the buffers then rebounded, causing the carriages to run back several feet. At first the company appeared inclined to say that the words "train in motion" included not only usual running, but "motion" in any direction, even if caused by rebounding after stopping. No doubt the company found that such a claim would not be upheld in a court of law, for nothing further was ever heard of the legal proceedings against this passenger.

The next time "S. J." has a similar case brought under his notice he will, perhaps, obtain valuable information by ascertaining if the train was running forwards and had not stopped; if the passenger was thrown down at the moment of stopping by the jerk of the carriage assuming its normal position; or, if after the train had actually stopped, the "motion" was the rebounding of the carriages.

Clement E. Stretton.

Leicester, October 21st.

APPROXIMATE PERPETUAL MOTION OF A PENDULUM.

[20678.]—As the subject of dynamical problems, &c., is now under discussion, perhaps a brief account of a self-driving pendulum which I designed more than 10 years ago may be of interest. It is, perhaps, unnecessary to say that I never went so far as to construct a model, being well aware of the impossibility of perpetual motion in general, and seeing the fallacy of this particular case. However, I claim that it is as near an approach to perpetual motion as possible. The principle of the arrangement is based upon a statement of Sir E. Beckett's, to the effect that a long and heavy pendulum requires no more power to maintain its vibration than a short and light one; moreover, it is well known that a well-made and heavy pendulum requires only a very small power to keep it vibrating when once started. Again, a long heavy pendulum will possess more momentum (to use an almost obsolete term) than a lighter one. These facts being granted, it is clear that if we can arrange the mechanism so that at certain short intervals the pendulum shall wind up the small weight (or spring) which drives the escapement, and we can largely increase the weight and length of the pendulum, and, therefore, its momentum, while the small driving-weight remains the same; then the more we increase the size of the pendulum, the more power has it of winding up its driving-weight, and the longer will it continue to work. The details were shortly as follows:—A long and heavy pendulum with an ordinary escapement driven, not by the ordinary train of wheels and pinions, but by one wheel and pinion only. The wheel is connected to a small barrel with ratchet, &c., and a light cord with small weight attached is coiled on the barrel. A small winch-handle is fixed to the barrel, and the whole is so arranged that at intervals, say, of one minute, and at a moment when the pendulum is at one extreme of its arc, the winch-handle is shifted into the same plane as the pendulum-rod is in, and coming in contact with it is driven through a small part of a revolution by the return stroke of the pendulum, thereby turning the barrel and winding up the weight to the necessary extent. Before the pendulum again comes back, the winch-handle has shifted out of its plane of vibration, and remains so till another minute has elapsed, when it again comes into contact with the pendulum, and the winding up is repeated. Of course, during the minute the winch-handle has performed a small part of a retrograde revolution. I will not occupy further space by showing why the arrangement would fail, the reasons will be obvious to persons having a knowledge of mechanical principles. However, it appears to me that if a certain sized pendulum under the above conditions continued to work for, say one hour, then, if we double the size of the pendulum it would work for two hours, and so on. Of course, to some extent this is due to the extra power exerted and stored in starting the larger pendulum from a state of rest.

Birmingham, October 21. **Wm. Granger.**

HARDENING AND TEMPERING STEEL TOOLS.

[20679.]—I am very glad to see this subject entered upon, and hope, with "C. A. T." that some of our practical correspondents will come forward and give us the benefit of their experience on tempering steel goods. I am quite aware that it is not so long since an article on this subject appeared in these pages; but the writer appeared to rely upon tempering by colour, and it is just at this point where, with modern steel, the difficulties begin.

The time was when I rather prided myself on my skill in drawing down hardened steel to a tough-cutting edge; but it seems to me that since the introduction of the Bessemer process a medium temper is very hard to get, and that tempering by colour is very uncertain in its results, excepting, perhaps, the "moral certainty" that you will not get it the temper required. On this account I have lately placed more dependence on tempering direct from a red-heat by cooling in oil.

Tempering in oil is not, however, applicable unless upon a small scale; therefore, your correspondent's idea that steel might preferably be hardened in water of different degrees of temperature, is a good one, and reminds me that music-wire is tempered by being plunged at the red-heat into boiling-water, and that the makers claim, that by no other process—not even by annealing in ashes—can they get the equable tough temper for which English music-wire is so celebrated. So satisfactory, indeed, is the temper, that skilled mechanicians are commonly in the habit of using it to make spiral springs, and I am informed by them that no other wire answers this purpose so well, as it rarely breaks, and, with fair treatment, never loses its elasticity. Watchmakers also, I believe, will not refuse a good word on behalf of music-wire. **W. H. Davies.**

LEGAL REPLIES.

[20680.]—Accident Compensation (48281).—This raises several complex legal questions, and cannot be definitely answered without fuller details of what actually happened. The case does not come under the Employers' Liability Act, and the difficulty as to making the owner of the van liable is that he was a stranger to the person injured, and there was no privity between them. If, however, the carman asked the querist to help him, he may be taken as having done so on behalf of his employer. But, in any event, it will be for the plaintiff to show that the rope in question was intended to be used as it was, and was unfit for its purpose by reason of the negligence, if not to the knowledge, of the owners of the van. The fact that it broke would not alone be sufficient proof, and unless the querist is prepared with some evidence upon this point, he had better not risk an action so legally doubtful.

Detention of Property—Creditor (48282).—I do not see how any creditor can have a legal lien upon articles intrusted to his debtor to be repaired, and I should advise the querist to summon the creditor to the proper police-court for illegally detaining his property, or he can sue him in the county-court if he chooses; but the other process will be both cheaper and quicker, the summons only costing two shillings.

Furnished House—Rent—Boxes (48283).—The safest and most strictly legal way to proceed in this case is for the querist to distrain upon the boxes for the rent only that is actually due, giving up the other items of gas, &c., and then, after giving notice of the condemnation, he can sell. But seeing that the tenant consented to leave the boxes with him as a pledge for the whole amount, he may determine that contract by giving notice to him that he will sell them within a certain time, say a week, unless the sum be paid; and at the end of that time he could sell. This course would, I think, be practically as safe as the other, and as it would be less troublesome and expensive, it might as well be adopted.

Infant—Administration—Account (48358).—This question is so confused that I cannot quite make out what has really happened. If the querist was entitled to a share of the intestate's estate, the administrator had no right to keep it to satisfy any sort of counter-claim he might have. The querist's remedy is to sue the administrator for his legacy, if he knows the amount; or to take out a summons, either in the High Court, or in the proper county-court, if the estate be below £500, to compel the administrator to render an account of his dealings with the assets.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

BOOTS AND SHOES.—TO "JACK OF ALL TRADES."

[20681.]—Your correspondent seems to know all about shoe-making. Will he kindly endeavour to answer me two questions? First, What is the difference in the present day between the shoes and boots which you purchase, either ready-made or to order, at any London shop, or at ordinary shops in any large town, and those which—apparently the same in make—you may get now and then at smaller shops at from one-fourth to one-third of the price? It seems to me that boots and shoes are nowadays among the most expensive of all goods. I have to pay from thirty shillings to two and a half guineas for shoes from West-end makers. My wife cannot get any shoes at these shops under about seventeen shillings, and yet the other day in a country town she found very good ones in a small shop for four shillings and elevenpence, which, moreover, had heels of a far better shape than any she could find in London. Can "Jack of All Trades" explain? Secondly, I have found a peculiar failing in boots—viz., the inner leather apparently rotting at the heel, about an inch or two up from the sole, while the boots otherwise show hardly any symptoms of wear, and this in boots costing from thirty shillings to four guineas the pair—the latter waterproof fishing-boots, which are rendered quite useless from this defect. The maker simply suggests that I must have them refooted at an expense of two pounds. Any hints or advice from "J. of A. T." I shall feel obliged for. **F.R.C.S.**

IMPROVED BICYCLE HEAD.

[20682.]—In letter 20653 "A Bicycle Rider" writes, "When the small wheel springs forwards." What this means I am fairly at a loss to understand; but, presuming that it means jumping when passing over uneven ground, allow me to explain that it would have no effect whatever on the head (not the rider's head), nor would there be the least tendency to throw the rider over the handles, through the backbone "shutting on" to the tires. If he ("A Bicycle Rider") will please refer to my sketch (20617) he will see that I have taken into consideration the safety of a rider in the event of the spiral spring breaking; as the only phenomenon that could happen would be the socket G sliding down the spindle until it stopped on the shoulder at the top of fork, which still allows plenty of clearance between the backbone and wheel.

I may add that I have a full-size model of the design I submitted, and the only fault I can get anyone to find with it is, that it puts the backbone an inch higher than the heads of existing design.

I consider that the advantages namely, "no spring under saddle," "no jarring on the handles," "less webbling from pedalling," and "easy access everywhere for cleaning," more than counterbalance this defect, which is also compensated for by the saddle having no spring between it and the backbone, except a thin piece of indiarubber. I should like Mr. E. Martin's opinion.

C. F. Archer.

Fine Art Gifts.—The South Kensington Fine Art Association certainly offer money's worth in the lifeboat pictures and cards they advertise. The specimens we have seen are very creditably executed, and we do not think any who receive them will wish their money returned—as the manager of the association offers to do, if purchasers are not satisfied.

Experiments have been recently made on the canal from Antwerp to Liège with a system of mechanical traction of boats by means of a moving cable—the invention of M. Rigoni. An endless cable made of Bessemer steel is set in continuous motion by fixed engines on the banks of the canal. It is supported along the bank by special pulleys, and directed by return pulleys of large diameter lodged in chambers of masonry under the level of the tow-path. The length of cable is eight kilometres, or five miles. Thus a canal is divided into as many sections, each worked by a fixed engine, as this length of five miles is contained in it. The steam-engine acts on the cable through a clip-pulley. The attachment of the boats to the cable is by means of cheeked nippers embracing the cable. On coming to a supporting pulley or a pulley at a curve, the nippers pass without releasing the cable.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46260.]—**Telephones.**—To "Amateur."—I am much obliged to you for kindly answering my queries, and shall be glad to accept your proffered aid. I have advertised my address in this week's issue. I have all Nos. of the last two vols. In No. 894 there is a description and illustration of Blake transmitter, and reference is made to No. 781, which No. I have not got. It appears to me not an easy instrument to construct. Where may the rubber ring be obtained? No account of the coil is given. In the last number (917) there is a good description by "W. H." of the Simplex transmitter, which seems an excellent article; though I fancy one objection to it must be the necessity of having a swing case. I have inserted one or two queries to "W. H." on some points about which I am not quite clear; but I hope this will not prevent your communicating to me about the Blake transmitter. I do not understand what you mean by a soft iron core being on the end of magnet; mine has none. Shall I screw one on? In that case I do not see how I can fix or adjust the magnet in the receiver, as magnet is tapped at one end only. Will you kindly explain? Also, could you tell me what is the best way to wind the wire on bobbins? I have been told that two or three lengths wound on together is the best arrangement; but, in that case, are the ends connected by two binding-screws, or more?—Cantab.

[47239.]—**Vegetarianism.**—At the end of "Nun. Dor.'s" reply to this query, p. 141, he refers, I believe, to my letter which appeared in the previous issue. He seems to treat the analogy existing between the human teeth and that of other frugivorous species as nothing to go by. Furthermore, he takes my letter as an argument, when, in reality, it was not meant for such. It was a statement of facts; but as an argument, I shall now most decidedly support it. The evidences, as I stated previously, are not alone in the teeth, but throughout the whole nutritive organism of man, that he is quite capable of thriving on vegetable diet. Will "Nun. Dor." show me in what degree man resembles other flesh-eating animals, and whether these outweigh those of the resemblances to the herbiverous species? I think if he will wade a little through the intricacies of comparative anatomy, he will find that the latter far outweigh the former. I am not a vegetarian, but speak on evidences. There are some persons—not a few, mark you!—who positively cannot digest meat in anything like an efficient degree; and when they eat it, they are always uncomfortable and unwell. I hope this, Mr. Editor, will not come within the pale of "statements which are not facts." I would refer "Nun. Dor." to page 106, No. 915, lines 21, 22, and 23. If "Nun. Dor." still contests that man was not originally a frugivorous animal, I will give him a few more facts. Some men can, of course, digest flesh; but what ills arise therefrom, and would those ills attack a vegetarian?—H. Stooke.

[47387.]—**Colouring Steel without Heat.**—I think you will find the best lacquer is made of, say, one gallon methylated alcohol, 10oz. of seed-lac, and sufficient Prussian blue to colour. Even this cannot be used well without heat, as to get a smooth coat the steel must be made quite warm.—Essar.

[47677.]—**To Unsize Paper.**—It would not pay to attempt to unsize the circulars, as each sheet would have to be treated separately, and you could not remove the printing. Better sell them as waste, and buy blotting-paper with the proceeds.—T. M.

[47735.]—**Eating Salt.**—Has it ever struck "Murano" (p. 141) that the persons he has noticed who are fond of salt, and are generally unhealthy or half-developed, may be troubled with worms? If not, he there has cause and effect, too. Might I ask what is the authority for the statements about certain poisons being harmless to certain animals. How much lachesis would a pig survive if it were injected into its venous system, or how much belladonna can a rabbit eat with impunity?—One Who Likes Salt.

[47885.]—**Turbine Pit.**—The shaft I speak of is driven from the upright shaft of turbine by a pair of bevel wheels. These wheels will be put out of gear, and an engine will be put alongside of shaft to drive it, so as the machinery will not stand during the repairs of turbine. The pump I thought of using is the pump that was used before a common 8in. pump (driven by four men), but I could hire a pump if you think the one I have will not do; from bottom of pit to height where water will have to be pumped to is 11ft.; give it to me as plain as you can, as I am no scholar; any suggestion from you will oblige.—A Templar.

[47911.]—**Photo-Zincography.**—You are not likely to get all the details of this process explained, as it is the interest of those employed in it to keep it secret as much as possible; otherwise they would lose business. The trade could supply you with a reduction or an enlargement of a subject on stone for litho., or a block for letter-press printing. The same with a pen-and-ink drawing, &c. See the printing-trade journals. The most skilful workmen are to be obtained from Paris.—T. M.

[47919.] — **South Kensington Training (U.Q.)**—The best books are Ganot's "Physics," and Guthrie's "Electricity." Examinations are held throughout the course in practical work, and one in writing at the end. Students are classified in order of merit. Much depends on the practical, but make full notes of the lectures. The theoretical is almost confined to the lectures.—Tunstall.

[47930.]—**Raising Water.**—Erratum, p. 165. In third line of reply, omit "that of a Poncelot-wheel working a p."—Glatton.

[47939.]—**Grinding Sawdust.**—Could be done by means of stones, like a flour-mill; or by an ordinary steel mill, such as pepper or coffee is ground in; but I suppose that would scarcely pay. —T. P.

[47953.]—**Geological.**—The Keuper bed is to be seen at Ashby de la Zouch and Alton in Staffordshire, and no doubt in other parts.—I cannot help with your fossils.—H. W.

[47956.] —**Matches.**—You could have some made to explode with the slightest touch; but they would be rather dangerous. Will not the phosphorus bottle answer your purpose?—C. T. A.

[47961.]—**Eels in Vinegar.**—*Anguillula aceti* is probably developed in vinegars containing much undecomposed matter—maltose, &c. The low-class article being doctored with sulphuric acid, is not likely to contain them; nor is the best, which is made from pure acetic acid and water.—E. W. M.

[47966.]—**Concrete.**—As an answer to part of this query, I would point out that there is a vast difference between slaked lime, which has fallen to powder, and finely-ground quicklime. The latter is quicklime ground to a powder, and is minus the water of the slaked lime.—Bricky.

[47980.]—**Pressure.**—The papers on Hydraulic Machinery will have answered this querist. I think he had better use cast plates instead of wrought iron. Of course he can crack a nut if he pleases, as there is no pressure until the motion of the ram is resisted.—Essar.

[48023.]—**Fixing Cylinder and Eccentric in Lathe.**—To "Working Blacksmith."—I should advise you to get cylinder and crank-shaft turned and planed up at some engine works, as you will not do much good with your lathe, not having a slide-rest. Your cylinder is much out of proportion. I should have one 8in. long by 4½in. To turn crank-pin, fix in lathe, with dogs on each end of shaft. "Glatton's" sketch shows exact way (No. 48028 of last week). I would get parts turned. You will then find plenty to tax your abilities with the fitting-up part. I will help you. Advertise your address.—G. Sumner.

[48032.]—**Zinc Cylinders.**—If the zinc is not of bad quality, you will be able to clean them and amalgamate them. Get some emery or sand, and tie on the end of a stick some rough flannel, then with the emery and water, well scrub all the insides of the cylinders, and with a similar piece of flannel and emery and water clean the outsides of the cylinders, then immerse in sulphuric acid one part, water five parts, then amalgamate, well rubbing the mercury inside cylinders with the stick and flannel. You will soon succeed, and in future don't let the zincs get dirty.—W. J. Lancaster.

[48043.]—**Dead or Chemical Black on Steel.** —Referring to "Auld Reekie's" reply, I shall be glad if he will let me know the proportion of turpentine and sulphur which must be boiled together, as I wish to apply it to the steel spokes of my bicycle.—A Bicycle Rider.

[48064.]—**Siphon.**—You will be unable to get the siphon to poll over more than 30ft. except in the summer, when the barometer is exceptionally high. On an average you will be able to clear between 27 and 30ft. You would not experience any difficulty with length of pipe; in fact, the longer the pipe, the quicker will the water be drawn over. Of course, the length I refer it to is a vertical and not a horizontal length. I shall be pleased to give you any further information you may require. —W. J. Lancaster.

[48068.]—**Eyesight.**—Of course, something can be done for you. There are thousands of people in the world like you, and I can assure you that I have never yet met with a human being possessed of a *pair* of eyes. I have had many who have been ready to demonstrate, without chance of contradiction, that they had equal eyes; but it is only a matter of a few moments to prove the contrary. Now, will you write another query, telling me if you can read this answer with your left eye at any distance, and, if possible, let me have the nearest point at which you can read and the furthest point, then I will tell you how to get suited?—W. J. Lancaster.

[48071.] — **Coil-Winder.** — Erratum, p. 166. In last line of reply for "bore" read "box."—Glatton.

[48072.]—**Induction Coil: Edison Lamp.**—Your coil ought to give you a good ¼in. spark; but I must know some little more of its construction before I can tell you where the fault is. The insulation, I am afraid, is not perfect. This must be as near perfection as it is possible for you to make it. Every layer of secondary should be tested as you are winding; then the chances of making a good coil are all in your favour. You want 12 Bunsens to light a 10-candle lamp. — W. J. Lancaster.

[48096.]—**Photographic.**—You can use your portrait-lens for views by inserting a stop ¼in. diameter; or you can use the front lens only, removing altogether the back lens; then put front lens into the back, and use a ⅜in. diaphragm. This will give you a very good view on twice the size of plate covered by portrait combination.—W. J. Lancaster.

[48098.]—**South-Eastern Engines.**—I beg to thank "E. W." for reply to above query. Could he not also give us the dimensions of bogie tank-engines 303 to 312, 5, 27, 177, 178, 182, and 162 class. Not the old ones, 149, 151, &c.; I have dimensions of those. The only bogie express engines I have any recollection of seeing are Nos. 19, 36, 67, 159, 165; also, if I remember rightly, 175 and 176. They are very like the G. and S. W. bogies in many respects. The latter have a shorter base of bogie and perforated splashers. I saw a letter some time since by "Clyde," asking further dimensions of the 7ft. singles. I believe I have weights, &c., of this class, but at present I do not know where they are, but will send in a week or two.—Carstairs.

[48112.]—**Photography.**—You must tone and fix, if you want to keep the prints, even for a few hours; and you can do this either in separate solutions or in one solution. The simplest way is to tone in a rapid bath, and fix for five minutes in a strong hypo. There are several formulæ in which gold forms no part; but I do not know of one of any real value. You can make up a stock solution of gold, say 7½grm. of gold in 2oz. of distilled water. Label this A. Then in another bottle holding 8oz. dissolve 2½drm. of phosphate of soda. Then, when wanted for use, make up as much as will be required, say 4oz., the quantities being gold solution 1drm., soda solution ¼oz., water 3½oz. This solution will tone very quickly indeed; but, of course, will not keep when made up; but in the above form it is the easiest toning solution I know of.—W. J. Lancaster.

[48114.]—**Magic-lantern.**—Obtain some of the very best vegetable black, and the best thin French-polish; mix them in a tin can with a tightly-fitting lid, and mix so that the liquid will flow easily. This will make one of the best black paints you can have. Keep the lid on when not in use, and when too thick add more polish.—W. J. Lancaster.

[48115.]—**Photo Lens.**—Supposing the two lenses to be of same foci, then the wide-angle lens will cover a larger plate than the ordinary lens at the same distance from the object. Thus I make two lenses, 5½in. focus, both of the same size, one an ordinary lens—this covers a ¼-plate; and the other a wide-angle lens—and this covers a ½-plate; so that you will at once understand the advantages of a wide-angle lens in confined situations. You want to photograph a church, and you cannot go sufficiently far away to enable you to get it on the plate with an ordinary lens: you then substitute a wide-angle lens, and you get the whole of the church on the plate.—W. J. Lancaster.

[48129.]—**Steam Boilers.**—"Boswell" wishes a fuller explanation, so that he may be able to advise. I may state the boilers are common, externally fired, egg-end boilers, working pressure 40lb. per sq. in. It is pure moss water, gathered in a loch in the midst of a moor, and conveyed 2½ miles in cast-iron pipes to where used; it is then pumped out of a pond beside each pit (which ponds are thoroughly clean); it is in no way heated before being put into boiler, so that no grease is in the water, and the boilers at each pit are properly cleaned out once every month. There is no scale, only a little roughness and some sludge, with the result as before stated—at the one pit the boilers are very much corroded, and at the other they are left untouched.—Steam User.

[48132.]—**Bacteria in Beer.**—Mr. W. A. Thoms, in replying to this query, says, "Where the brewer carries attenuation too far there is not enough food for the (yeast) cells to reproduce by this form of free cell formation, and the protoplasm, instead of developing into healthy spores, is disaggregated, and escapes from the sac as bacteria." Now, I should like to ask Mr. Thoms if he has ever seen such a phenomenon take place? My experience, as well as the experience of every other person who has really worked at this subject, points to a contrary conclusion. It is now well known that a bacterium always remains a bacterium, a vibrio a vibrio, and a torula a torula. I most emphatically deny that bacteria are ever developed from either "the components of the starved and disaggregated protoplasm of the yeast cells," or that "they have their origin in the non-coagulated albuminoids." I am sure, if Mr. Thoms had been conversant with the researches of the last few years on the lowest forms of life, he could not possibly have made such blunders.—John Heron.

[48135.]—**Indicators for Electric Bells.**—There is this difficulty in making a series of indicators by an amateur, that unless all the points were mastered before commencing the job, I am much afraid it would prove a failure. However, apart from the making, are you prepared to lay insulated wires all through the house, stripping paper and plaster, and lifting parts of floors, &c., for wires to pass? If you are prepared to do this, and will say so, I shall be pleased to give you drawings of indicator, and instructions how to make them.—W. J. Lancaster.

[48158.]—**Short Sight.**—Don't trust to what all your friends tell you: rather ask one who you believe knows all about it: take his advice. I know people who have a lot of friends, and one will say one thing, another will say another, and the poor fellows would, if they followed everybody's advice, soon go to grief. Now, if you will allow me to be one of your friends, I will advise you to wear the glasses when writing or reading, and not to wear them out of doors, if (now, mind this if) you can recognise anyone on the other side of the road, or can see a cricket-ball as it goes through the air. On the other hand, if you cannot recognise any one, or see a cricket-ball, wear them, or, at any rate, wear some a little weaker. If you have time on your hands at night, borrow or buy a telescope, and use it as much as you can; your sight will then improve as years roll by. I am, of course, assuming that you have concaves of the right focus. Don't keep them in your pocket because you are afraid of the criticisms of your friends; wear them out—both the glasses and the criticisms of your friends if they annoy you.—W. J. Lancaster.

[48159.] — **A Water Question.** — From what you state I think you have made your junction with lead pipe upon the old ¾in. outlet at B, the outlet being flat, or hole with a sharp edge, instead of with a trumpet-mouth: the consequence is, that when the draught is rapid at A and D, the air is drawn in in the vortex at B. The consequence is, the air accumulates in the inch pipe and rises near the tank B. The shoulder in junction, the while the water is running, prevents the exit of air, and therefore it retards the flow of water as well, except at D. Take a small air-pipe out at elbow (shown at B) on lead pipe, and that will put you right. Whatever made you put an air-pipe in the lowest portion, I cannot think.—Jack of All Trades.

[48159.]—**A Water Question.**—I should say there is some deposit in your ¾in. pipe which occasionally gets loose, and is driven along pipe till it lodges and stops flow of water; increasing pressure, by filling B, forces it on and out of pipe, which then runs freely till another piece of solid matter is carried into pipe. Supposing this solid matter comes from some sediment in B, increasing diameter of pipe from E to B might increase the mischief, inasmuch as a piece large enough to clog a ¾in. pipe would pass through B E till it stuck in a place where (the pressure being greater) it will be jammed more tightly than it would under the smaller head of water near B, supposing the pipe to be small enough there for the solid body to stick. I should put 1in. pipe down all the way. The air-pipe will not do much good.—Glatton.

[48160.]—**Hood for Camera.**—To Mr. Lancaster.—Any black apron will do to cover back of camera when in use. I have, however, dispensed with hood altogether. I make a focusser to go into a small pocket, consisting of two lenses fitted into a tube, having a thread on it; this thread fits into another tube, which is held against the ground glass; thus, by holding the focusser against ground glass, and putting the eye against focusser, there is no need for a hood, as the interior of space of ground glass covered by focusser is quite dark, and the image is seen not only clearly but much magnified. I shall be pleased to send you a sketch and description of one.—W. J. Lancaster.

[48190.]—**Boiler.**—"Leakage," on p. 123, says "Egg-end boiler," and on p. 167 refers to flanges (?) There are no flanges about ends of an egg-end boiler, as the end-plates are bent to the exact same radius as the shell-plates. Fractures at overlaps are due to several causes; but principally three—viz., 1, Low quality of material punched by a bad punch die; 2, overheating, owing to excessive thickness of material between fire and water; and 3, to the expansion and contraction of the plates surrounded by the fractured overlaps. The constant heat of the plate causes it to become somewhat granular, and easily fractured or broken, and in this case the fractures found first may be due to any of the above causes; but the fracture in the patch-plate can only be due to the second cause, namely, overheating; as the patch appears to have been applied without removing the defective parts, and so placing two thicknesses of plate (for 2ft. by 8in.) with fire on one side and water on the other, and at the original seam there will be three thicknesses in the fire: the heat may be more excessive than "Leakage" is aware of, as he can only see the fire with the door opened. The fire should be about 1ft. 8in. to 2ft. from boiler bottom. To repair, cut away the defective parts, and apply patch plate, with seam end of plate looking upwards on the outside, and downwards on the water side. This class of boiler is known as camber-ended boiler, and like the egg-end boiler, is very subject to fracture at and near the overlaps, which are not considered serious unless they extend beyond rivet into solid plate, in which case it is best to drill a hole in end of fracture, and put in a rivet: this prevents the fracture extending. When fractures are in a longitudinal direction they are serious, and should be repaired at once; and in repairing, be sure to cut out all the fractures, and do not try to save material when repairing, and try to keep as many seams as possible away from the fire.—Boswell.

[48196.]—**Teeth of Mortise Wheel.**—Although at first sight "A Would-be Millwright's" question appears very simple, yet it would take a great deal of writing to fully explain. In shops where there is a circular or band-saw, and a cog-cutter, cog-making is a very simple job; but where it has all to be done by the hand-saw and paring chisel, it is a different matter altogether, and often the last is the only available method. Suppose, first, that you have a new spur-wheel, say, 3ft. 4in. diam., 1¼in. pitch, 80 teeth or mortises, depth of tooth, 1½in.; breadth of face, 4in.; depth of mortises or thickness of felloe, 1¾in., which you are to cog in the workshop. Commence operations by getting the wheel keyed up true, and then give the inside of mortises a rub out with an old file. Now take a piece of hard wood board ¼in. thick, and make a mould for cog. Fit it carefully to the taper of mortise, and see that the shoulders come fair down. Let it come 1¼in. through the felloe, and leave it ¼in. or so longer above the shoulder than the depth of tooth, also about ¼in. broader. This is for turning upon. When finished, it will resemble Fig. 1. Next take another piece of board, and make a mould for thickness of cog, letting it come same distance through the felloe as the other, but flush with the top, and on to the edge of this tack a slip of wood same length, and about 1in. broad, making it like a pice of T iron (Fig. 2). Now comes the question: are the cogs to be wedged or pinned? Taking the first method, another mould will be required for cutting the wedge-grips. For this, get a piece of wood 8in. long by 2in. thick, and make it 1-16in. narrower than the depth of mortise. Cut out a piece half-way down, so that the cog will just go in quite easy; the dotted lines in Fig. 3, representing the cog when in mould to be cut. These are all the moulds required, and the other tools will be planes, a good tenon or fine-toothed hand-saw, a broad paring chisel, spring dividers, and a heavy cogging hammer. Now saw off your wood for the cogs (beech being most commonly used) into strips the breadth of first mould, i.e., 4½in., and about 1¼in. or 1½in. thick, and give them a face up (on one side only), cut it up into lengths of 10in., each cut making two cogs, as they are easiest managed in pairs. Place the mould (Fig. 1) on face side, and draw round with a pencil; then grip in vice, and cut out corners, leaving the cogs as in Fig. 4, taking care to cut square. Now take mould (Fig. 2) and apply it to the edges of cog, and draw round; then cut off piece as before, which leaves your cog as in Fig. 5. Great care must here be taken to keep exactly to the mark, as the best-fitting cogs are those which require least paring. And now for the wedge grips. Take mould (Fig. 3) and place cog in it as shown, taking care to keep shoulder hard up to edge of mould. Hold the cog firmly down with your left hand, and saw a draught about ¼in. deep across cog, keeping the saw as near the mould as it will work; then turn over and do the same with other side, after which turn end for end, and treat the other cog in same manner. Take paring chisel and cut out corners, leaving it dovetailed, as in Fig. 6. Then pare corners off end, cut in two, and your cogs are ready for fitting into wheel. I must now stop, as I fear that I have already occupied too much space; but if the Editor thinks he can spare an odd corner, I would very gladly describe, as far as I am able, the method of pitching and paring out the cogs. Next week many of the readers of the "E. M." (and more especially those who are accustomed to see cogs rattled off by machinery) will think, from my prosy description, that this is a very roundabout way of doing the job, but when once started, it is wonderful what a number can be turned out.—Mack.

FIG. 1.

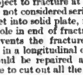


FIG. 2.

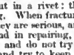


FIG. 3.

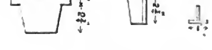


FIG. 4.

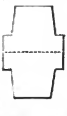


FIG. 5.

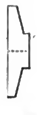
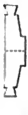


FIG. 6.



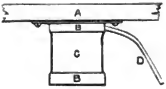
[48197.]—**L. and N.W. Engines.**—No. 518 is a 5ft. four-coupled outside-cylinder passenger side-tank, built at Crewe about 1850, stationed at St. Helens, and I think the cylinders are 15in. by 20in.; 819, named "Puck," is a four-coupled passenger engine, and I am almost certain it is the same as "Constance," 817; if so, it would be a 6ft. four-coupled inside cylinder passenger engine, cylinders, 16in. by 20in., and weight 26 tons 2cwt.; 1148, named "Boadicea," is a 5ft. 6in. four-coupled inside cylinder express engine, designed by Mr. Webbe, cylinders 17in. by 24in.; weight 31 tons 8cwt., and is stationed at Crewe; if not, it is stationed at Bangor; 981, named "Councillor," is a four-coupled express engine; it is either the same as "Boadicea," or else the same as "Clarendon," "Dagmar," &c.; 1121 and 2200 are 4ft. 3in. six-coupled goods engines, cylinders 17in. by 24in.; weight 29 tons 11cwt., and designed by Mr. Webbe; I think 2200 is stationed at Willesden, and 1121 is stationed at a town further north than Crewe; 1437 is a four-wheeled four-coupled shunting-engine; the same as 385, 387, &c., cylinders, 14in. by 20in., and designed by Mr. Ramsbottom; this engine very likely belongs to Crewe, as I have never heard of an engine of this class stationed anywhere else; 1798 is a six-coupled goods engine, stationed at Holyhead, cylinders, 17in. by 24in.; weight, 27 tons. I have heard that No. 8 is a four-coupled outside cylinder passenger tank, the same as Nos. 3, 5, 161, &c.—Prometheus.

[48205.]—**Tricycles.**—I strongly advise "Dick" to purchase a front-steering double-driver if he requires a practical machine fit for work; and with regard to size, he cannot do better than have 46in. wheels, geared down to about 40in. or 41in. I speak from experience, riding almost daily, for business purposes, such a machine as described, only my wheels are 48in. running as 43in., my weight being 12st. 1lb., and being 5ft. 10in. in height. By all means have ball bearings. The difference they effect in the running must be felt to be understood, and this is one of the least of their advantages, the wear being almost nil, while they do not require a quarter of the lubrication of plain or cone. I am in the habit of travelling on all sorts of country roads, at all hours, and I would not ride a single-driver or back-steerer, and, as a practical man, I say this, not from prejudice, but as the result of a good deal of experience. I may add that I have ridden my present machine close upon 3,000 miles since the beginning of last spring.—T. J. Scutt.

[48209.]—**Regulating Boston Lever Watch.**—If your regulator is at the far end for slow, see if your hair-spring is between the pins of the regulator; see also if your pins are not too wide apart, so that they do not come in contact with the hair-spring. If so, make them closer, so that when you move regulator either way, it will affect the hair-spring. If all right on that point, take out your pin of hair-spring, take out the balance, and twist round the collet on the staff that your hair-spring is pinned to a little, so as to press the length of your hair-spring a little. With a little practice you will succeed. See that it is on beat and free.—James Taylor.

[48211.]—**Fret-Saw.**—"Fides" does not say whose make machine he has. I have a "Lester," to which I affixed a table; on the under side of table I suspended a circular bellows, about 3in. diameter. This I work by a connecting-rod from treadle going up to a beam suspended on a stud from lower part of table. Bottom of bellows is fixed to opposite end of beam, and rises and falls with motion of treadle. The air is conveyed in ¼in. flexible tube along underneath the top arm of machine, and delivered just behind the saw by a metal tube. It answers admirably, and adds so much to the comfort of working.—H. C. B.

[48211.]—**Fret-Saw.**—I have one of the cheap treadle machines, with a blower, which perhaps would suit "Fides," as it is very simple and easily made. A is the upper bar to which the saw is fixed; B B are two discs of wood, the lower one is weighted with lead, and the upper one is screwed to a piece of tin or iron, which is screwed to the wooden bar A; C is a strip of thin leather glued round the discs B B, so as to form a cylinder; D is a piece of bent tube, communicating with the interior of the cylinder.—Hemisus.



[48225.]—**Rust from Gun-barrels.**—Use a ramrod with a scratch-brush at the end of it. You can get one at any gunmaker's; it will also remove lead from grooves of rifle, if required.—D. D., Lancashire.

[48226.]—**Truss.**—Seeing "T. M." has the kindness to try to answer my question, I shall describe more fully. It is a spring-fitting truss from hip to hip, and fits well. I never allow it to protrude before I put it on, and I would wear it regularly, but the spring in the hoop is so strong I tire of it in a day or two. My work is quite light, and I can do without it except any time I go to do anything to cause a strain on myself. It is never larger than my thumb, and in walking up a bank, if I place my hand in my pocket against it, I feel less than half the pressure of the truss keeps it in its place. Now, I want to know how to weaken the spring myself, as it is a thing a person feels rather private about. I don't care to take it to anyone.—Truss.

[48235.]—**Carbonic Acid.**—The sp. gr. of liquid CO_2 is as follows:—

Temp.		sp. gr.
− 10° C	……	·9951
0° C	……	·9470
+ 20° C	……	·8266

—Caius.

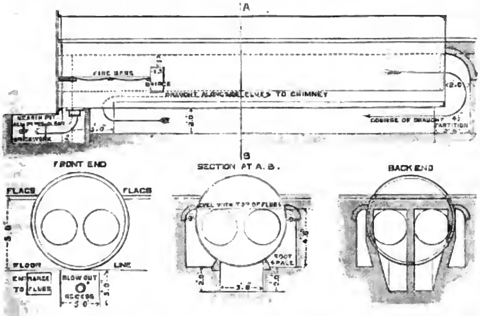
[48239.] — **Fret-Saw.** — The sewing-machine table would answer capitally for a fret-sawing machine. If "Nil Desperandum" will purchase a little book by Williams on "Fret-Sawing," published by Messrs. Churchill and Co., of Cross-st., Finsbury, he will find a full description how to make a home-made treadle-machine, and also some excellent hints on woods, work, and instruction for using the machine. If "N. D." intends going in for fretwork in the winter evenings, I do not think he would regret his outlay for this little book.—H. C. B.

[48242.]—**Fishing-rod and Tackle.**—I always black-varnish my rods with Brunswick black; it is very durable. No better work on making flies than "The Fly-Fisher's Entomology," by Alfred Ronalds. It is a somewhat expensive book; 14s., I think I gave for mine, but it is all you will require.—D. D., Lancashire.

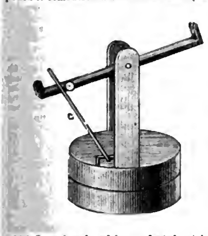
[48247.]—**Model Ship.**—The planking of real cutters is not overlapped, but placed edge to edge, and caulked. If your model is intended for sailing, I should recommend you to make the outside surface as smooth as possible, and polish it when finished. Have no bulwarks, but keep the deck free to allow the water to wash over it.—H. C.

[48249.]—**Fly-wheel.**—R. Moore must not alter his rods, but turn the eccentric round on crank-shaft. If the engine is of an old date, it will have sheave fastened to crank-shaft by a small screw, which slacken, then turn eccentric round till exactly reverse of crank as it stands, as near as can be judged. Then take off steam-chest cover and set valve exactly, taking care to have boiler hot if possible, as, if not, almost ¼ would have to be allowed for expansion; then tighten up screw securely. It may be as well, having once got right adjustment, to make a cut on crank, for saving trouble at future alteration. If the engine be comparatively modern, the eccentric would be held by a bolt screwing into a disc, keyed close alongside on shaft; this disc would be provided with two holes, one for fore and one for aft motion, in which case mode of procedure is obvious.—T. J. Scutt.

[48219.]—**Boiler-Setting.**—The best way of setting such a boiler will be as shown in sketch, on two side-seating walls, the boiler resting on fireclay blocks, with about 4in. bearing surface. The front cross-wall 9in. thick, set back about 4in. from front end, leaving rivets in front end shell ring clear. Be sure to set it on dry, well-drained ground; and where my dimensions cannot be practically followed, be sure to make all flues large enough for a man to pass through for cleaning, inspecting, &c. If the feed-water is fairly clean, let the draught pass from the tubes (iron flues) to bottom flue, and along the side flues last; but if the water contains a great amount of sediment, let the draught pass along the bottom last. In building the walls use fireclay if possible. "Firer" does not say what amount of work is required, so that I cannot give grate-area beyond stating that if the boiler is working to its full capacity without pressing or urging, about 33 square feet of fire-grate will give good surface, and this may be slightly varied according to the quality of coal used. If the flues are of the usual size for this size of boiler he will require fire bars 6ft. long, or two lengths 3ft. long, about 1in. thick, and ½in. windage. The back end of boiler should be 1½ higher than front; width of bottom flue equal to radius of boiler, and crown of side flues equal in height to crown of flues in boiler. Suitable shaped blocks for seatings and crowns of flues can be had at all firebrick yards. See sketch for dimensions and form of flues.—Boswell.



[48251.]—**Astronomical.**—As I have just mounted a 3¼in. as a simple equatorial, somewhat in the manner your correspondent, "A Young Astronomer," proposes, my experience may be of some use to him. This telescope has been hitherto mounted on a garden tripod stand, with sliding steadying rod; but as I found observation with it difficult, owing to the double motion required to follow a star, I determined to mount it equatorially when an opportunity occurred. I happened to come across a stand second hand (see Fig.), which I purchased and have adapted. A is a circular disc 10in. in diameter, 3in. thick. From the centre of this rises a little pillar about 2¼in. high and 2in. diameter. This fits into a circular cavity in B, a similar disc, so that B can slide round on A. I fixed my steadying-rod C in position, and at once had a very firm and steady altazimuth. To convert this into an equatorial, I bought a piece of a tree-trunk, 6ft. long and 10 or 12in. in diameter, for six shillings. This I fixed to the depth of 2ft. in the ground in my garden. The top was horizontal, and had to be cut parallel to the Earth's equator. First I determined the north approximately by observing the Pole-star with the naked eye, and drew a line north and south across the top of my post; then by means of compasses and scale I drew on a thin board a triangle, one of whose angles was 39° (our latitude being 51°) and used this to determine the angle at which the top of this post must slope. I borrowed a double-handled saw from the timber-merchant, and I and my coachman cut off the top of the post, so that its upper surface is now a plane sloping to the horizon at an angle of 39°, and a horizontal line drawn on it is approximately east and west, thus a normal to it points approximately to the Pole. Next I got three screws 6in. long, with square heads, and with them screwed down disc A to the top of my post, and by means of wedges between the disc and the top of the post I can, by loosening one or more of the screws, get the stand into true adjustment. I have now only to carry out the telescope screwed on to the upper part of the stand, which is fixed to disc B. Put it on A, and it is ready for use. Last night the clouds cleared away sufficiently to allow me to test it for the first time, and I found that I was able to keep Jupiter pretty well in the centre of the field for about 15 minutes (after which clouds obscured him) by one movement, the steadying-rod being clamped. I should advise "A Young Astronomer" to cut his post in the manner described above, then obtain a circular sheet of iron sufficiently large to allow the claw feet of his stand to be screwed to it, and also to drill three other holes through it equidistant from each other, and pass screws about two or three inches long through these, and having put nuts on them on the underside of the plate he will be able to screw the iron plate on to the post, and with a little trouble by means of the screws, get the plate accurately parallel to the Equator. To do this, let him get a star near the Equator into the centre of his field, clamp his steadying-rod, and so alter the screws that the star remains in the centre of the field as the telescope is turned round; then do the same with a higher power. Having once got his plate in proper position, he can screw on his pillar-and-claw stand when wanted for observation.—T. P., Shaftesbury.



[48254.]—**Tricycles.**—The "Convertible Coventry" runs even better in its single form than as a double, it being, to all intents and purposes, the same as the old side-driving pattern. The leg-rests are slightly higher than in the "Salvo," or other machine of that class.—T. J. Scutt.

[48262.]—**Electro-Plating Solution.**—Your best way is to throw the whole down with plenty of common salt. Pour off the supernatant solution, and add water to the precipitate several times to cleanse it; then dry well, and add to it twice its weight of dry carbonate of potash and fuse in a crucible in a blacksmith's fire.—D. D., Lancashire.

[48264.]—**Dreaming and Unsound Sleep.**—Did you ever try moving your bed? And if you are now lying north and south try lying south and north. Try all the different points of the compass, and the chances are you will eventually find one agreeing with your own personal electricity, and thereby obtain restful nights.—D. D., Lancashire.

[48267.]—**Contact Series.**—The following series is given by Techner (as quoted in Wiedemann's "Galvanismus," p. 59), for solution of common salt:—Zinc, lead, tin, iron, antimony, bismuth, copper, silver, gold, platinum. I do not know of any experiments with acetic acid. I should not, however, call this a "contact series," the contact theory being a fallacy. "Electromotive series" is better.—J. Brown, Belfast.

[48268.]—**Potash.**—(1) The best way to find the percentage of CO_2 in a solution of caustic potash, is to place 100 parts of the solution in flask provided with an acid funnel and gas-delivery tube, and connected thereby to a wash-bottle containing sulphuric acid (conc.). This is then all weighed, and a weighed quantity of dilute hydrochloric acid is then added gradually. Any CO_2 present escapes through the wash-bottle, leaving all moisture behind. A stream of air is then drawn through to extract all traces of CO_2. The whole is then weighed again, and the loss in weight is the weight of CO_2 escaped. (2) Sulphates may be removed by adding a solution of Ba, when $BaSo_4$ will be precipitated. (3) K_2CO_3 is certainly the correct formula for carbonate of potash, and I think "Mon." will see what becomes of the H from the following equation:—$2\,KHO + CO_2 = K_2CO_3 + H_2O$. (4) When CO_2 is passed into a solution of KHO it is absorbed, forming K_2CO_3 as shown above; but if an excess of CO_2 is passed in, then $KHCO_3$ is deposited in crystals, as it is less soluble than K_2CO_3, thus:—$K_2CO_3 + H_2O + CO_2 = 2KHCO_3$.—Caius.

[48271.]—**Boiler.**—Has C. Weir got the exhaust from his engine turned up the chimney? If so, I should contract the nozzle, and bring the discharge as close above tubes as possible. If this is not practicable he had better write to Brown and May, Devizes, who would fit him on, at a small expense, one of their patent steam-blast tube cleaners. This, although not always effective on long portable tubes, would thoroughly clean his vertical ones, provided his smoke-box door and connections are air-tight.—T. J. Scutt.

[48271.]—**Boiler.**—To C. Weir.—I should judge from what you say in your question about the stoppage of tubes in your vertical boiler, that it is owing to the lack of a good and clean draught. I have myself experienced the same inconvenience with vertical boilers, but have never found it to be the case with horizontal tubular boilers. I should recommend you to try a better draught by lengthening your chimney, and burning anthracite coal. This, I think, will remedy the choking of the tubes, which is caused by unconsumed gas (soot) which a good draught will utilise.—Stingo.

[48274.]—**Watchmaking.**—To "E. H. E."—You can get hairspring collets any size drilled; they often require broaching out for spring; use an ordinary pivot-broach, and work it in the same way you put the spring in; this will make a taper pinhole. To clean parts of watchwork from grease, use essence of Lemoine; you can get it at tool-shops connected with the trade.—G. Sumner.

[48274.]—**Watchmaking.**—Open holes in hairspring collet with a fine broach until you can get hairspring end in easily, then pin up. I should not advise you to put plates in any liquid without it be spirits of wine. If they have got oil on get it off with a bit of chamois leather, then clean with chalk and brush. Don't try to put in escape-wheel without you have proper tools.—Hamlet.

[48274.]—**Watchmaking.**—The hairspring-hole in the collet can easily be made larger by broaching it out. You can do it in no other way after the hole has been drilled and found too small to admit the spring. Various essences are sold for the purposes of watch-cleaning; one is called "Essence of Lemoine." Rectified benzine is quite as useful, perhaps more so when the watch is a very greasy one. I do not think you will succeed in fitting a new escape-wheel to a Geneva watch. It is too delicate a wheel for an amateur to have anything to do with in the way of repairing.—Alfojoe.

[48275.]—**Gout.**—Though this question is addressed to Dr. Edmunds, I may, perhaps, venture to reply to it from the fact that, in my own person I am, as to age and the possession of hereditary gout, in the same position as your correspondent, and have for some years most successfully overcome the enemy. I don't know what position of life "Podagra" is in, so, possibly, some of my advice may be out of place, but he can take as much of it as suits him. Let him avoid pastry and rich food, eat plenty of green vegetables, not potatoes, and he should do with as little sugar as possible. For drink, light claret and water, and if he requires more, weak gin and water, or whisky, or pure brandy (not British). He should wear flannel under-garments, and sleep in flannel. He should take as much exercise as he can; but if he cannot do this, Turkish baths once or twice a week will be a substitute. For medicine he should take occasionally for, say, three weeks at a time, some citrate of lithia, 6 grains, in half a tumbler of water or soda-water, twice a day, three-quarters of an hour before breakfast and dinner. He should take this whenever he feels any gouty symptoms approaching, and also at the commencement of warm weather. If gouty pain in the stomach comes on at any time, a little warm weak brandy-and-water should be taken, and the feet put into hot water.—F.R.C.S.

[48277.]—**Platinum and Copper Alloy.**—The alloy referred to by R. Parker is one which cannot be made in a brass furnace, and can only be produced with difficulty in a good forge or blast furnace. It fuses only at an intense white heat, far beyond the melting point of steel, and is practically unmanageable in a small crucible, owing to the difficulty of pouring it into an ingot before it cools sufficiently to set. I believe the practical difficulty of its manipulation, and its cost as compared with inferior gold alloys, have prevented its ever coming into commercial use. It is, of course, possible to make a ring of an alloy of 2 parts platinum and one part copper; but it is a very doubtful question whether the result would be worth the trouble, and whether it would be any better for the purpose than the alloy of aluminium and copper, known as aluminium gold.—Thos. Fletcher, Museum-street, Warrington.

[48280.]—**Steam Crane.**—If you must use steam, you can have steam unions made same pattern as the couplings on fire-engine hose-pipe. You can also buy flexible hose to stand 30lb. steam pres. But if you have a shaft in the place, why not drive the crane with a rope, and then you can travel the whole length of room easily?—Labor Omnia Vincit.

[48291.]—**Softening Steel.**—Make the steel red-hot, then put it in a heap of dry sawdust till cold, when it will be found to be quite soft.—T. S. H.

[48291.]—**Softening Steel.**—Place a quantity of newly-burnt lime in a damp place, where it will fall in the form of flour; put it in an iron box. Heat the articles to dull red, clean off all scale, and put in lime, and completely cover with lime; cover box over with iron lid, and leave until cold. The more lime and larger the box the better. Keep airtight if possible.—Boswell.

[48290.] — **Daytime Observations, &c.** — Though addressed to Mr. Pearson, my experience may be useful to "Tyro." Some months ago I drew a circle on stout paper, finding the radius by supposing the degrees to be equal to quarter inches on the circumference. Now, 360 of these equal 90in., and this divided by 3·14159 and then by 2 gives the radius. This radius length applied as a straight line to any part of the circumference, so that each end may just touch it, will mark off a sixth part containing 60° (degrees). This can be bisected into 30°, then into 15°, add ¼in. to this length to make it equal 16°, which can be successively bisected until you reach single degrees. Shortly after I was about to buy of Mr. Stanley, who advertises (page iv.) in this journal, a 12in. engine-divided card for 2s. 6d. (and this would be the best thing for you to do, as it will guide you to draw the lines on a circle of sheet-brass or zinc), but I happened to pick up second-hand a pair of 12in. globes, with mounted brass meridian circles divided into degrees. I shall be pleased to help you further; and as regards verniers, if no one else replies, I will write again and tell you how to manage it.—J. C. L.

[48294.] — **Concrete Floors on Upper Stories.**—I send two drawings of concrete floors. Wood joists are used in dwelling-houses. They are the same distance apart as when used for ordinary purposes. A small fillet of wood is nailed to the joists, as shown, A, Fig. 1, upon which rough boards are nailed, and the concrete laid on these. The concrete should be about 2in. thick, and if wished, you can pave over this with Minton and Hollins', or other tiles. Fig. 2 shows how concrete floors in warehouses are generally built. The iron girders are built into the wall at either end, not more than 10ft. apart, and the brick arches built from one to another. The camber of these arches is 1in. rise to every foot of the span. Thus the arch between two girders that are 6ft. apart should have a camber or rise of 6in. After all is built, the space between the arch and girders is filled up level with concrete, as shown. This just gives the outline of construction. Before building, I should advise you to consult a handbook on the strength, &c., of girders. Most firms who make girders publish such books.—Grapho.

FIG. 1.

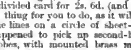
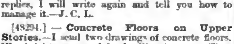


FIG. 2.



[48294.]—**Concrete Floors on Upper Stories.**—The wood joists ought to be placed 12in. apart, and if the floors are large they can be supported underneath by iron or wood beams placed across. Begin by nailing strong runs 3in. down from top of joists, use up any wood not less than ¾in. thick, put small naped bricks or stones on top of boards, and fill up to top of joists with blinding, gauged four parts of gravel to one part of cement; beat well down. Now mix up a little cement, two parts gravel for dots and screeds; lay down a little cement at convenient distance, and put a small bit of slate on the top; this makes a better bearing than the soft cement. Now fill in, in line with the dots, a screed about 4in. broad, and place on the top of screed a rod dressed on the one side 1in. broad, and press down to the level of dots. I ought to have said to level the dots, as it saves the time and trouble of levelling the screeds and makes true work. If the floor is not a large one, say about 20 or 30 square yards, mix up enough to fill in whole, two parts gravel to one of cement. When it is all down and firm enough, lay down a board so as to do as little damage as possible, and lift out the rods, and fill up the space left. Place a board for the knees and toes of the workmen, and finish out by hand floating, but without water, and polish up fine with trowel. On no account use dryers or water, and if ground granite is to be had; use it instead of gravel for the finishing coat, as it gets as hard as the granite block. I am almost safe in saying that it is everlasting; 2in. will be sufficient thickness on top of joists.—Auld Reekie.

[48296.]—**Photography.**—"Tyro" could take photographs of a sunset cloud effect with a single landscape-lens, well stopped down, and a by-no-means "instantaneous" exposure. As the subject would be a still one, he would use his smallest stop, and give full exposure; but the "cascades," I fear, he will find not so easy. One or other form of the rapid doublets would be necessary. As to shutters, much has been written, and many forms have been suggested and tried; but it seems that very few inventors are working out the principle proposed by Mr. Alexander Cowan at a meeting of the South London Photographic Society in 1880. Undoubtedly he is correct in saying that the great point to secure is that the full power of the lens shall be at work during the whole exposure, and this is not the case in any of our present shutters working before or behind the lens. Mr. Cowan leaves the lens uncovered, and works his shutter directly in front of the sensitive plate. I am now making a shutter: a spring roller-blind with a slit in it, which travels very rapidly across the plate, the lens being uncapped all the time: and I am sure that the principle is correct.—Shutter.

[48297.]—**Ebonised Pianos.**—With the exception of American work, which is japanned, all ebonised wood is polished with white or clear polish. This never seems to set as hard as the polish made from common shellac, and is always liable to sweat and become sticky or dull. The only lasting remedy is to wait until the polish has become thoroughly hard and dry, and then to clean it with a rag just moistened with methylated spirit (not "finish.") It may be brightened with very thin benzoin polish and the slightest suspicion of raw linseed oil; but the latter process requires great care, for though the benzoin gets exceedingly hard, it takes time in doing so; therefore, it would be as well not to venture rubbing in circles or figures of 8, but rather in straight lines, until the rubber leaves no marks when drawn across the work.—W. H. Davies.

[48298.]—**Cleansing Oil Vessel.**—Put some benzoline in, and shake well; or try hot solution of washing soda.—Nux. Dor.

[48298.]—**How to Cleanse an Oil-Vessel.**—Take a handful of common quicklime, such as bricklayers use, and a handful of common washing soda; boil them in a large kitchen iron saucepan (which will only be cleaned, not damaged, by the process). When cold, the fluid will be soap lye; put this into the vessel you want to clean with some small pebbles or shot; make it warm if you can, and shake up or let it soak according to the nature of said vessel; of course, a large cistern will require more stuff. This is a cheap process, and won't hurt your cistern.—Jonah.

[48300.]—**Geneva Watch.**—The set-square passes through centre pinion and cannon pinion. Give it a tap on the end that large hand fits on with a small hammer; this will generally move it. To let down lever watch, put on sliding tongs, and remove click.—G. Sumner.

[48300.]—**Geneva Watch.**—First put in three screws, see that the pivots are in the holes, then turn the watch upside down; take it in your left-hand, then with a small watch-hammer gently tap the opposite end to the square, and it will come out easily. To let lever down for cleaning, take off dial, put key on winding-square, and hold it there till you take out those two screws and false plate under the dial, and then take out the third wheel, and let the watch down carefully; then take off ratchet; take it to pieces and clean it.—Hamlet.

[48300.]—**Geneva Watch.**—Ordinarily the set-square of the watch passes through the hollow pinion of the centre wheel from the back, and is fixed there solely by friction; the cannon pinion is held on the other end by friction also. To remove the set-square and cannon-pinion from the wheel, place an old loose-fitting watchkey-pipe in the bench-vice, and let the movement rest upon it with the square inside the pipe, then lightly tap the point which protrudes from the pinion; this will loosen the set-square and stem, and the cannon-pinion at the same time; both are then easily removed. Occasionally, in old Genevas, the cannon-pinions and stems are made in one piece; the square being attached by a small pin passing through it and the stem, both being drilled. Lever-watches are best let down by giving a half-turn to the click-screw; then, with a small screwdriver or pin-push, held firmly in the mouth and the click-wheel held securely in the jaws of the cutting-nippers, alternately let it run a few teeth, press the click back into the wheel, take a fresh hold with the nippers, and so on, until the spring is right down. This is a safe and easy way to let down the spring, if the watch has stopped with all or much of the chain on the fusee. I have seen it recommended in these pages to unpin the plates on one side, and ease out a wheel, and then let the train of wheels run; but there is altogether too much risk in such a plan, so it should never be adopted.—Alfojoe.

[48301.]—**Consumption of Gas.**—No.—Nux. Dor.

[48304.]—**Battery Power for Swan Lamps.**—I have tried to light 10 candle-power lamps with Bunsens holding 20oz. in outer jar; 30 cells lit two such lamps when freshly charged, but would only light one to full extent the following night. I gave up the idea of using Bunsens on account of the trouble of having to recharge every night, to say nothing of expense, consumption of zinc, and fumes; 30 Daniells will not light one 10 candle-lamp, and the ordinary bichromate cell falls off in power immediately. You will find information for arrangement of cells in answers by Mr. Sutcliffe to a query of mine, the clue to which you will find on page 42 of No. 912 (47683). As soon as I can find time I mean to rig up 50 cells with the carbon in bichromate solution and hydrochloric acid, and the zinc in solution of chloride of zinc, and if of any use to you, shall be delighted to report the result.—S. H. Salt, 96, Regent's Park-road.

[48305.]—**Grand Piano.**—You can buy a new set of drilled wrest-pins of Dawkins, Clerkenwell, for 4s. to 5s., or Mr. Davies (who advertises in this journal) would supply you, and new double strings also. I could advise you more fully, if you care to advertise your address, and lend you a music wire gauge; more particulars are required than would interest the readers of the "E.M."—J. C. L.

[48306.]—**Grand Piano.**—You ought to use the same size wire as near as you can. Most likely the case is not strong enough for thicker wires. Put brass wires as before. Buy a set of pins with holes in them, they will cost you about 3s. 6d. It is impossible to put the wire on without holes in the pins. The wire we have now is too stiff. Buy the thinnest set of pins you can get, and get a bit to open the holes with to receive them. Music-smiths make the pins, but you can get them where you get the wire.—J. H. Schucht.

[48305.]—**Grand Piano.**—Probably the tuning-pins referred to by "Birmingham" have not been bored for the wire. In this case, it requires some knack to make the wire hold. Steel music-wire will not temper, so that the only way to really soften it is to make it red-hot, and let it cool gradually; it will then be like iron wire. About 10in. of wire should be allowed for winding; of this 3in. is turned down and held between the middle finger and palm of the left hand. The free part should then be tightly wound round the pin and over the piece that is turned down, until there is nearly sufficient wire on the pin. The thumb of the left hand then placed on the coil, to prevent it springing back, and the eye hooked on to the hitch-pin. The remaining coil or so may be wound up, using the tuning-key as a handle, the spare piece twisted off, and the pin pressed into its hole, when it may be hammered home. During the whole of this process the wire must never be allowed to slacken; such slack as there may be must be taken up by pulling the wire with one hand, while the note is being tuned to pitch with the other. The sizes of wire should match that of the old strings. The bass should be of brass, with about eight of the lowest notes open covered.—W. H. Davies.

[48308.]—**Soldering.**—This is simple enough; file and scrape the surfaces bright and chemically clean, rub with soldering fluid till it flows well and without appearing to be in contact with grease; use best soft solder, and a clean well-tinned copper bit, with sufficient heat in it, just under a very dull red. A good plan is to "tin" the iron or brass surface first, as the solder does not flow quite so readily as on tin or zinc; but amateurs more often fail through not having the bit hot enough, and well "tinned." You will find replies on soldering in nearly every volume of the "E. M.," and lots of information in Vol. XXXIII.—J. C. L.

[48308.]—**Zinc and Iron Soldering.**—File or clean the iron or brass quite bright and free from grease, &c.; put as much zinc-cuttings into a pennyworth of spirits of salts as will dissolve. Now get a copper-bit, make it hot, file the face, and dip its nose into the "killed" spirits of salts, and touch the face with some fine solder. This will give a tinned appearance to the face of the iron. Now, paint the prepared iron with the "killed" spirits, and apply the soldering-iron with solder to the prepared iron, when it will be tinned. Then place the tinned-iron upon the zinc, and with raw spirits of salts paint the zinc, and apply the copper-bit with solder, and the lot will be soldered or amalgamated together. Use a little "killed" spirit to the iron or brass when soldering the lot together.—P. J. D.

[48309.]—**Boiling Point.**—This question has been recently answered. If the process requires the temperature of 212° Fahr., the vessel containing the boiling water must be so fitted that the temperature can be reached under pressure. If the articles are small, an ordinary Papin's digester would answer the purpose.—Nun. Dor.

[48310.]—**Sal-Prunella.**—This is simply nitrate of potash, or saltpetre fused by heat (about 660°), and run into moulds or balls.—J. C. L.

[48310.]—**Sal-Prunella**—Is simply nitre, i.e., nitrate of potash, fused and cast into bullet moulds. —F.R.G.S.

[48312.]—**Watch-Dial.**—If you first peel the enamel off you will find it solder easily. I should advise you to put feet on dial, or a new dial, as doing it the way you describe only makes a poor job of it.—Hamlet.

[48312.]—**Watch-Dial.**—Unless the dial is bereft of feet sufficiently long to pass through the frame or bottom-plate, and be drilled and pinned, do not attempt to solder them. You cannot solder without either acid or rosin. In one case the acid may create rust upon an important part, or the rosin used may run in, crumble up, and possibly stop the watch by getting into the teeth or pinions. It must also look an ugly job where soldered up. Notwithstanding this, I will tell you how to do it, the risk being your own concern. Notice where the dial sets closest to the plate when placed in position, and remove a small portion of the enamel from the underneath side; apply a little acid, and tin the parts with a thin layer of solder, then wipe away all traces of acid from that. The bottom plate should be marked at the points of contact with the dial just where the solder is put on. Now on the plate melt a little solder also, in the same way (this should be done before the watch is put together) and wipe away all traces of acid. When the watch is put together, a little heat directed by a blowpipe will melt the solder together without the application of any more acid. Proceed gently with the heat, as if too quickly applied the dial may crack. At the same time, don't be too long in doing the job, or the heat may travel into the pivots or other parts. To say the least of such a plan as this, it is a botch.—Alfojoe.

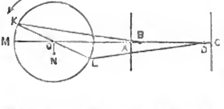
[48313.]—**Heron.**—The natural food of the heron is fish, not worms.—F.R.C.S.

[48315.]—**Pianoforte-Tuning.**—I am not quite clear as to the method employed by "Pianist." E flat is certainly the note where the errors are likely first to be appreciated, but it is, nevertheless, the last note to be tuned; therefore, however discordantly the "wolf" may howl when it is tested with its major intervals, there is no "thenceforward" in the matter, but rather a careful retracing until the error is discovered and corrected. The whole art of laying the scale, or groundwork, consists in dividing an octave into twelve equal parts; but this cannot be done without destroying what a "Pianist" poetically describes as "the beautifully harmonious sound of the chords," though, to a tuner, this would represent a tame smoothness which, even were he not obliged, he would very gladly get rid of. Perfect intervals, though perhaps theoretically correct, are not possible where an arbitrary scale of 12 notes has to be divided; consequently, if it be attempted on a piano, the difference of about six musical vibrations per second will accumulate at the last interval. An equally tempered scale is one where each note is made to bear its share of this deficit. This is effected by tuning each ascending fifth one beat, or half a vibration, flat. For the sake of convenience an inverted fifth (or major fourth below) may be—and in modern tuning invariably is—substituted for alternate fifths above. For a full description of a very simple scale for amateurs, including "proofs" for each interval, see page 571, No. 850.—W. H. Davies.

[48319.]—**Engine Query.**—Procure Mr. Wood's work on the Steam-Engine Indicator, as advertised in "E. M.," and all will be clear. The language and explanations are to be understood by the greatest novice.—J. O. E.

[48319.]—**Engine Query.**—If I have rightly understood your query, I should imagine the fault lay in the connecting-rod, or, if a beam-engine (which you did not say), that the bearings were out of line. I make it a custom, whenever I have occasion, to let connecting-rod brasses altogether, which occurs very often in a month, to preserve the original length of the rod from centre to centre, by cutting a piece of sheet-iron to fit between the flanges of the brass, and of a suitable thickness. To keep taking up wear in these brasses, and putting liners between the gib and collar, would cause the stroke of the piston to be as you say. If your engine is horizontal, your remedy is to put a piece of sheet-iron or brass, ½in. thick, between each brass and connecting-rod end, which will make 1in. each end as you require.—Fred. Walker.

[48319.]—**Engine Query.**—The difficulty referred to has, I daresay, puzzled others besides "One Puzzled"; and it may, therefore, be worth while to explain the matter mathematically. When the slide-valve is in the middle of its stroke, the piston will have nearly completed its stroke at one end of the cylinder, and after a half-revolution, when the valve is again at half-stroke, the piston will have nearly completed its stroke at the other end; but it does not follow that the uncompleted portions of the stroke are equal to each other—in fact, they cannot be equal. We will suppose the valve to be worked by a crank instead of an eccentric, so as to simplify the diagram. Having adjusted the angle between the engine-crank and the valve-crank, so that the steam-port shall be open to the extent of the "lead" when the piston is at each end of the stroke, we will find that this angle, or N O K, is greater than a right-angle, say, 110°; when, therefore, the valve-crank is in the position O N, or vertically downwards, the valve will be at half-stroke, and the engine-crank will be in the position O K (the engine turning in the direction of the arrow), and the angle M O K (call it θ) = 20°; after half a revolution the valve-crank will be vertical upwards, and, again, the valve will be at half-stroke, and the engine-crank will be in the position O L. A and C are the ends of the stroke of piston; K B and L D are the connecting-rods in both positions. Now, according to the querist, A B and D C should be equal to each other, but it will be shown that this is not the case. I have formed an equation between the angle θ and the length of stroke, measuring from A towards C, such as A B or A D, which will enable us to calculate the uncompleted parts of stroke A B and D C. We will call the engine-crank r, and the length of connecting-rod l, call the length of stroke (measuring from A towards C), x. The equation is $x = \sqrt{(l - rz)^2 + 2rz(l - r)} - (l - rz)$. Where $z = 1 - \cos. \theta$ or versine θ. This is true for any value of θ. As an example, suppose $r = 10''$, $l = 30''$, $\theta = 20°$, from the tables we find cos. 20° = ·94; substitute these values in above equation and it will be found that $x = \cdot405'' =$ A B. Again, when K comes round to L, the angle becomes 180 + 20, or 180 − 20, according to which direction we measure. The cosine of this angle is − cos. 20° or = ·94 and z = 1·94; substitute as before and it will be found that $x = 19{\cdot}205$; deduct this value of A D from A C or 20", and we get D C = ·795, which is nearly double of the value found for A B.—M.I.C.E.



[48323.]—**Gold Paint.**—If it is better than Bessemer's it is no doubt real gold-leaf, laid on in usual way.—Nun. Dor.

[48323.]—**Gold Paint.**—"Charlie" has probably failed with his gold paint from having either too little or too much gum in the water he used. If too little, the gold will rub off; if too much, the gold will stick to the burnisher and make his paint streaky. Experience alone will insure success. For a burnisher, some use ironstone, some agate, and others a lion's or dog's tooth. Any gold or bronze powder can be used in this way; but pure gold alone will remain untarnished. "Charlie" is probably aware that silver is seldom or never used, as it tarnishes very quickly; and that the colours should not be applied in thin washes, but in what, I believe, artists call "body tints." For a knowledge of the terms used in heraldry, together with the rules and history of the science, he cannot do better than read "English Heraldry," by Charles Boutell, M.A., in Cassell's "Illustrated Family Paper," beginning in the number for Nov. 10, 1866. Possibly it has been published in a separate form.—G. McIntosh.

[48326.]—**Telescope.**—I should think there is little doubt that the original object-glass has at some time been broken and replaced with a common lens of a much shorter focus. The best plan would be for "A Reader" to unscrew the cell and get it fitted at any optician's with a 1¼in. achromatic lens of about 30in. focus, for which he would probably be charged 4s. or 5s. The eyepiece is of the usual terrestrial kind.—Aldebaran.

[48326.]—**Telescope.**—This is either a very common instrument, or, more probably, a common convex lens has been substituted for the original achromatic one. If you know nothing much about telescopes, one can scarcely advise you; but I should think you would require a new lens in a new cell. I shall be pleased to help you if you care to communicate with me, by advertising your address. I should require a sketch and measurements of parts.—J. C. L.

[48328.]—**To Artists and Others.**—I know a person who paints satin for sale, but never fixes the colours at all. Of course, they could be sized with thin glue size and then varnished, but I do not think it would be any improvement. Any water-colour painting could be done that way. I have often done it myself. For wood painting it must previously be sized with isinglass or gelatine soaked in cold water, and then dissolved in boiling water. The wood ought to be sponged quite evenly with the mixture. Silk requires sizing the same way. Satin can be painted upon without sizing.—C. J. R., Ventnor.

[48330.]—**Timepiece and Watch.**—Very likely the main-spring is not correct to size, not long enough, or too strong. To cure Boston lever, bend guard-pin nearer to roller; you will then very likely have to open banking-pins to free guard-pin of roller edge.—G. Sumner.

[48330.]—**Timepiece and Watch.**—Clean out the timepiece, then try it; perhaps the spring is at fault. You ought to have mentioned what kind of clock it is; then, perhaps, I could have told you better. To alter Boston lever, take out balance and bend the pin (in the lever) near the roller; also see that the two pins in the plate at the opposite end of lever are perfectly straight; if not straight make them so, and you will find your watch right.—Hamlet.

[48330.]—**Timepiece and Watch.**—I imagine the mainspring of your watch is not regular in its action—i.e., it must exert more or less power, according to whether it is nearly down or fully wound up. This is at times produced by a corroded state of the oil in the barrel and upon the spring; at others by want of freedom of the spring between the bottom and cover of the barrel. The guard-pin of the Boston lever is not set sufficiently close to the roller. The pin I mean is to be found close to the notch in the pallets bar. To remedy the error, carefully bend the pin slightly towards the roller, only a trifle. It is safer to remove the pallets from the plates to do this, but with care you can do it without, having regard at the same time to the safety of the pallet-staff pivots.—Alfojoe.

[48330 and 48348.]—**Timepiece and Watch.**—I think the following may be of some use to the above two queries respecting the ruby pin of lever watch getting out of the fork of lever. The fault, I should say, lies with the small brass pin fixed on lever close to fork. Take out balance wheel and look at the roller—(that is, the steel disc carrying ruby pin). You will see that the side where pin is fixed is ground flat or hollow. This is to allow the brass pin at fork of lever to pass clear of roller when thrown backwards and forwards by ruby pin. When ruby pin is in any other position than entering or leaving the fork of lever, the circular edge of steel roller is turned towards the brass pin, and stops same from going to and fro by any other way except the proper one—viz., being struck by ruby-pin. In your case, I should say the pin at fork of lever is either missing, or bent too far away from roller; if broken, take watch to pieces, and fit another, high enough to reach top of steel roller; if the pin is still in lever, you may bend it forward with your tweezers (using care) without taking watch to pieces; bend very little at a time. Now replace the balance-wheel and cock and screw down, taking care that the ruby-pin is now within fork of lever, and also that balance-wheel swings freely; now turn balance-wheel round so as to take ruby-pin as far as possible from fork of lever; hold it in this position, which you may do by inserting a light piece of brass wire between one of the arms and plate, take hold of the tail end of lever with tweezers and see if it will move all the way to and fro between the stop-pins: if it will not, the defect is cured; if it does, you must bend the brass pin further until the desired effect is obtained. Setting hands back and winding may both cause ruby-pin to leave roller when the brass pin in roller is not properly adjusted.—H. A. D.

[48334.]—**Power for Circular Machine.**—If steam power isn't handy, and there is no water power you can use, why not get a set of horse-gears?—Labor Omnia Vincit.

[48336.]—**Electrical Measurements.**—It is not easy to express details in a table; this is the cause of the difficulty "J. D." experiences. Perhaps the following expressions may improve the table and avoid any ground for misconception:—

V Velocity 1 centimetre per second.
F Force imparts V to 1 gramme. Dyne.
E Energy produced by Dyne in one second, or }
W Work stored per gramme at unit V } Erg.

I shall be glad to hear if this seems more clear to the readers' minds, as these articles will form the basis of the chapter on measurement in the new edition of my "Electricity," and it is very desirable that any such difficulties should be removed prior to the issue of the book, which is now in the printer's hands.—Sigma.

[48339.]—**Tin-Pot Battery.**—I may say that I have tried everything that I have seen in the pages of "ours," that has been recommended by successful makers of the Bennett battery with scrupulous exactness, but could never succeed in obtaining anything but a weak current, not approaching a Leclanché battery for intensity, though more constant. I could never get one cell to ring a 2½in. bell, and do not intend to waste any more time or porous pots in another trial.—Fred. Walker.

[48341.]—**Horse-power of Winding Engine.**—To find the actual power of the engine, take an indicator diagram, and from that find the average pressure on the piston. Then multiply the area of cyl. by twice length of stroke, and again by the number of strokes per min. Multiply the product by the average pres. on piston, and divide by 33,000; the quotient is the actual or I.H.P. of the engine. —Labor Omnia Vincit.

[48341.]—**Horse-Power of Winding Engine.**—You will see, upon reflection, that unless you indicate your engine, you cannot find the mean pressure—an important factor in calculating horse-power. If you can get a diagram, and find the said mean pressure, proceed as follows:—Multiply the area of piston in square inches (in this case 1385·44) by the mean pressure, the result by twice the stroke, this result by twice the number of revolutions per minute, 31½; divide the total by 33,000, the result is the indicated horse-power. You may arrive at the nominal horse-power of your engine by taking the mean pressure at 7lb., and piston speed 300ft. per minute, but I cannot see that it is of any use to you. If I were near you I would gladly indicate it for you; as it is, I will assist you as far as I am able to do, if you could forward me a diagram, taking both sides of the piston when the engine has her full load.—Fred. Walker.

[48344.]—**Softening Lime.**—Try dilute muriatic acid: don't let it remain long enough to spoil the egg-shell. Fifteen thousand eggs won't go in one tub, so it will be worth the experiment on one cask. I would suggest that "confectioner" should report to "ours" the result; indeed, with the Editor's permission, it would be very satisfactory if we could learn how the various plans suggested in "our" columns turn out. Readers never know this, and a lot of information is consequently lost. We should all like to know how our various eggs hatch.—Jonah.

[48345.] — **Geneva Cylinder.** — Our friend "Fellow Workman," seemingly intends to drop out of our sight. I am sorry to see him thus disappear from our "little stage." Can he not be induced to reappear, or is he gone to "join the majority"? To save possible disappointment, by the querist not receiving an immediate reply, I will simply say that the plugs of cylinders are driven out by suitably-formed punches, when the cylinder has been placed in an inverted position on a hollow stake, the shoulder of it passing into the hole.—Alfojoe.

[48346.]—**Scotch Locos.—North British Engines.**—To "Alaric."—Before writing this I made out a table of 20 classes of passenger, 15 of goods, and 10 of tank engines (N.B.R.) But, this finished, I was myself quite surprised at the result. Locomotives, differing widely from others in every respect, with exception of cylinders, wheels, and weight, are so numerous that the mere figures and scanty dimensions that space admits of, convey but a faint idea of the engines themselves. For instance, on the N.B.R. we have some half-dozen classes of engines, all with 6ft. driving-wheels, cylinders all 16in. by 22in., and weighing all on an average as close as possible to 31 tons, but in other respects very different. The same with goods engines. Apropos of these remarks, "Alaric" will find some information on the subject in Vol. XXIX., p. 627, and Vol. XXXIV., pp. 163 and 500.—Carstairs.

[48346.]—**Scotch Locos.**—The two principal classes of locos. used for passenger traffic on the G. and S.W.R. are:—Four-coupled express bogie engines (similar to those by Mr. Stirling on the S.E.R.), 7ft. 1in. drivers; cylinders, 18 by 26; they are fitted with steam reversing gear, and have the Westinghouse brake. They are very fine engines, and make quick runs. 6ft. 8in. four-couped express engine, inside bearings (by Mr. Smellie), coupled behind, cylinders 18in. by 26in., Westinghouse brake, steam reversing gear. This engine has Smellie's modern improvements in the motion and fittings, iron buffer plate, &c. They are well finished, and painted a darkish green; the splashers are unperforated. They are very handsome engines, and are used to take the London expresses to Carlisle. For goods traffic six-wheeled four-coupled engines, 5ft. 6in. wheels (leading and driving wheels coupled), are extensively used. There are also six-coupled goods engines. All engines on this line have inside bearings, are fitted with commodious cabs of the G.N. style; no domes; Ramsbottom's safety valves.—E. J. A.

[48348.]—**To "Alfojoe."**—See my reply to "Timepiece and Watch," 48330.—Hamlet.

[48348.]—**To "Alfojoe."**—Like the Boston watch previously referred to in letter 48330, the guard-pin needs to be set closer in to the roller, and the advice there given will apply to your case exactly.—Alfojoe.

[48350.]—**Tricycle Worked by Spring.**—There would be nothing gained by driving a tricycle by means of a coiled spring, for a spring cannot *create* power—it can only store it; consequently, before the spring could give out enough power to drive the machine a given distance, the same amount of power, plus a little more to overcome the friction of the mechanism, would have to be put into it by winding it up; thus it would be more advantageous to employ the power direct, as in the ordinary tricycle, than to use it by first storing it in a spring. Of course, if you can get steam or animal power to wind the spring, then there would be a clear gain to the rider; but the necessary gearing, &c., would be so weighty and complicated as to render the arrangement impracticable. It would be possible for the rider to store power in the spring by winding it up, say, for 1 hour a day for 5 days, and he would then have enough power to take him a 5 hours' ride, that is roughly speaking and neglecting friction—but, as I have said above, the weight and complication put the matter out of the question. If the inability of the spring to create power has not been clearly shown, let us consider the case of an ordinary watch. When I wind up my watch it is the slight exertion of my strength for a few seconds that keeps the watch going for the ensuing 24 hours, such strength being simply stored in the mainspring and not created by it. It has been proposed a great many times, by as many different people, to arrange springs so that they shall be wound up by the tricycle when it is going down hill, the power thus absorbed by the springs acting as a brake to the tricycle; and when a hill has to be climbed the springs (already wound up by the machine running down hill) are brought into gear so as to assist the rider up hill. The idea is based on a sound principle; but owing to the necessary complication of the arrangement it has, I believe, never been brought to a practical result, and probably never will be—at least so far as tricycles are concerned.—Wm. Granger, Birmingham, Oct. 21.

[48357.]—**Verge Watch.**—If your balance has a pin in it, there should be a pin at either side of the cock to keep it from going too far. If one pin has come out put in another. If your watch hasn't a pin in balance, you will find two in the potence where the verge is; bend one of them nearer the centre.—Hamlet.

[48357.]—**Verge Watch.**—The bankings are in fault. Some verge watches are banked in the potences and top plates; others in the plates alone; others against the cock. Notice which method has been adopted in your watch. If it has banked against the cock, see whether the pin is still in the balance-wheel, or, if any pins have been fitted in the edge of the cock, whether they have fallen out. If so, replace them, and the error may possibly be corrected. To decide as to the mode of banking, if a pin is set vertically in the balance-wheel, then it banks in the cock; if a pin is set in the edge of the wheel, it banks against vertical pins in the plates; if neither of these methods is adopted, then, without doubt, it banks in the potence and top plate. In the latter case, the pins must be eased forward to the verge holes, or, at least the offending pins. In the others, the pins must be set closer to the centre of the arc of vibration, or replaced if gone. Owing to this triple form of banking in vogue with verge watches, I cannot give more definite instructions, not knowing which form exists in your watch.—Alfozoe.

[48357.]—**Verge Watch.**—The escapement is out of order: the balance very likely banks; if the escapement is all right, put a pin on each side of cock to keep the pin in balance rim (if there is one) from going too far on each side; if inside bankings, the watch will want taking to pieces. You can try pushing the follower in a little.—G. Sumner.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last Tunstall has answered 47919.

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QUERIES.

[48359.]—**Legal—Launch.**—To Mr. Wetherfield.—Supposing I have a steam-launch 26ft. long, and wish to take a friend or two a few miles along the coast? Am I allowed to do so? Or, is the boat supposed to be licensed for passengers? If the launch comes under the Passenger Act, can you tell me the substance of it?—Launch.

[48360.]—**Weakness of Knee-Joint.**—"S.R." would be grateful for any hint as to means of strengthening knee-joint, the muscles of which have become relaxed, and are slightly wasted, owing to frequent and too-long-continued hot applications after a bad sprain. There is no disease, and nothing out of its plac ; but as the injury caused a good deal of anxiety, much nervousness regarding the joint still continues; this seems to retard the recovery, and any suggestion as to increasing strength would be gratefully received.—S. R.

[48361.]—**Plating.**—I am desirous of plating in gold, silver, and copper, several hundreds of concave discs varying in size from a ½in. to 3in., somewhat resembling watch-glasses. These will be punched out of sheet-tin, lead and copper. I should like to know of a good, quick method of gilding, silvering, &c., either by solution or battery. Would any of our experts kindly give me a simple method, and cheap? Can the colour or shade be toned? If so, how? Is it necessary to copper the pieces of tin before gilding? There are no holes to suspend by. References to any books on the subject will oblige—Costumier, Exeter

[48362.]—**Polariscope Slides.**—I should be greatly obliged if some kind practical microscopist among your readers would help me with some information: I have lately been making some polariscope slides from salts and chemicals, most of them with fair success; but, in several instances I regret to say, I have completely failed to obtain satisfactory crystals. These failures consist of the following:—Carbonate of lime; cinchonine, cinchonidine, iodide of mercury, iodide of quinine, nitrate of bismuth, phosphate of lead, quinidine, sulphate of lime, uric acid, urate of ammonia, and urate of soda. The smallest portion of clear information as to modes of procedure to get proper solutions of each, so as to get the right crystallisation, will be very gratefully received by—X.X. X.

[48363.] — **On the Production of Looped Figures by Gearing.**—The description of the eccentric chuck by "J. L." is very interesting, especially as the making of such a chuck would seem to be within the power of many an amateur mechanic; but, before beginning to make one, I should be extremely obliged to "J. L." if he would give me some information on the following points:—1st, How is the pin upon which the division wheel A revolves fastened to the upper plate? Might it be part of the casting of that plate? 2. What would be a suitable size for the foundation or lower plate of such a chuck for a 6in. centre lathe?—C. E. L.

[48364.]—**Toning Lantern Transparencies.**—To Mr. Lancaster.—Would you kindly inform me how the above is done? I have tried chloride of gold, but can't get anything like the colour of the bought ones; in fact, no amount of flowing on and off or immersing appears to alter the colour one bit. Strength of solution used: 4 grains to 1oz. of water.—J. Jackson, Liverpool.

[48365.]—**Legal.**—Will Mr. F. Wetherfield kindly inform me concerning the use of a right-of-way? The public path to the church leads through a farmyard. Can this path be used by persons going to and from the vicarage by way of the church, for the vicarage grounds join the churchyard? The farmer says no; but is he right?—Vicar.

[48366.]—**Lathe Flywheel.**—What is the best arrangement for fixing a lathe flywheel to its shaft when it has to be moved about to bring its slow speed opposite to the mandrel pulley? I want something better than the ordinary set screw. Also, will it be detrimental to the truth of the flywheel to slide it on the crankshaft for the above-mentioned purpose?—Hellespont.

[48367.]—**Induction Coil.**—To Mr. Lancaster.—I wish to decompose water into its constituent parts, and to do so intend to make a coil about 6in. long. Will that be strong enough? If so, please say what work I could do with it? And at the same time kindly advise me as to the smallest amount of wire for secondary and primary that will answer my purpose?—Telegraphist.

[48368.]—**Catarrh.**—To Dr. Edmunds.—I shall feel so thankful for some advice on the following case:—I have a daughter who for some years has been suffering from catarrh. The discharge of mucus is copious, and during sleep the passage becomes partially stopped, so that she has frequently to use great force when blowing her nose, and then large flat pieces of congealed matter pass from the left nostril. She was advised to use the nose douche, and tried it several times, but found on putting it up the right nostril that the water would not pass down the left, so she can only use it at the left side, and then it passes quite freely from the right. I would like to know if she ought to use anything in the water (a friend advised alum), and if the water should be hot or cold. She has always used plain warm water. When she uses the douche in the morning she sometimes takes cold after it. Would it be better to use it at night? Is bathing the face in cold water injurious to it? Would warm baths be good for her? For some time she took a tepid one every morning, but I think that she was more susceptible to cold after them. Her chest is delicate, but she seldom suffers from it except when exposed to the night air. Are the fumes of tobacco injurious to catarrh?—An Anxious Mother.

[48369.]—**Varnish.**—I have a mixture of shellac, methylated spirits, and yellow ochre as a varnish, but cannot get it to dry quick enough—one thin coat taking about five minutes. Would some of "ours" kindly tell me what to add to cause it to dry almost instantly without reducing the brilliancy?—R. J.

[48370.]—**Threshing-Machine.**—I have at present a threshing-machine driven by a 14ft. dia. by 3ft. 9in. overshot water-wheel, which I would like to improve, as it has very little power at present. There are 210 teeth in segments of water-wheel, 33 teeth in pinion working into same, then there is a spur-wheel of 88 teeth on this pinion shaft with a pinion of also 33 gearing into it, and on this second pinion-shaft there is a 44in. pulley working into a 20in. pulley on machine. Now, if I were putting a 7ft. pulley on first pinion-shaft, and driving direct on to a 12in. on machine, thus doing away with the spur-wheel and the second shaft, would I gain any more power? At present the water-wheel seems not to get up to its proper speed, which I think is caused by so much intermediate gearing between it and machine. If any of "ours" would kindly help me I would feel obliged. Revl. of machine 350 to 400.—A. R.

[48371.]—**Fixing Water-Colours.**—I do a deal of water-colour painting (mixed with Chinese white) on wood, such as small boxes, paper-knives, &c. Can any of your readers inform me how to set the colours so as to prevent them running when the wood is polished? Surely, there must be some preparation for mixing with the colours. Any after-application is sure to do some damage.—H. C.

[48372.]—**Staining Elm.**—I have completed a small vehicle which is largely composed of elm timber. I should feel much obliged if some of your readers would kindly let me know how I shall set about the process of staining it.—Spex.

[48373.]—**Legal.**—To Mr. F. Wetherfield.—Would you kindly advise under the following circumstances:—A. dies and leaves by will three leasehold dwelling-houses and one shop. He has a son B. and a daughter C. He leaves, on trust, to B. the shop and one dwelling-house; to C., also on trust, two dwelling-houses—B. having the most valuable share. To make them equal, he devises his trustee to pay the whole of the ground-rent from the profits of B.'s share. C. is now dead, and her share is to be sold free from ground-rent. When B. dies, his share is to be sold subject to the payment of the ground-rent of the whole of the leasehold property. I wish to know if such a thing could be done? If so, should I be obliged to consult the landowner as to whether he would accept B.'s share as security for the whole of the ground-rent.—Trustee.

[48374.]—**Frozen Feed Pipes.**—I am employed as loco. shed fitter, and during the coming winter I shall have to look after the engine feed-pipes at nights, and see that they do not get frozen up. What is the best means to adopt to attain the desired end?—Dona Joint.

[48375.]—**Blower.**—Would "Jack of All Trades" kindly say whether the blades of fan must be as wide at end of blades as at the end near spindle, as his sketch shows them much narrower at the end? Is this right? Will not the wind escape past? Thanking him for his drawing of fan.—Tony.

[48376.]—**Fret-Saw.**—Will some reader kindly give instructions for making a treadle fret-saw? Also, some diagrams. I may say that I have a wooden stand and iron flywheel grooved, which have been for a dentist's grindstone.—A Would-be Piper.

[48377.]—**L. and N. W. Engines.**—Will any of "ours" let me know the principal dimensions of No. 1 Saracen single express, and numbers and dates of the following?—Æolus, Ambassador, Byron, Caithness, Columbus, Cromwell, Cygnet, Dalton, Diomede, Di Vernon, Euxine, Eamont, Emperor, Eden, Franklin, General, Hecate, Hardwicke, Henrietta, Hotspur, Linnet, Locke, Marlborough, Mazeppa, Martin, Merlin, Nightingale, Newcomen, Narcissus, Outram, Penguin, Planet, Peregrin, Roberts, Rowland Hill, Rose, Star, St. Patrick, St. Arnaud, Sunbeam, Scott, Tubal, Tennyson, Theorem, Tartarus, Terrier, Vampire, Woodlark, and Zamiel.—Dublin.

[48378.]—**The Voice.**—Will some brother-reader oblige me with name, publisher, and price, of a good treatise with exercises for improving and raising the upper notes of the voice? I can read and sing bass fairly well, but cannot without much straining sing higher than the upper D—and cannot always make D. This, I believe, is caused by not knowing the correct method of making the high notes. Any advice or hints will be thankfully received.—Choristra.

[48379.]—**Gower-Bell Telephone.**—Will any kind reader explain the following fault on a Gower-Bell telephone which I have on a ¼-mile circuit?—I think the fault appears to be either in the transmitter at the distant end, or else in the receiver on the instrument which is bad to hear. I can scarcely hear the person speaking without shouting, and then only indistinctly, compared with similar instruments I have on longer circuits. I use bichromate batteries with two cells for microphone. I have regulated the magnets to various distances from the diaphragm, but find it no better. About how far should the two small coils attached to poles of the magnet be set from touching the diaphragm to get best results. I do wish some brother-reader would kindly give a few good practical hints on the working of the Gower-Bell telephone.—Verax.

[47380.]—**Steam Boiler.**—Will any qualified reader of "ours" assist me in the following?—I am about putting down an egg-ended boiler, fired externally, 3ft. long and 2ft. diameter. A short time ago I saw a statement in the "E.M." that such a boiler would require opening out every 3 or 4 weeks for the purpose of removing scale, &c. Would it have a good effect to give the inside a thin coating of hot tar before putting in water? Has any reader tried this experiment?—Nemo.

[47381.]—**Galvanising.**—Will some practical man kindly give me a detailed description of the process of galvanising iron tubes and fittings? Also, the chemical actions of the acids on the iron.—H. Clear.

[48382.]—**Bell Indicators.**—Would Mr. Tolman, or some other electrician, kindly give me a sketch and description of these? I believe some are mechanical, and some electrical, but do not know wherein the difference lies.—Zu.

[48383.]—**Retouching Negatives.**—Will someone kindly describe how this is done? I wanted the other day to take out the heavy shadow from one side of a portrait. I tried first Indian ink, and then pencil, on the gelatine, but neither would do; then I varnished the negative with ordinary negative varnish, and tried the pencil and Indian ink again, but still I could not get anything like an even surface. The ink all ran in streaks, and the pencil would not mark at all.—Zu.

[48384.]—**Pump.**—I have a small steam-engine (that is able to saw from 4in. to 5in. deep) which I am anxious to apply to pumping water out of a quarry. The height would not exceed 10ft. Would some kind subscriber let me know the best mode of applying some agent for lifting the greatest quantity of water with the aforesaid engine. I have been thinking a small centrifugal pump would be best, but I do not know the size that could be worked by my engine, which has 10in. stroke, 3½in. cylinder, and is about 2h.p. Any information on the subject will be esteemed by—J. H. A.

[48385.]—**Cement for Blotting-Paper.**—Can anyone kindly say the best means of sticking blotting-paper together? Ordinary glue or gum, however thick, will not adhere on unsized paper. The double blotting rollers, when exhausted, I have found difficult to refill for this reason: as each turn of the paper has to be separately fastened to the foregoing one, so as to enable one to cut it off when used, without waste, and I can find nothing that will adhere satisfactorily.—Ethel Constance May.

[48386.]—**Iron Hoops.**—Would any of our readers kindly give me the exact measurement of iron hoop-making, allowing for jumping and scarfing both ends? I have 3 dozen hoops to make of iron, 3½in. by ⅜in. thick.—Anxious Inquirer.

[48387.]—**Soap-making.**—Can anyone give me directions for making a pure soap, containing soda, potash, or ammonia as an alkali, and tallow, oil, and glycerine as fats? What are the best substances and best proportions? The soap should be preferably soft; cost no object, as a pure soap free from lime, resin, &c., is required.—Dandia Dismont.

[48388.]—**Parker-Smith Brake.**—Will anyone describe the Parker-Smith screw-brake shown at the Darlington Exhibition?—Castle Coombe.

[48389.]—**Semi-Incandescent Lamp.**—Will "H. T. B." (25619) have the kindness to inform me how to construct a battery that will work this lamp? Will he give me its exact size and power, its cost, and everything necessary for one to know who desires to prove his lamp?—A Reader.

[48390.]—**Fossils.**—Will some reader interested in geology answer me the following queries: (1) Do fossils appear in flints, and, if so, are they of any great value? (2) How are so many stones or pebbles accounted for in the ground? Are they the remains of beaches, or is there any ground for the supposition that they grow?—W. E. Scriven.

[48391.]—**Legal.**—To Mr. Fred. Wetherfield.—My deceased father's will states that his house and effects (value about £200) were left to his widow, my stepmother, for her use and benefit during her lifetime; at her death the whole to belong to me. She refuses to have the will proved (and there being no executors appointed), can I compel her to do so, and if so, by what means?—Perplexed.

[48392.]—**Lathe Bed.**—Would some kind reader help me in the following difficulty? I have the heads of a 3½in. back-gear lathe, and want to make a bed (gap) to suit same? The difficulty I am in is, how to make the pattern for the casting, as several I have thought of will not leave the mould? A rough sketch with dimensions will greatly oblige—W. H. Scriven.

[48393.]—**Scraping Cast Iron.**—Would any reader tell me how to scrape cast-iron after it comes off the machine without scratching or narling? Also, give particulars as to steel to make scrapers out of.—W. W. K.

[48394.]—**Aperture of Object-Glasses.**—Would "Prismatique" kindly inform me why opticians adopt the present ratio of aperture of object-glasses to their focal length; 2in. to about 30in., or even less, is usual? But if you read upon the subject, great authorities—as Kitchener, Maskelyne, and others—are loud in their praises of long foci. If long foci are best, how is it they do not prevail in practice? The glasses, surely, to say the least, would not cost more—the fittings about the same, and a few feet of brass tube would cost but a trifle.—A. H.

[48395.]—**Astronomical.**—I live in the country on a hillside, and am much troubled with the winds that blow hereabouts. Can someone suggest (1) a light, suitable screen to serve as "walls" behind which I can shelter a little? (2) I have a Lancaster Altazimuth mount, and want to know how I can make it steadier than the steadying-rod does? I have tried sand-bags, screwing up tight, spreading out legs, &c., &c., but the weakness is at the joint. Would a larger and stronger action do better? (3) Can somebody describe or picture a portable observing stool or chair, suitable for a 3¼in. telescope? If I remember rightly, Mr. Lancaster promised this in the course of some letters he began a year or two ago, and never finished.—X. P. V.

[48396.]—**Cistern.**—I wish to erect a cistern for rain-water 8ft. above the ground, to contain 1,000 gallons for use in my garden. What would be the best materials to construct it of—wood, galvanised iron, or concrete? If the last, how should the pipes be connected with it? I propose also to have a small one attached to catch the first of the rain and the soot, &c., it washes off the roof. This small cistern would be emptied by a siphon or pipe of fine bore at the bottom when the rain was over. Now, what would be the best method of diverting the water into the large cistern automatically when the small one is filled?—J. B. T.

[48397.]—**Greenhouse.**—Is wood or iron the best material for the construction of a greenhouse 30ft. × 20ft., and how would they compare as to price?—J. B. T.

[48398.]—**Regulating Clock.**—Would any contributor give me some hints how to correct clock when losing or gaining—day or eight-day clock? Also, watch when finger is as far at f. or s. as possible? How to calculate length and strength of springs for watch or clock? How are the teeth cut in wheels, and what kind of oil is best to use? Is there any book (illustrated) which shows the different use of tools, and treats on practical watch and clock-making, with price?—Contributor.

[48399.]—**Telescope.**—I have a telescope which has a plano-convex lens for an object-glass, and a focal length of something like 7ft. It is fitted with an eyepiece of very low power, containing four lenses; also plano-convex. The object-glass is about 5½in. in diam. As a telescope, or anything else, it is, in its present condition, perfectly useless. Would Mr. Lancaster, or any reader, inform me what I can do to make it of some practical value? I would not care to lay out any sum approaching the price of an achromatic object-glass of English make, and I wish to know if one of Continental or other make would be of any service, what power it would stand, and, along with the necessary eyepieces, the probable cost? Would it do as good work as one of the best English made telescopes with an object-glass of 3in.?—Eleph.

[48400.]—**Gas-Power.**—I can obtain a plentiful supply of the gases, hydrogen and oxygen. Will some kind reader inform me the best way to use them in the production of h.p. without calling upon steam? I may add the gases produce but little pressure or power on their production; in fact, scarcely any.—P. O.

[48401.]—**Commutators.**—Is there not some other mode of making a commutator than the revolving one generally seen? I mean for coils. I fancy I have seen somewhere three or four strips of brass with a movable shunt kind of arrangement. Would one of our electrical friends kindly oblige with a rough sketch?—B. H.

[48402.]—**Slide-Rule.**—How can I find decimal ·7854 on the engineers' slide-rule on C line?—Slide-Rule.

[48403.]—**Lantern Ghosts.**—How can I raise a ghost with a magic-lantern?—Magician.

[48404.]—**Safety Matches.**—How are those matches prepared in which the moment the flame goes out the charred wood turns black, no part remaining red? The ash is very strong.—Glatton.

[48405.]—**Interference of Light.**—To "Odeneic Vital" or Others.—Suppose a beam of parallel rays to fall at an angle on a sheet of glass, part of the light is reflected and received, say, on a screen, part passes into the glass, is refracted, and is reflected from the inner surface of the glass. It passes out again (being refracted again in so doing), in a direction parallel to the direction of the first beam. Now the second beam having traversed a greater distance than the first will differ from it by a certain number of wave-lengths. Suppose the glass to be of such a thickness that this difference is an odd number of semi-undulations, and the two images are large enough to overlap on the screen, should not interference take place, and the parts overlapping be extinguished. I have tried a variety of thicknesses of glass, and have failed to produce this result. I should be very glad to know why I fail?—Ll.B.A.

[48406.]—**Reed Organ.**—Thanking those correspondents who have answered my query, will they oblige by a little further advice? I will just state that I am a joiner by trade, and have been making my organ from instructions given elsewhere by a correspondent signing himself "Saxophone"; but as he did not say what reeds to use, I thought a query in the "E. M." would get me what I wanted; but you all seem agreed that American reeds and tube-board is the only way out of my difficulty. Please say how I am to mount it to work above the key-board? The space at command is 3ft. wide by 16in. from back to front. I have got as far as the top of the bellows, which is 30in. from floor; so I don't think I have got room now for my tubeboard under the keys. My keys are 21in. long. My bellows and feeders resemble the ordinary harmonium, only all the valves and springs are reversed.—E. J. L.

[48407.]—**Creation of Power.**—In Wormell's Lectures on Magnetism, &c., in inquiring into the source of magnetic power, he says a magnet does not lose its power by imparting it to iron or steel, and hence arises the query, Where does this imparted power come from? And he then states that "inquiry shows it comes from the muscular force we exert in drawing the loadstone over the steel." This point has puzzled me before, and I confess I do not quite understand the explanation yet. Suppose I take a loadstone and draw it two or three times along a steel bar, using to convert the bar into a magnet as much muscular force, say, as would move a 4oz. weight an inch in a second. I now take my steel bar and place a number of needles before it, which are attracted; these I remove and present a fresh lot, and so on until the attractive force of my magnet has (collectively) pulled 4oz. of needles in a second, or at that rate. Now if I put another set of needles to my magnet, it will still go on attracting as before, and so on. Where has this power come from? The original magnet has lost none. My muscular force in making my magnet has been expended, and yet there is a considerable balance of attractive force left. Of course, I am wrong somewhere; but would our friend "Sigma" (whose new book I shall be glad to see), or some other magnetical friend, enlighten my ignorance?—B. Harcourt.

[48408.]—**Gramme Machine.**—I have made a Gramme machine, but am not certain as to the best size of wire. The armature ring is 4½in. outside diameter when wound. I want to know if No. 16 on the armature in coils of four layers, and No. 12 on the field magnets would be better than No. 18 on the armature and No. 14 on the field magnets, and if there would be less heating in the machine and better results?—Gramme.

[48409.]—**Telescope Driving Clock.**—I should be much obliged if any of your correspondents could give me hints upon the construction of a clock to drive an equatorial telescope. My instrument is a silver-on-glass reflector, 9¼in. aperture, 6ft. focus. Motion in R.A. is given by a tangent-screw 12 threads to the inch, working driving-circle about 14·5in. diam. The wheels of clock I propose to have cut, as I have not any appliances for cutting them. The pinions of the lantern kind (so highly praised by Sir Edmund Beckett) I propose to make myself. The information I desire is principally with regard to the following particulars:—(1) Size of barrel. (2) Pitch of driving-wheel, and width on face. (3) Best form of regulators. (4) Number of revolutions of regulator per minute.—Stargazer.

[48410.]—**Solvent for Marine Glue.**—What is the right solvent for marine glue? I have tried benzole, benzoline, ether, and absolute alcohol, but it only partially dissolves. Perhaps there are two qualities, as what I have bought lately is much cheaper than it used to be. Is the manufacture still a secret? If not, I should like to know how it is made.—S. S.

[48411.]—**Derrick.**—I have a derrick with a block 26ft. from the ground, through which my chain passes for lifting a weight of 10 tons, and the back guy is made fast to derrick-head, and carried away and made fast 40ft. from the heel of the derrick. The derrick stands at an angle of, say, 5° from perpendicular, and I want to know what proportion of the 10 tons comes on the back guy, and how to calculate it for any other angle?—R. C., Birkenhead.

[48412.]—**Gunter's Quadrant.**—Will any reader tell me how to make and use a Gunter's quadrant? It is used for finding the height of various objects, the latitude and longitude of any place, the time of day, &c. I should like to know how to set out the various lines and degrees.—Grapho.

[48413.]—**Ornamental Slide-Rest.**—I have been anxiously awaiting the publication of drawings and description of the larger and more complicated slide-rest than the one described on the 13th of January last, which Mr. J. H. Evans promised to give us. Perhaps Mr. Evans would also give us drawings and description of the spherical slide-rest with all the latest improvements, and also inform us whether the spherical slide-rest would also take the place of the ornamental slide-rest?—Traversing Mandrel.

[48414.]—**Gelatine Plates.**—Will Mr. Robinson or Mr. Lancaster tell me what is the cause of spots on gelatine negatives? Brown spots appear on them after printing two or three times. Can the negatives be restored? They are not varnished, and were developed with iron.—E. E. R.

[48415.]—**Steam Cock.**—Could any of your readers tell me how the plug of Needham's patent steam-cock for water-gauge of boiler is taken out, as mine is leaky? Must I take the cock off boiler before I get the plug out? Is it fixed with nut inside of boiler, or screwed in plate of boiler?—A Stoker.

[48416.]—**Brush Electric Lamp.**—Having nearly completed a small dynamo-electric machine of the Brush type, which I expect will absorb about 1½-h.p., and being desirous also of trying to construct a suitable lamp for do. I looked over my back numbers of the "E. M.," and found on page 230 of No. 764 (November 14, 1879), a very good engraving and description of Brush lamp. I would feel exceedingly thankful to any competent person who would kindly furnish me with particulars and sizes of respective parts marked thereon, that would enable me to start making one for the above machine, particularly in regards to gauge and quantity of wire—silk or cotton covered—I should use on the principal helix marked A, with number of convolutions. Also gauge and quantity of wire I should put on to make up the adjusting helix marked I, with number of convolutions, in order to be in due proportion to the resistance, &c., of helix A, as therein stated.—Trydanydd.

[48417.]—**Simplex Telephone.**—To "W. H."—Will "W. H." be kind enough to say what is the size—i.e., diameter and depth of the carbon cups in above telephone? What size and shape the three carbon discs are, and how far apart they are placed from the cups? Also, if an amateur can cut the carbons? In the receiver, how are the diaphragms adjusted, and is there no permanent magnet, for I do not perceive one in your account? I, for one, should much like to see a sketch of the switch arrangement.—Cantab.

[48418.]—**Wheel-Grease.**—I bought, a few weeks since, a good quantity of thin black grease. Can anyone tell me a cheap way to thicken it to make it saleable?—Broker.

[48419.]—**Drilling or Working Chilled Cams.**—Will any kind friend give me a few hints? The ones I have to operate on are difficult of removal, so I want to do them in place.—J. O. E.

[48420.]—**Chime-Clock Construction.**—Will any reader of "ours" tell me of a simple and neat way to construct two sets of movements of American eight-day weight clocks, to chime quarters and hours, to imitate Westminster clock and to work a musical box to play a tune and change at intervals of every three hours.—Ohio.

[48421.]—**Battery for Bell.**—How must I re-charge my battery? It consists of glass bottle with two small carbons and zinc between them; to ring the bell you press the zinc (which is fitted with a spring) and it goes into a solution. I wish to know what the solution contains.—A Dabbler.

[48422.]—**Carbon Binding-Screws.**—The binding screws have come off the carbons in my Bunsen battery; they appear to have been soldered on to the carbons, but under the solder there seems to be a thin coat of pure copper. I wish to know how to re-copper the carbons so that the solder will take. How can I prevent the acid acting upon the carbon tops—the acid seems to creep up?—A Dabbler.

[48423.]—**Night Sweats.**—To Dr. Edmunds.—Six months since my wife was induced to try cold sponge bath—and being of rather feeble health, found the shock too great. Since then, she has been subject to sudden perspiration, succeeded by chills, especially about 3 o'clock in the morning. Can you suggest cause and any treatment to prevent these unpleasant symptoms.—Anxious.

[48424.]—**Rain-Band Spectroscope.**—Will Mr. Rand Capron, should this meet his eye, kindly reply to the following? He states in his "Plea for the Rainband" that some persons fail to see it. May I ask, Does he mean that this is a peculiarity of the eye in some, for I have never been able, except during some heavy, stormy weather, to see anything like the band on the red side of the D lines depicted in his plates. But, on the other hand, I see distinctly before the approach of rain, the two sharp lines which he has drawn in his No. 3 spectrum, the line furthest from the D of the two being always the strongest, and showing often alone. I may say, I think that during the past nine months these lines seen in Browning's rain-band spectroscope have never falsified their prediction of rain during the succeeding ten or twelve hours; the presence of the smaller line and the distinctness of the two indicating the nearer approach and a larger amount of rain. But, as I said before, I never can distinguish the band. Perhaps your correspondent, "A Fellow of the Royal Astro. Society," has had some experience with the rain-band spectroscope, and will kindly reply.—F.R.C.S.

[48425.]—**Dynamo Machines.**—Several questions that have recently been addressed to a correspondent on the subject of commutators for these small machines remain unanswered—either from want of knowledge or for a desire not to publish the information. May I, therefore, appeal to our courteous correspondent "Sigma," to ask which of the two currents is employed for the electric light—the one formed on the approach, or the current that is induced upon the armature receding from the permanent magnets? and oblige—Electra.

[48426.]—**Electric light.**—Will "Sigma" kindly state the most suitable size of wire for a small dynamo machine using a Siemens 3in. by 2 armature to run between horse-shoe steel magnets? and oblige—Electra.

[48427.]—**Indicator to Block.**—Will you kindly favour me with a little more information? Would not the armature B be better if in the same plane as C D E, and the magnet A vertical, the pivot-point being about D? What is H? Are there any counter-poises, or do M and N effect this?—Gerard Hasley.

[48428.]—**Arithmetical Progression.**—Will some correspondent kindly show me how to work out the following: Whereabouts in a coal-shaft will the corves meet if the radius of the roll be 3½ft., the thickness of the rope is ⅛ft., and the depth of the pit 1,020ft.?—R.

[48429.]—**Garden Path.**—I have an elliptical flower-bed in the centre of my garden, and I want to make round this bed a path of a uniform width, say 2ft. How shall I describe the outer outline of the path, as I know it cannot be an ellipse? Will a mathematical fellow-reader tell me what sort of a curve it is, and its equation referred to the axes of the ellipse?—Jardin.

[48430.]—**Electrical Resistance.**—Can any fellow reader give a descriptive sketch of a new apparatus they are using, I believe, at South Kensington (for above)? It consists, I believe, of a number of bars of German silver wire fixed in at frame.—J. R. E.

[48431.]—**L. and S. W. R.**—Can "C. N. G.," "Waterloo," or others state the size of cylinders and driving-wheels of tank engine 318; also of Castor, 96? Why are the fast trains principally taken by the 96 type? Are they better than the bogie express engines?—Desmond.

[48432.]—**Electric Railways.**—The English Mechanic supplies a great many wants, and gives very fully the latest information of inventions, &c., at a minimum of cost. There is, however, one want I have been looking for a long time in vain, and that is plain and simple directions with working diagrams for the construction by amateurs of model electric motors, especially as applied to railways. Will not some of the numerous competent electrical contributors to "our" columns supply this necessary want at an early opportunity? Electric railways excite great interest just now, and a course of lectures or essays upon the subject will, I am sure, be welcomed by many as well as by—S. R. C.

[48433.]—**Cleaning Clocks.**—Will "A Fellow Workman" kindly state the best way of removing the rottenstone and oil from clock-plates, &c., after having cleaned them, so as to allow of polishing them?—E. W. B.

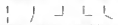
[48434.]—**Single-Needle Telegraphs.**—I have made a pair of single-needle instruments, P.O. pattern, but they do not work satisfactorily; the pointer, instead of striking dead on the ivory pegs, rebounds and strikes it twice, thus making it impossible to read the messages. I have tried a heavy magnet, but then it moves too slowly; and with a light one (made of a piece of wide watch spring) it has the above defect. I have also tried weak and strong batteries, but all to no purpose. There is a large coil of fine wire, with magnet in centre, and pointer in front of dial, with small spindle, and fine pivots. Would someone kindly give me some advice, as I have taken a lot of trouble over them, and am very anxious to make them work well?—Telegraph.

[48435.]—**Fretwork.**—Will some kind reader oblige by giving an insight into the way of making a simple treadle machine?—Novice.

[48436.]—**Clock Cleaning.**—I have an American 8-day fusee drum clock to clean, and the stops to prevent overwinding are lost. If any reader will tell me how to make the same they will oblige.—Amateur Clock Cleaner.

[48437.]—**Electric Clock.**—To "Glatton,"—Will you please describe how the pendulum works the train of wheels?—Amateur Clock Cleaner.

[48438.]—**Gearing.**—Will someone who thoroughly understands gearing give a drawing of the section of gear-wheels, which will gear correctly with one another through 180° thus—



I want these to gear at every angle right and left, the extremes being a right angle.—M. C. M.

[48439.]—**Foundry Practice.**—In reference to a Useful Note on page 23, No. 911, could any one tell me the sizes of such a furnace, say, for one 12in.? Also what size of blowpipe and what pressure of wind?—Moulder.

[48440.]—**Crucible Steel Castings.**—Can any correspondent inform me how to make the above? Will scrap steel, old files, &c., do for the purpose; if so, what proportions of each to use, and what flux? I have a brass furnace with blast—would this do to melt the steel in? Any information on the moulding, melting, and pouring steel castings would greatly oblige—R.

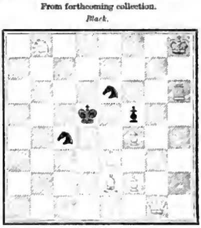
CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXCIII.—By Miss F. F. Beechey.

From forthcoming collection.

Black.

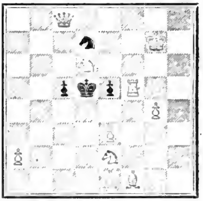


White.

White to play and mate in two moves.

PROBLEM DCCXCIV.—By J. W. Abbott.

Black.



White.

White to play and mate in two moves.
Solutions are cordially invited.

Solution to 789.

White.	*Black.*
1. B to Q 8	1. Anything
2. Mates	

Solution to 790.

White.	*Black.*
1. B takes P	1. Kt takes R
2. Q takes B (ch)	2. K moves (a)
3. P mates	
	(a) 1 K to Q 4
2. R to Q 6 (ch), &c.	
	(b) 1. K to K B 4
2. Kt to K 3 (ch)	2. K takes R
3. Q to K 8 mate	

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, NOVEMBER 3, 1882.

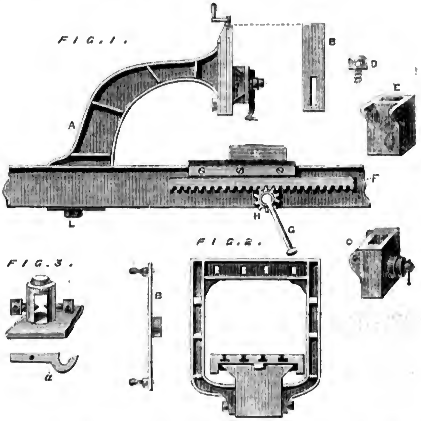
LATHE PLANERS.

THE majority of these planers are driven by a pin in a face-plate attached to the mandrel. It is so in Booth's and in Lee's, and in most of the designs that have appeared from time to time. Munro, who is now lost to the world of amateurs, knew better than to work his planer thus. I saw the design in embryo and had a good deal of conversation with him about it while yet on paper, and he fully recognised the loss of power that would be sustained, as also the limit to the stroke, unless it was worked direct from the crank-axle. I still think Munro's the best planer yet introduced. But then it is cumbrous, because it is in reality a distinct and separate machine, which does not utilise the existing lathe, except as a stand and driving power. It is therefore a machine which would be infinitely better by itself—the mandrel headstock and lathe fittings being entirely removed, and a lathe bed and stand devoted wholly to the planer. It would then become a most useful adjunct to any workshop, although it could no longer be called a planing attachment to the lathe.

But for planing—as opposed to shaping, in which the stroke of the cutter is quick, and the distance through which it travels small—it is a question whether driving by foot-power through the medium of a flywheel is either necessary or desirable. A lever worked by hand affords great power, with slow steady motion. Munro himself sent out many a good lathe-bed so planed, and he also made for sale a similar hand-driven machine.

I am by no means an advocate for combining in one machine a lathe and planer, if room can be found for two separate ones; but there are cases where such a combination may be effectively and economically carried out. The matter has lately occupied my attention, owing to the possession of a small screw-cutting lathe of the Britannia Company's build, and another of similar bed and headstocks, without the screw and change-wheels. Watching the process of self-acting turning, it struck me that there existed in such a lathe the elements of a very simple planer, and that, even without the driving-power of the screw. There was the rack and pinion as the driver—the V bed and saddle for longitudinal traverse, and the slide-rest, if it could be set up on end, as the tool-holder, giving the cross slide and vertical one. These small lathe-beds with V edges, too, are so cheap, that the whole might well stand as a separate machine, if preferred. One great advantage is the length of stroke thus obtainable, which may without great difficulty extend nearly the length of the lathe bed. The cross slide is of course limited by the length of that of the rest, if that rest is used. About this, however, I shall have something to say presently. For a planing head to hold the slide-rest vertically, I was inclined to fall back on that illustrated in Northcott's book; but a hollow casting would be expensive, and I think the one illustrated cheaper and nicer in appearance, while its effective shape is the same. The cost of the machine will be reduced to the items specified. 1, Small lathe-bed planed with V edges and stand; 2, rack and pinion; 3, slide rest; 4, planer-head. The fittings to be done by the amateur who can add self-acting feed. Starting with these alone, we get all the parts of an effective planer at the lowest possible cost; and even without self-acting feed or swinging tool-box, much may be done. But I think no amateur will be content to stick at this point. Finding that he has thus far obtained a useful tool, he is no mechanic if he does not go a step or two further, and add the feed and tool-box. Let us now revert to the longitudinal traverse or length of stroke. With a planer-head of L shape, the stroke cannot extend to many inches, unless the top of the head is unduly lengthened, which would need a somewhat heavy casting to keep it stiff; and the sliding bed of the machine cannot, of course, go further than the upright part of pedestal of the casting. Hence it is desirable that the head should straddle the lathe-bed, so as to allow the saddle to pass it in either direction as in a large planing machine. If the lathe, however, as such, is retained, I should keep to the simpler planer-head and put up with the limited traverse; but if a separate machine is desired, the second is the better form. In the latter it is also desirable to shift the rack to the under side of the saddle, so that it shall be under the middle of the lathe-bed, in which will then be the bearings of the pinion axle. I have also shown, in the cross plate of this second planing-head, Fig. 2, a series of bolt-holes, by means of which the slide-rest can be shifted bodily so as to bring the tool over other parts of the work; which will practically lengthen to any desired extent the cross traverse, and which will be also convenient when the work to be planed is of such shape as not to be readily placed in the centre of the saddle. This, in some degree, supplies the place of the slide to which, in a planing-machine the tool-box is fitted. We know that these plans fall under the head of "Inferior Expedients"; but this cannot be avoided in an amateur's workshop. In the present case our object is to make use, as far as possible, of what comes readily to hand, and can be applied to the desired purpose without very great skill and at low cost. There is no difficulty in getting a better machine if the pocket or the skill, or both, are equal to such a task.

Give me the cash, and no semblance of trash or makeshift machine in my shop shall be seen. But if a man's poor, he is fain to endure, What his brain may create and his hands perpetrate—and "perpetrate" is, I dare say, not so inappropriate a term by which to describe our home manufactures. If, however, such are not marketable, they keep a good many otherwise idle hands out of mischief. We may, I think, sum up the present contrivance under three heads:—1st. The simplest possible planer, in which the slide-rest is used, and the L-shaped head to carry it, while the saddle with rack and pinion retains its usual place. 2nd. The planing head which spans the lathe-bed with a more efficient arrangement of rack and pinion, and with the lathe-fittings altogether swept away; and 3rd. A still more efficient arrangement, in which either the slide-rest is made to traverse bodily on a cross bed above and parallel to the saddle, or a second slide is added, working on the saddle and at right angles to it, which is the easiest of the two to arrange. When, however, the top horizontal support of the rest is planed to V edges and the slide-rest, made to traverse it, we get so near to the real, independent planing machine that we may as well have it complete. For this reason I do not intend to give particulars of the 3rd arrangement in the present paper. Castings, too, of such a machine can be had from one or two manufacturers if the amateur has pluck enough, and thinks he has skill enough, to make a real upright and downright and horizontal-right planer. Fig. 2 is the other form of head which spans the lathe-bed, and has a row of slots on the horizontal bar to receive the tenon of the slide rest. B is another and better form of handle, with double lever arm, which will conduce to the easy and steady working of the pinion and rack. The planer table should be cast with T slots, as shown, to take the heads of the holding-down bolts which secure the work. I intend to fit one of the small Britannia lathes in this way, using the bed of one of their Number 13 screwing lathes, because it has V edges, and is but little dearer than those with plain, parallel edges. As I have another lathe of the kind, I shall prob-



ably remove permanently the headstocks of the planing one and make it a separate machine. It will be easy to get twelve or fourteen inches of longitudinal traverse. If the tool-holder of the rest is made as a cylinder with a long slot in it, Fig. 3, which cannot readily be removed, it may, I think, suffice for light work, such as is likely to be undertaken, to put a couple of short steel centre screws tapped into the cylinder as shown, and to drill hollow centres on the sides of the shank of the tool itself, thus allowing *it* to swing instead of the tool holder. A very little motion is needed to relieve it during the back-stroke. A block behind it at A will give it a bearing, if it does not touch the plate of the rest when cutting.

Of the illustrations, Fig. 1, A, represents the cast iron planing head attached to the lathe-bed by the bolt and washer L. The base of this should be as wide as the bed and have a tenon exactly fitting between the bearers like those of the poppets. It will thus be very steady. The slide-rest is shown attached by a bolt to the face of the horizontal arm of the casting. This face is planed flat, and has a slot to receive the tenon of the rest as seen at B, which represents the face in question. F is the rack attached underneath the near side of the saddle which slides along the lathe-bed, and K is the work. The pinion H has its bearing on the side of the bed, and is turned by G, the winch-handle, which should be long to give greater leverage. The ordinary tool-holder of the rest is but a makeshift. It will serve casually, but ought to be replaced by the swinging holder shown at C and E, the latter being its back. This tool-box swings on centres, so as to relieve the tool during the back or return stroke, when it would otherwise drag and deteriorate its edge and leave marks on the work. To add one to an ordinary rest, it will be necessary to remove the tool-holder, and screw into the top plate a pair of eyes similar to D, placing them just so far apart as to take the legs of the tool-box between them; a pair of centre screws are then added to form pivots for the tool-box to swivel upon. While the tool is cutting, the back of the tool-box presses against the top plate of the rest, and cannot yield in that direction.

J. L.

THE HISTORY OF COAL-MINING.*

MR. GALLOWAY, in his endeavour to delineate the growth of the coal industry, has contrived to bring out the salient points of its history, and to give a readable and interesting account of the rise and development of an art which has played an important part in the progress of this country. Who first used coal as fuel is a question that cannot be answered, though it is tolerably certain that the inhabitants of those districts in which it crops out were the first to discover its most useful property. The Venerable Bede who died in the first half of the eighth century, and who mentions the stone "gagates" of the district in which he lives, says nothing about their being used as fuel, though he notes that when kindled they possessed the power of driving away serpents. It is tolerably certain that coal fires were unknown during the curfew period, for chimneys, then, were of recent introduction, and were found only in the stone and brick houses of the wealthy. The dwellings of the "people" were built mainly of wood, and the fire was placed in a cavity in the centre of the floor, a situation in which coal would be unendurable, especially when the curfew gave the order to put out the fire. Down to the end of the twelfth century it is certain that wood, charcoal, and peat were the fuels in common use, though it may well be that the use of coal had been discovered and kept secret. by those who had had occasion to light fires, perhaps on the outcrop itself, or at the side of a cliff exposing a seam. The term sea-coal is probably derived from the fact that at parts of the coast the coal crops out, and would naturally be broken away by the sea; while, therefore, charcoal had the generic name coal, the term "sea" was a convenient and definite adjective to indicate the mineral dug out on the sea-shore. About the end of the twelfth century we find indications that the people had begun to recognise the usefulness of coal, and according to Mr. Galloway, the monks at Holyrood possessed a grant of the tithes of the colliery of Carriden, which was probably made before 1200, by King William the Lion. Several other references are to be found in old chronicles, but 1240 is a definite date at which the value of coal may be said to have been recognised, for, in that year the monks of Newminster Abbey, near Morpeth, received a special and supplementary charter, in which they were empowered to collect sea coal, for the use of the forge at one of their granges. This fact shows that the value of the mineral had been previously known, and its use spread rapidly, for in 1257, Eleanor, Queen of Henry III., left Nottingham on account of the smoke of the sea-coals. Limeburners and smiths appear to have been amongst the first to use the mineral as a fuel, but their practice was soon imitated by manufacturers and others requiring much heat, and, at last, after many complaints, a royal proclamation was, in 1306, issued against its use in London. Edward III., however, was wiser, and in some letters patent granted by him, it was expressly stated that, "by the leading of coals of this kind to all places within our kingdom, the greatest benefit will result to us and our people." In spite of that, it was many years before the use of coal for domestic purposes became general, and that was hastened by compulsion, for wood was becoming scarce and dear. The coal-trade at last attracted the attention of the tax-gatherer, and from that time to the present it has flourished. In its earlier periods the coal-getting industry was no doubt carried on in the simplest manner, only the seams within easy reach being worked; but as they were exhausted, the miners devised means to follow them below the water-level, and adopted the practices of other miners, by pumping the water out, and eventually by sinking shafts. As the miners followed the coal they met with another enemy besides water, for several underground fires are recorded in the sixteenth century, probably originating from explosions of firedamp. In a few pages Mr. Galloway recounts the principal features of the early attempts to use sea-coal for smelting iron, and of the endeavours made to charke or cook the coal—that is, to burn the sulphur out of it, and render it more suitable for use in the residences of noblemen and gentlemen. About the beginning of the 17th century a great demand for coal existed, and the miners were beginning to experience considerable difficulty in getting it. Beamont or Beaumont settled for a time in the Newcastle district, and introduced many of the practices which he had probably seen adopted by the workers in metalliferous mines, and though he "consumed all his money and rode home upon his light horse," he set the tide of invention in motion and showed the miners how to find fresh seams. Plain chain pumps, or chains carrying buckets were used in those days to clear the workings of water, the "engine" being the ancient horse-mill. Later on water-wheels were utilised for working the chain-pumps, and as the shafts became deeper the water was lifted in stages. Railways for carrying the coal to the shipping quays were introduced about the middle of the 17th century, and in 1698 Sir Humphry Mackworth had one in connection with his colliery at Neath, which, after being eight years in use, was declared by a grand Jury at Cardiff to be a nuisance, and a portion crossing the high road between Cardiff and Neath was accordingly broken up. In 1702 the tables were turned, and it was shown that the rail or waggonways really preserved the roads, and thenceforward they were allowed to be built in Wales, as they had been for years in the North of England. During the 17th century the miners met with many disasters from fire-damp and choke-damp, and the necessity of ventilation was recognised. Fire-damp was overcome in a crude way, by boldly exploding the gases. One of the pluckiest of the miners was chosen, and called the fireman, whose duty it was to go down into the mine and fire the gases, which he did by covering himself with a wet sack, and crawling along the floor of the workings, extending a pole carrying lighted candles towards the part where the gas accumulated. An explosion followed, more or less violent, which sometimes did considerable damage, but the fireman kept close to the floor, and generally escaped. The pit was thus cleared for a day, the motions of the workmen and the conveyance of the tubs of coal out of the mine sufficing to keep up a circulation of the air. In some pits this operation was needed every morning; but the greater risk appears to have been from choke-damp, which the miners detected by lowering a dog or a candle into the pit, the dog beginning to howl as soon as it reached the foul air. Separate air-shafts were also sunk to assist in ventilating the pits, which at this time were rarely more than 15 or 20 yards deep, owing to the difficulty of draining them. Towards the end of the 17th century many valuable coal-pits were abandoned, the pumps then available being found unable to keep them dry. In 1702 came Savery's engine, which could raise water from a depth of 80ft., but does not appear to have been much used, and a few years later it was superseded by Newcomen's engine, a machine which really effected a revolution in the mining industry of this country. The first Newcomen engine was erected at a colliery near Wolverhampton in 1712, and so rapidly did its powers become known that in a few years all the principal mines in the kingdom were fitted with one or more. The miners thus having full control over the water, sank their shafts deeper and deeper, and mining progressed apace, especially after the introduction of the furnace, in 1732, for ventilating the workings. James Spedding, of the Whitehaven collieries, has the credit of being the first to introduce the system known as coursing the air, in which the passages of the mine were so arranged by means of doors and stoppings, that the air passed in a steady current from the downcast to the upcast shaft. That was about 1760, a time when great advances had been made in the construction of machinery, and steam-engines of colossal proportions had been introduced (the engine at Walker had a cylinder cast at the Coalbrookdale Foundry, 74in. in diameter and 10½ft. stroke). Even up to the beginning of the present century the crude method of firing the gas to remove it from the workings was practised in some mines, and continued until in 1815 the Davy and Stephenson lamps were introduced. From that time the history of coal-mining is too well known to need brief repetition here. Much has been done to render it safer by legislation and by improved appliances; but much remains to be done, especially in the matter of examining the workings previous to the colliers descending to their labours. Mr. Galloway has chapters on recent inventions and on modern mining, which complete an interesting book on the history of our most important industry.

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* A History of Coal-Mining in Great Britain. By ROBERT L. GALLOWAY. London: Macmillan.

CART AND WHEEL-MAKING.

By J. Charles King.

(*Continued from page* 83.)

CART spring-plates are cut off from the bar of steel in lengths reckoned so much longer by the sort of "eyes" or "ears" which are formed at the ends of the back-plates, as well as by their shortening by curving out of the straight line, which amounts to 3¾in. on the plates, whether long or short ones. The following proportional lengths will be correct for a pair of six-plate dog-cart springs, 4ft. 2in. long in a straight line from the centre of bolt-eye to bolt-eye; 6in. are generally the extent of the curve of the springs before being weighted with the carriage-body and riders.

Working Measures for Plates of a Dog-Cart Spring 4ft. 2in. Long.

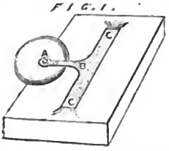
	No. 1. Thick.	No. 2. Curve.	No. 3. Extra length for curve.	No. 4. Extra do. for "pipe-eyes."	No. 5. Length cut off.		No. 6. Finished length.
	in.	in.	in.		ft.	in.	ft in
Back Plate	5/16	3	1	5in.	4	8½	4 2
2nd „		3¼	1¼	4in. less length.	3	8	
3rd „		3¼	1	3in. „ „	3	4	
4th „		3¼	¾	3in. „ „	2	11	
5th „		3¼		3in. „ „	2	5	
6th „	5/16	3½		2in. „ „	1	9	
Totals	1⅞				18	9½	

The above table of measures may serve spring-makers to guide them to essential details of the sizes, curves, &c., of every separate plate of a dog-cart spring, and relatively for other springs. We will begin with No. 1 in the table—the thicknesses of steel at 2in. wide: this measure is for the carriage draughtsman. No. 5, the lengths the steel must be cut off: No. 2, the curve or "span," as it is termed, of each plate; No. 3, the reduction in the length of plates by curving—mark well the fact, though the final curve of the made-up spring is 6in., none of the plates are made to an arc of 6in., as No. 2 shows the back plate with 3in. arc, and the others with gradually increasing arcs; the whole, when "pinched up" by powerful pressure in the middle closing all the plate tightly together, yields an arc of 6in. for the finished spring.

Nos. 1 and 6 are sizes and length mostly given to the smith to work his steel plate by.

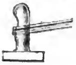
A dot punch-mark is made in the centre of every cut-off plate, from which to measure. No. 4 is the critical estimate made by the smith, to insure practical results from the technical operation of "drawing" steel—this word fittingly indicates one of the essential operations of spring-making. The steel must not be smashed, kinked, or warped by hammering, but "drawn" gradually to a thin end. This is how it is done: Make up a "hollow fire," of which Fig. 1 will help to explain the use and the knack of making-up this fire, which should last for a long day's work. Error and failure are grave teachers. To point them out to a learner may save him from this down-hill way of paying for experience, so costly in time and money. The failure of an attempt to draw a spring plate in on "open" fire would be in burning your steel or melting it, when you expected you had only a fair heat. Fig. 1 is a plan of a "hollow fire."

FIG. 1.



A is the boss of the tue-iron; B, the draft-channel or pipe for the wind from the bellows; *c c*, the arch of banked-up small coal, into and through which the hollow fire is blown for a space of 30in. in length across the forges, into which the steel plate is put to be heated. The wind-current from the bellows becomes heated to a degree that it will fuse steel: this fusion is to be avoided, except for welding, and yet almost approached for "drawing" steel. A hollow fire is thus a flue of live coal, made by the current of air and the act of probing the coal as it becomes caked outside into a solid mass. The coal fire has to be made solid by beating it with a shovel, and mixing it with water by degrees as the blast of air and the probing of the coal proceed. It takes from 20 minutes to a half-hour to make a hollow fire, the bellows being plied properly. I may pause to tell the novice there is a right and wrong way to blow a pair of smith's bellows by the "rock-staff" or bellow's-handle. The right way is to *lift up quickly* and *pull down slowly*. By this simple movement a good workman may be known; a short jogging stroke is faulty.

FIG. 2.



The old saying of "he has too many irons in the fire" may apply well to spring-making; two plates at a time is quite enough for a smith to attend to. The tools used are hand-hammer, sledge-hammer; and set-hammer. Begin with the back-plate and draw the ends to a long chisel-shaped edge, which is thus done: The plate is heated for about 2in. of its length; the degree of heat must be white heat, not fusing (which is known by the molten sparks flying from it); the plate is drawn out of the fire with something like a flash-of-lightning dexterity of the left hand, and it is brought down with a smart blow on the further edge of the anvil-top; the jar thus given knocks off live coal and the fused scales clinging to the surface. The outer surfaces and end are nearly welding hot, but not the inner substance of the steel. The first blow should be by the smith on the plate at the extreme end, as if to knock down the sharp angles; for, remember, one blow is two in effect, for the anvil reciprocates the action of the hammer-face, and knocks up the other corner at the same time as the hammer. The smith now strikes one or two blows on the end of the plate: this is done while the steel rests flat on the anvil, a little overhanging the further edge. Less than half a second should be taken for each of these blows. As soon as these have been given, and the hammer is off the white-hot steel, the striker brings down his sledge-hammer with a smart heavy short-fall blow, the smith turns up the steel on its edge by a wrist movement, and strikes it with force enough to make the steel narrower than its original 2in. width, and by a wrist-turn the steel lies flat on the anvil to receive the next blow of the "sledge, which widens the steel ⅛ of an inch at each blow at first. Thus it seems a contest between smith and mate, one hammer making the steel wider the other narrower, at the rate of three blows of the hammer and two turns of the wrist in a second of time; this is continued as fast as hammers can be moved by human hands, so that to a listener the pattering blows sound like the running-down of a clock without a pendulum.

Steel, like iron, has a tendency to split at the end of the plate if not properly worked by the hammers, so that the smith watchfully keeps the end of the plate well hammered-up; even light taps of the hand-hammer on the edge near the end has that effect of preventing it splitting up.

It is a pleasing sight to witness a spring-maker at work with two strikers, regulating their blows by his, either on the steel or by timed taps on the anvil. The pace, weight of blows, spots on which to strike and when to cease: even when the hammers are on the swing down to the steel, a tap of his hammer arrests them instantaneously. When the steel is drawn down, and before cooling, while it is a dark red colour, a set-hammer (Fig. 2) is held on the plate and the striker gives heavy blows of his sledge-hammer on it. This makes the drawn surfaces of the steel level and smooth; often the smith will dash a little water on the face of the anvil if hot, and also dip the face of the hammer or set-hammer in water. This gives a denser surface to the steel. All the plates are drawn at one end first in the same manner, and a dot punch-mark is put on the end of the plates, so as to know the back or front ends in fitting together. The other ends of the plates are drawn in like manner, according to the measure of each in the table of dimensions.

The next operation is making the slits and studs near the ends of the plates; this requires special tools, of which the springmaker is the maker. They vary but little I purpose giving illustrations of the best forms of each, and how to use them.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XLIX.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 177.)

Pumps.

THE pump is a hydraulic machine for raising water by means of atmospheric pressure, or by otherwise lifting or forcing it with a bucket, piston, or equivalent means. It is very uncertain by whom or when it was invented. Some ascribe it to Ctesibius of Alexandria, 224 B.C., whilst others ascribe it to Danaus. We have, however, very good reasons for believing that the pump was known to the ancient Egyptians. Among some of the modern interesting discoveries in the Egyptian monuments were bellows, which must have been worked with clacks, sculptured in the tomb of Thebes, and which bear the name of Thothmes III., a Pharaoh, and contemporary with Moses. Then Herodotus (Laurent's 2nd Edition, Vol. I., page 34, Clio I. 68) writes about the astonished Lichas whose wonder was aroused at the blacksmith's forge, "Seeing the smith's two bellows, he inferred they were the two winds."

The two bellows were for the purpose of giving a continuous blast, as our double-acting pumps. For my part, I believe that pumps have been known at least 3,000 years.

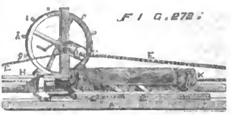
Tree Pumps.

The old method of making and boring the ancient tree pumps, which to this day is much practised in the West of England, &c., may interest many of my readers. For this refer to the perambulator or frame, Fig. 272 A. It is from the practical work of G. Gregory, D.D., 1807, and is a correct drawing of a frame much used by my late Uncle Watkins, well sinker, &c., of St. John's, Worcester, and whose wooden pumps are to be seen in hundreds of places about that and the adjoining counties. This frame was in constant use for over fifty years, and I am told that this same frame is still used by the sons of the above, who are now living in Herefordshire, where wooden pumps are also very common.

This kind of carriage frame was also used for making the stone water-pipes, many of which may to this day be seen in the yard of the West Middlesex Pumping Engine Station at Hammersmith.

The method of boring the above trees will be plain. The auger-rods H are generally, when at work, as in this case, so far as regards lateral or reciprocating motion a fixture, although made to run upon the grooved wheel M, and the tree P made to move upon the carriage or frame B, which travels upon the V-shaped runner-wheels in a V-shaped groove backwards and forwards. Such motion is given to the carriage from the wheel *g h*, and from there to the axle and cord F F, which passes over pulleys at the end of the

FIG. 272 A.



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* From the *Building News*. All rights reserved.

lower frame, and back to the top frame as shown at D and K. Of course it will easily be seen that reciprocating motion may be given to the auger-rods, as also to the top frame, and that, under the circumstances, the rods or frame must move in a true straight line with each other, and if the auger-rods are made to run upon grooved wheels or runners in a fixed straight line with the centre of the tree, it follows that the tree must be bored truly throughout. At times the boring is commenced by first boring a small hole with an ordinary bit-auger, after which a different-sized and taper bit is used to enlarge the bore. Of course as the boring proceeds the tree is worked backwards and forwards to clear the borings or chips from the bore. In the above carriage frame water, steam, or horse power may be used.

Some pipe-borers and well-sinkers do not use a carriage frame, but simply fix the tree in an oblique direction, so that the weight of the boring-rods will force the auger forward. They use "straddle struts" for the support of the boring-rods; but this method requires much practice for good work, as the pipe is apt to be bored out of the true line or centre of the tree. Of course, this kind of boring is only done by hand. The ends are shaped to fit into each other by means of a cone-shaped inside and outside cutter, or otherwise, and in such a manner that when the two are put together they *fit exactly*.

The tree pumps are made of elm or oak—the latter is the better. Elder is also used.

When oak is used, for the first two or three months the water has a very nauseous taste, owing to the iron stain getting into it. Many a score times have I had to pump wells dry to rid them of this kind of water, but after they are once right such pumps are by far the best, in a sanitary point of view.

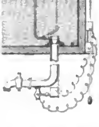
When the tree-pump is bored too green, and fixed exposed to the sun and wind, it will split and crack, sometimes with cracks as much as 18in. long and ½in. wide. When such is the case, and you are called in to repair same, you must first dry the place, then paint it, and with a good putty-knife fill the crack with stiff red and white lead, plastering it well over the crack; then get a piece of sheet-lead long enough for the crack and about 2in. wider, and with some 1in. clout nails nail the lead over the crack. This is known as pump-stopping, and is one of the first jobs the plumber's apprentice has to do in my part of the country.

It may be asked, why wooden pumps still continue to be made. The answer is that in many parts of the country leaden pipes are objected to on account of the material; and, for my part, I say that I prefer wood or stone, especially for some kinds of water.

(*To be continued.*)

PREVENTING WATER-PIPES FROM BURSTING IN FROSTY WEATHER.

A SIMPLE method of preventing the bursting of water-pipes during frosty weather has recently been patented by Drs. Buxton and Ross, and was exhibited at the late Electrical Exhibition at the Crystal Palace. A valve of special construction, called by the inventors a ventilating valve, is screwed or soldered into the end of the house main service-pipe in the cistern, and a piece of string or wire conducted from it to any convenient spot, and fastened to a nail or hook. When frost is expected, all that is needful is to unhook the spring, when the valve falls upon its seat, and air being admitted through the small pipe which rises above the surface of the water, the pipes can be emptied by simply turning on the tap at the lowest point in the house service, the water in the cistern being saved.



To obviate forgetfulness on the part of servants, the inventors have called in electricity to their aid. A thermometer of special construction is so arranged that when the temperature falls below 33°, a current is sent through an electro-magnet, which releases a catch, causing the valve to fall upon its seat, and at the same time opening a small pet-cock at the lowest point in the house service and draining the pipe. The battery is cut out by the fall of the catch, and when the valve is raised again that water may flow into the pipes, the connection is made good. The electrical part of the apparatus is by no means an *essential* feature, but simply saves trouble, and prevents the possibility of allowing the pipes to remain full during frost, as the contrivance is rendered automatic by its agency.

WATCH CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 301, Vol. XXXV.)

NOW I suppose you have got a mandrel (Fig. 54, page 277), and also a depth-tool. With reference to the depth-tool I might add, that if you do not drill the holes straight in blocks E, you must remove blocks, fit fresh ones, and try again until you succeed.

When you have made your mark on the plates (*i.e.*, scored off) for the hole, you place the plate on chuck (*c*, Fig. 54), with the said mark running true with the centre, and drill as shown Fig. 54, rule Fig. 57, B to C; you will find it easiest to drill a larger hole and fit in a bouchong.

FIG. 62.

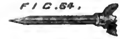


FIG. 61.

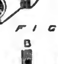


FIG. 64.

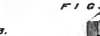
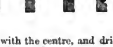


FIG. 65.

FIG. 63.



Jewels and Endstones.

The mode of fitting jewels will be easily learnt by anyone who has had any experience with the mandrel; but it certainly does require a lot of practice, and a deal of care: you must finish up every point as you go, to your entire satisfaction; your tools must be sharp, so that they will cut easy and not jabber, and do not require any pressing, for you must understand that if a drill or any other tool wants any extra pressure to make it cut, it is sure to run wrong; it must have a keen edge, and set so that it only needs sufficient pressure to keep it to its work.

After having "scored off" and proved that your scoring is correct, you put the plate in the chuck of your mandrel and drill a hole about half the size of your jewel (A, Fig. 73); you next take a larger drill, same size as jewel, and drill nearly through (B, Fig. 73); you next take your cutter, Fig. 72, and cut a groove round the outside of this hole (see C, Fig. 73 and Fig. 71); now you will have made a hole as shown by section Fig. 71, and it is ready to receive the jewel. Now put jewel in the hole, and put a piece of pointed pegwood in the place of drill, Fig. 54; let the point of the "skewer" go against the jewel, and that will keep the jewel from dropping out while the plate is running. Now take the pointed tool, Fig. 74, put the point into the groove until the point touches the bottom, then you, as it were, see-saw your tool on the rest, at the same time passing the point of the tool in a circular direction over the face of the jewel, which should leave the jewel as shown, D, Fig. 73. If there is too much brass over the face of the jewel, you must cut it away with the graver. The other jewels are put in as shown Fig. 75; they are let in to the level of plate, and then chamfered on the other side; endstones are put in similar.

Jewel-holes for lever watches are turned up in a piece of wire (brass), the endstones in a piece of steel wire. The working is just the same.

If there is any point that the reader does not understand, I will willingly explain.

(*To be continued.*)

HYDRAULIC MACHINERY.—V.*

By Prof. Perry.

IN my last lecture I pointed out to you the importance of the fact that, when water was in steady motion from one place to another, if we consider that gravity is the only force acting on it, then the whole store of energy in a pound of water consists of:—

Potential, h foot-pounds, because it is h feet above some datum level.
Pressure, $2\cdot3\,p$ foot-pounds, because the pressure is p pounds per square inch.
Kinetic, $v^2 \div 64\cdot4$ foot-pounds, because there is a velocity of v feet per second.

And however any of these stores may alter, the sum of all three remains constant, except that there is a loss at every place which is proportional to the kinetic energy. If at any place other forces than that of gravity act, we have a change in the total store, and we saw what this is in the case of pumps. Each pound of water gets an increased store of energy, which may be in the shape of pressure energy, or kinetic energy, or both, but which mainly becomes potential.

Now, in water-wheels, turbines, water-pressure engines, including hoists and lifts, we take part of the store of energy from each pound of water, giving it to machinery. As a simple case of the abstraction of energy from water, and as an illustration of the acrobat and railway-train principle which I gave you in my last lecture, consider this vessel from which the water is flowing. Water leaves this vessel horizontally from an orifice, taking away with it momentum. The quantity of momentum it takes away per second is simply the force acting on the vessel. You see that there is a force acting, for I have arranged the vessel as the bob of a pendulum. If we let the water come from an orifice which allows it to flow in parallel streams with uniform velocity, it is easy to show that the force acting on the vessel is twice the total pressure which would act on this little sluice when it closes the orifice, and no water is flowing.

It is very strange that some of the soundest writers on this subject imagine the force to be less when the vessel is moving. They forget in their calculation that the water leaving the vessel had at the beginning the motion of the vessel itself. Here is a vessel floating on a pond, and moving under the action of this jet. If I had delicate enough apparatus, I could show you that the force on it is the same as if it were at rest.

It is a very different problem to consider the force of propulsion on the steam-ship *Waterwitch*. Here we must consider that the acrobats enter the train as well as leave it. A large centrifugal pump draws water from beneath the ship, and propels it out at the sides and sternwards.

Suppose the water moves through the nozzles with the velocity of 30 feet per second, and that the ship is moving the other way at 20 feet per second, then it is evident that the water has a velocity relatively to the sea of 10 feet per second. The momentum, therefore, of a pound of water is $\frac{1}{32} \times 10$, and this, multiplied by the velocity of the ship, gives 6¼ foot-pounds of energy, which each pound of pumped water imparts to the ship.

It is easy to see that the greatest efficiency is arrived at by letting the water take with it only a very small amount of kinetic energy as it mingles with sea-water; that, is by letting the backward nozzle velocity of the water be very little greater than the forward velocity of the ship.

A turbine, water-wheel, or water-power engine, takes energy from each pound of water, and gives it to machinery. You must forgive me if I dwell on the turbine, for I see a magnificent future before it which electricity is opening up. Suppose, for example, that we have water in a tank or dam, and we have a clear fall of sixty feet. Now when a pound of water is nearly motionless at the surface of the dam, it has just sixty foot-pounds more energy than when it is nearly motionless in the tail race at the bottom. A water-power engine of any kind is constructed to abstract this sixty foot-pounds of energy with as little waste in friction as possible. Instead of being at the same pressure in the dam and tail race, we may have the pressure energy much greater beforehand, as well as the potential energy; but in every case we try to take out of a pound of water the total difference of energy. Thus suppose a pound of water to be motionless in a mill dam sixty feet high above the tail race, we cannot take more from it than sixty foot-pounds of energy. Suppose a pound of water to be motionless sixty feet above the tail race, but that it is also inside an accumulator, where the pressure is 700lb. the square inch; we can take from it 60 + 2·3 × 700, or 60 + 1,610, or 1,670 foot-pounds of work.

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

If you have understood the action of the centrifugal pump, you will have no difficulty in understanding the action of the turbine. It is because you have studied the centrifugal pump that I mean to dwell upon this turbine of Prof. James Thompson. Water flows from a pen-trough through cast-iron pipes to A. Remember our old rule, these pipes must be bell-mouthed; they must open out gradually into the cistern; they must be as large in diameter as we can conveniently make them. In that case the velocity in the pipes will be small, and, therefore, the friction will be small. Fig. 1 shows a plan of this chamber, B, into which the water flows. This chamber is so large that the velocity here is small, and the water finds its way equally readily into the central space whether it flows between the guide-blades 1 and 2, or 2 and 3, or 3 and 4, or 4 and 1. Observe that at last we are allowing the water to flow quickly, for the guide-blade chamber is narrow. When the water is just leaving the guide-blades, observe that it flows rapidly; of course it is flowing radially as well as tangentially to the rotating wheel, but the tangential motion is equal to that of the wheel.

FIG. 1.

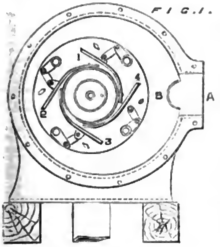


FIG. 2.

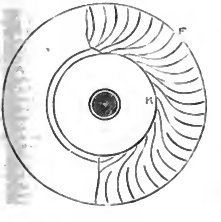
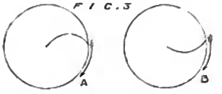


FIG. 3



Suppose you wanted to enter a railway train without shock, you ought to try to get a velocity equal to that of the train, in the direction of the train's motion, before you ventured to enter the train; hence the tangential velocity of the water must be equal to that of the end of this radial vane of the weel, if the water is to enter it without shock. If the vane is inclined like Fig. 3, A, the tangential velocity of the water ought to be less than that of the wheel just here. If the vane here is inclined like Fig. 3, B, the tangential velocity the water is made greater than that of the vane. In fact, you see that the relative velocity of water and vane must be in the direction of the vane, if there is to be no shock. Usually the vane is shaped as you see it in Fig. 2, which is an enlarged section of the wheel; but I will suppose it to be radial just at the outside, for simplicity of calculation. Remember, then, that, somehow or other, we must try to get tangential velocity of water, equal to velocity of vanes there. The water now flows through the wheel; which lets it escape at the centre. Here, again, we must remember that the water has to escape with no velocity, except a radial one.

If we wanted to let a stone out of a railway carriage so that it would just fall to the ground vertically, so that it would possess no forward motion, you know quite well that you would have to shy it backwards, with respect to the train; give it a velocity backwards as much as it has forwards already. These vanes, then, at the centre, let the water out backwards, just because we want the water to have no forward velocity when it has left the wheel. The water has, of course, a radial velocity everywhere, which simply depends on the total quantity flowing per second, divided by the tangential areas of these orifices.

We want, now, to know how much store of energy has each pound of water lost in passing through the wheel, and we employ the rule I told you about before. Get the tangential momentum of the water at F. We have one pound of water, and if the velocity of the outside of the wheel is v, then $1 \div 32 \times v$ is the forward momentum of one pound of water. This, multiplied by v, is the work done by the pound of water, or $v^2 \div 32$ foot-pounds, because it enters the wheel. Now, you see that the wheel does no work on the water as it leaves at K, because the water leaves with no forward or backward momentum. Hence one pound of water, from the time it enters the wheel to the time it leaves, loses $v^2 \div 32$ foot-pounds, from its store of energy, and gives this store to the wheel.

If then it loses no energy by friction anywhere when it enters the tail race, it has just this much less energy than when it left the pen-trough. If h is the total height of the fall, evidently one pound of water really gives out h foot-pounds of energy. We know that in practice, what it gives to the wheel is only a portion of this, and $v^2/32 \div h$ is called the hydraulic efficiency of the turbine. It is the ratio of the energy given to the wheel to the total energy lost by the water in falling from one level to the other. If, then, there is no shock to the water in entering or leaving the wheel, its efficiency is twice the height due to the velocity of the rim divided by the real total fall of the water.

Of course all the energy given to the wheel is not utilised. Remember that there is friction between the wheel covers and the wheel case, friction at all the bearings, &c., of the shafting, which transmits the power of the wheel to a mill, &c. I am only speaking now of the efficiency of the passages through the wheel, which is, however, the most important matter in connection with turbines.

Knowing the average amount of water passing through the wheel, and therefore the radial velocity at K, the angle of the vanes at K is determined if we know the average speed of the wheel. If the speed and quantity of water were exactly proportional to one another—that is, if the speed of the wheel were exactly proportional to the horse-power—the inner ends of the vanes once settled would remain right always. But if our wheel is to be regulated as a steam-engine, so that quickening speed causes less water to flow, then it is obvious that the inner ends of the vanes, although right for the calculated flow, are not properly shaped when the horse-power diminishes or increases. The loss of energy here is not, however, likely to be great in any case. It is different at the entrance to the wheel F. Unless the guide blades are directed so as to give a tangential velocity to the water equal to that of the wheel, there is a considerable loss by friction at F.

Suppose that less water flows through the turbine, the inclination of the guide blades ought to alter, and this arrangement of links, which you see in the drawing, is for the purpose of making the guide blades alter their inclinations to the wheel. Each guide blade is pivoted at its extremity, K, and when one is shifted they are all shifted in position. Unless there is a great variation in the work which we require a turbine of this kind to do, it is not necessary to apply a governor which partially stops the water supply when the machinery runs a little too quickly, although such governors are very necessary for a great many water-wheels and turbines.

It is to be remembered that this turbine is really a centrifugal pump, through which the water is flowing negatively. Increased speed tends to stop the flow. If the wheel were at rest, the flow would be very much greater than it is. Hence, increasing the speed somewhat stops the flow, allows less water to pass through, and less work to be done. This action cannot be called a governor action, for it does not maintain a constant speed; but it may be called a steadying action, as it prevents any great change of speed, even for a considerable alteration in the work done.

Except at the speed for which the positions of the guide-blades are fixed, there is some loss in friction, and the guide-blades are rearranged should any considerable change be meditated in the power to be given out.

In arranging a turbine, it is obvious that the great point to settle beforehand is this:—What ought to be the speed of the wheel for a given height of fall? If there were no loss in friction, we could say at once, if v is velocity of rim of wheel, $v^2 \div 32$, the total loss of energy by one pound of water, ought to be equal to h; that is, the velocity of the wheel ought to be that due to half the height of the total fall of the water. Thus, for a fall of 60 feet in height, half of this is 30 feet; and if a stone fell 30 feet, it would be falling with a velocity of 43 feet per second. The rim of the wheel ought to have a velocity of 44 feet, then, per second, and it is easy to show that, wherever the turbine may be placed, whether it has a long discharge pipe, or is submerged, the water may be made to flow tangentially into the wheel with the same velocity as the wheel itself has. But we have usually to calculate on the assumption that a certain fraction of the energy of the water is wasted in the supply and discharge pipes, and the discharge chamber, and hence the velocity of the wheel is less than that due to half the height of the fall.

(To be continued.)

GEOLOGY ITS PRIMARY AIMS AND BEARINGS.[*]

By Prof. James Geikie.

PROFESSOR GEIKIE said he could hardly do better, perhaps, than try to set forth the primary aims and general bearings of the science of Geology, and to indicate the nature of the problems with which it dealt. Dealing, as geology did, with the operations of Nature in the past, it was obvious that before proceeding to interpret the record of the rock we ought to have a clear knowledge of the mode in which Nature worked at present. All geologists were agreed upon this, and were ready to acknowledge it as the chief article of their faith. Nevertheless, this obligatory article had received different interpretations. Some, for example, had held that the present condition of things must be taken as the exact type of all the phases through which the earth's surface had passed, during the different stages of which we had any recognisable records preserved in the stratified rocks of globe. Other theorists, again, were of opinion that, while the agents of change had necessarily been through all time the same in kind, they had yet varied again and again in degree, and that the present moderate condition of things could not therefore be taken as an exact type and pattern of all preceding phases in the world's history. Thus each school had its own method of interpreting the fundamental axiom of the science—that the present was the key to the past. And as the primary aim of geology was to interpret the stony record with a view to the reconstruction of our earth's history, it was obviously important that they should be able to satisfy themselves as to which of these rival conceptions was most consonant with truth. In other words, they must do their utmost to ascertain which gave the most reasonable interpretation of geological phenomena. Meanwhile, their chief concern in beginning their studies must necessarily be to detect resemblances between the present and the past. They examine, let them suppose, a section of strata exposed upon the sea-shore or along the banks of a river. Their knowledge of the different kinds of sediment in course of transportation and accumulation at the present day enabled them at once to recognise, in the conglomerate sandstone and shale of their section, simply the consolidated sediments of earlier times. The occurrences of fossils in the strata determined whether the deposits were formed in fresh water, brackish water, or the sea—whether near a coast land, or at a greater distance from the shore, and so forth. In short, there were many almost obvious conclusions which the appearance presented by an individual exposure of rock must suggest to any observer who had previously become familiar with the operation of the natural force in the world around him. He simply compared the facts with what was now taking place, and was thus led to conclude that effects the same in kind had been produced in the same way. Sometimes, however, the rocks presented appearances which were harder to interpret in this obvious and ready manner. They encountered, for example, a rock-mass having none of the features presented by ordinary sedimentary strata. Instead of being made up, like conglomerate and sandstone, of rounded stones or grains, arranged in layers, it was entirely composed of larger and smaller crystalline particles, not lying in lines and layers, but scattered indiscriminately through the whole mass. It did not occur in beds like ordinary sedimentary strata, but on the contrary they saw it cutting, as it were, across other rocks, and sending out veins which penetrated the latter in all directions. The observer immediately concluded that the crystalline rock was of younger age than the beds traversed by it; and that the whole mass with all its veins was injected into its present position in a liquid, semi-liquid, or pasty and probably heated condition. And, in confirmation of this last conclusion, he might perhaps note that the rocks immediately adjoiniagg the dykes and veins betrayed the appearance of having been subjected to the action of heat. All these features the observer might have seen exemplified in a modern volcanic district, and he might therefore feel justified in the opinion he had formed as to the formerly molten state and therefore igneous origin of our crystalline rock His induction, however, was not complete. He compared his supposed igneous rock with the undoubted products of existing volcanoes, and although many of these last sent out dykes and veins and had a crystalline texture, yet not a single one might have any further resemblance to the crystalline rock of his section. He could not, therefore, be any longer certain that his dykes and veins had originated in the same way as those of Etna and Vesuvius. The origin of such a crystalline rock as he was speaking of (which they might suppose to be granite) could not be determined, like that of conglomerate or sandstone, by direct comparison with similar rocks in process of formation. Exhaustive examination of the granite itself, and intimate knowledge of its ingredients, and the conditions of formation which these implied combined with careful observation of the mode in which this rock occurred wherever it was met with—these and other studies must be prosecuted before any assurance could be obtained as to the precise mode in which granite dykes and veins had originated. The observer then learnt that these were really of igneous origin as he at first inferred, but his notion that they had been injected into strata at or near the surface like the dykes of modern volcanoes could not, he found, be maintained. All the evidence supplied by careful microscopical examination and physical considerations led to the conclusion that granite had been formed and consolidated at considerable depths. As another sample of the mode of interpreting geological phenomena, he went back to the section of conglomerate, sandstone, and shale, supposed to belong to the tertiary period. The fossils were numerous, and so well preserved that they were enabled to compare them with living forms. A few belonged to existing species, others were closely related to these, while yet others, although without doubt extinct, could nevertheless be referred with confidence to living genera. These facts enable them to come to a trustworthy conclusion as to former climatic conditions—for all they had to do was to examine the conditions under which the existing species flourished, and draw the obvious inference. But suppose the fossils indicated a warm and genial climate, and that the locality in which they discovered the section lay far within the Arctic circle—what must their conclusion be? Simply this: that the climate of those high latitudes was formerly much warmer than it was now. But the next question arose—How could such a climate obtain within the Arctic circle? This was one of those crucial cases which must eventually determine whether Uniformitarians were justified in maintaining that the present was the exact type of all that had gone before, within known geological periods. According to them it was not necessary to look beyond this earth itself for an explanation of such an apparent anomaly as the occurrence of southern faunas and floras in the Arctic regions. All they had to assume was a former very different distribution of land and water. They referred to the well-proved fact that there had been frequent considerable elevations and depressions of the land, which must have indirectly affected the climate of wide areas by modifying the course of oceanic and aerial currents. This hypothesis was opposed by others who maintained that no such distribution of land and water existed at the epoch in question. According to them, the position of the main continental ridges and oceanic depressions was established at a very early period in the earth's history; and they must look beyond our globe itself if they wished to find the key to those greater revolutions of climate of which they had evidence in such a case as the occurrence of a southern flora within the Arctic circle. The greater climatic revolutions of the past were due, they were assured, to periodical changes in the eccentricity of the earth's orbit, combined with the precision of the equinoxes, and the influence which such mutations must have exerted upon the ordinary agents of geological change. The soundness of these opposing views must, of course, be tested by an appeal to facts, and it would be their duty in the course of their investigations to examine all the data which had been adduced in their support. In the initial stages of geological investigations they were occupied in detecting the more apparent resemblances and correspondences between the present and the past; but the results obtained by geologists could not have been arrived at had they confined themselves solely to the detection of such resemblances and correspondences. The natural forces had always been the same in kind, if not in degree; and they could often watch the gradual development by their means of products which more or less closely resembled the rocks of their sections. But experimental evidence of this kind took them only a short way, and they were sooner or later confronted by appearances, which were not reproduced by Nature before their eyes. The fact that a large proportion of the lakes of the world rested in rocky hollows or basins had been long known before it occurred to anyone to ask how such rocky hollows had come into existence. The question was first asked and the answer given by Prof. (now Sir) A. C. Ramsay. He had pondered over the problem for years before its solution dawned upon him. None of the ordinary agents of geological change seemed capable of producing the phenomena. But while studying the glacial features of Switzerland, his scientific imagination enabled him to reproduce in his own mind the aspect presented by the Alps during the glacial period, when the great mountain valleys were choked with glacier ice, which flowed out upon the low grounds of Germany, France, and Northern Italy, so as to cover all the sites of the present lakes. He saw that under such conditions enormous erosion must have been effected by the ice, by means of the rocky rubbish which it dragged on underneath, and that this erosion, other things being equal, would be most intense where the ice was thickest and the ground over which it advanced had the gentlest inclination. Such conditions, he inferred, would be met with somewhere in the lower course of a valley between the steeper descent of its upper reaches and the termination of the glacier, and, after some time, would necessarily result in the formation of elongated rock basins. The examples given of geological methods of inquiry might suffice to show that the process of reading and interpreting the past in the light of the present necessitated not only accurate observation, but an extensive acquaintance with the mode in which the operations of Nature were carried on. In a science of observation like geology, theory was necessarily often in advance of the facts. If additional evidence was required they must first have some notion where to look for it. In other words, it was essential to progress that they should have preconceived opinions or theories, which enabled them to arrange the facts they already possessed, and to point out the directions in which further evidence might be looked for. They could not be too careful, however, that their preconceived notions did not lead them to colour the evidence or to blind them to facts that told against their views.

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[*] From a lecture delivered at the University of Edinburgh, Oct. 28th.

READING AND SPEAKING.*

By Prof. A. J. D. D'ORSEY, Lecturer on Public Reading at King's College.

ALL good reading was natural, and if asked what natural reading was he (Prof. D'Orsey) would say—that which suits the nature of the speaker or reader, the nature of the thing read, or the nature of the place or circumstances in which it was read. What would suit an actor would be out of character in a clergyman, and *vice versâ*; what would be quite proper in reading the Bible would not be the style for Shakespeare, and a Shakesperian style should certainly never be applied to the Bible. Mannerisms, with all the other faults of our public reading and speaking, should be carefully avoided. This was difficult, as was illustrated by an anecdote of Mrs. Siddons, who went to a shop for a pair of gloves, and asked, "Woman, hast thou gloves?" in such a tragic style that the shopwoman, trembling lest her customer were a mad woman with a dagger beneath her cloak, stammeringly replied, "Oh, please, madam, you may have all the gloves in the shop if you'll only spare my life." The first thing to be reformed in schools, colleges, and everywhere else, in this matter was attitude, to illustrate which Prof. D'Orsey imitated the attitude of a village school boy, with shoulders well up to his head, his chest flattened, and his book with both hands pressed lovingly and affectionately to his breast. (The attitude and the sing-song tone of the lecturer created roars of laughter.) A prevailing note, E, F, or G, sharp, flat, or natural, was the general characteristic of school boy or school girl reading in England. A similarly amusing sketch was given of public school reading. The "h's" were not dropped, and the tone was more gentlemanly, but there was equally unmeaning monotony. Lastly, the reading of the ladies' school or college was illustrated—a niminy-piminy, namby-pamby style of reading, in a very low tone, with no expression, and with no manifestation of intelligence. Why should reading be thus defective? The attitude must be first reformed. The book should never be held with both hands—a little light octavo as if it were a ponderous folio. It should be held with the left hand slightly extended, the shoulders should be thrown back, the chest expanded, the windpipe straight, the chin at right angles to the windpipe, and the voice thrown to the end of the room. The cultivation of the voice for reading and speaking was at least as important as for singing. Prof. D'Orsey imitated a certain mayor who introduced him in a speech which he bent over the table to deliver till at lengh there was a head near the table with two elbows up on each side of it, and said that to stoop while reading made twice as much exertion necessary. He reminded his brother clergy of the rubric before the first lesson. "Then shall be read distinctly and with an audible voice"—two very important provisos—"the first lesson. . . . . he that readeth so standing and turning himself as he may best be heard of all such as are present." When did they see a clergyman turn himself during the reading of the lesson so that his voice might go all over the church? This rubric contained all the guidance necessary in the matter of attitude. The next matter for reform was breathing—for although we were at that all our lives we needed hints on the management of the breath. Some by drawing in the breath every fourth or fifth word laid the foundation of the disease of stammering, and bad breathing was at the bottom of much bad reading. A first principle was never to breathe through the mouth if it could be avoided. It dried the mouth, particles of dust were inhaled, with occasionally an enterprising fly, and the vocal organs were injured by turning the cold air upon them when they were in an excited and heated state. Medical men would bear him out in this. Let the mouth be kept tightly shut whenever possible, and let the air be inhaled through the nostrils, but let it be done quietly. It was important also to take a full breath: for when the lungs were fully inflated the chest was a natural sounding-board. To speak with a half-breath was to put great pressure on the vocal organs, croak like a frog, and ultimately ruin the whole voice. Fully inflate your chest, and you could say "Shoulder arms" with a voice like thunder. The voice was not sufficiently attended to in schools. Mr. D'Orsey gave examples to show that the same inflections and emphasis which were natural in ordinary conversation should be cultivated in reading aloud. It should be known that there were speech notes just as there were singing notes. Did they ask what was the shortest way of learning to read naturally? He would say—if you were to divide yourself into two, as it were, and call one the reading man and the other the speaking man, and let the speaking man but teach the reading man, you would be sure to read well—the natural voice of the speaker would be transposed into the reader, and the dreary monotone and mismanagement of the voice would disappear. The voice, like every thing else, was improved by cultivation and ruined by mismanagement. By training it could be made as delicate, as sonorous, as musical, and as powerful for reading as for singing. On the other hand, out of 25,000 clergy more than 3,000 were on the shelf from physical derangements, the result of mismanagement of the voice. Men shouted instead of being distinct, and raised their voices instead of modulating them, and so ruined their vocal organs. He knew a clergyman who had two voices, who preached with a gruff bass voice, varied with an occasional falsetto. He had the misfortune to fall into an open grave. Said he, in his deep bass, "Is any one passing? I have fallen into this grave." "Where are you?" some one asked. "Here, done in this corner," said he, in his falsetto; whereupon he received the reply, "Oh, if there are two of you, you may help each other out." Another necessity of good reading and speaking, Professor D'Orsey said, was articulation. As a nation, compared with other nations of Europe, we were a most indistinct set of speakers. Out of this arose the habit which shopmen had of repeating an order given them. Every letter should be sharp and clear so that not one word could be missed A whisper ought to travel 300 or 400ft., and to show the possibility of this Professor D'Orsey stated that he had proved it in York Minster and in the large church of St. Michael's, Coventry, 300ft. long. Not only did he make other persons hear his whisper at Coventry, but he heard theirs the whole length of the church. He had also succeeded in such an experiment in the Albert Hall, and this showed that it was not loud, but distinct, speaking which did it. A lecturer who was very loud in his tones and very energetic was once rebuked by a quiet Quaker when he sat down. "Friend," said he, "before thou beginnest thy laborious work again wilt thou allow me to say a word? Thou wilt not be offended if I say to thee that thou makest such a dreadful noise we cannot hear thee." Indistinct articulation was an absurdity, and we should do well to remember Bishop Wilberforce's advice to his candidates for holy orders—"Spare you throats and use your lips." To teach pupils to articulate correctly they must be shown what organs produced certain sounds. To pronounce one's "r's" properly, for instance, the tip of the tongue should be put at the back of the upper teeth, and then by the pressure of air removed, and replaced, and the operation repeated.

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* From a Lecture delivered last week at Saxmundham.

Let them attempt to say "r r r r r r" and they would soon know whether they pronounced it accurately. In the same way the teeth must be used for d and t sounds, and the lips for five sounds, b, p, m, f, and v. Some people never used their lips at all, and to them he gave the advice he once gave to a young man who came to him—that they should go and seat themselves before a looking-glass and make all the faces they could think of. As to pronunciation it was another matter of importance, for which there was no real standard—but he recommended Walker's dictionary edited by Smart. A provincial dialect was a hard thing to encounter, but why not try to encounter it? As an instance of mispronunciation he spoke of the cockney "a i" or "i" for the sound of "a" in fate, remarking that out of 4,000,000 of people in London nothing like half a million people spoke respectable English. Passing on to speak of the intellectual part of his subject, Professor D'Orsey said no man could read what he did not understand. He advised that before a piece was read a five minutes' lecture about it should be given to the class, that the boys and girls might understand what it was about. Then get them to mark with their pencils the words on which emphasis should be placed, to put a little tick like an apostrophe where a pause should be made, and a vertical stroke where a long pause should be inserted. Let them not say "It *was* a summer's evening, Old Kaspar's work was done" for nobody disputed the statement, but let them put a short quantity mark over "was" to show that the emphasis should be taken from that word. "Do you walk to Birmingham to-morrow at four o'clock?" was a sentence. *Do* you walk? Do *you* walk? Do you *walk* to Birmingham? Do you walk to *Birmingham* to-morrow? Do you walk to Birmingham *to-morrow*? Do you walk to Birmingham to-morrow *at four* o'clock? A different meaning was conveyed each time according to the position of the emphasis. There should never be an emphasis on personal pronouns except for a decided reason, nor on substantive or auxiliary verbs. In "Our Father which art in heaven," *art* should be spoken lightly and not with emphasis, for in a Christian congregation all believed that God was in heaven. In the creed, again, we heard it said, "The third day he rose *again* from the dead," whereas the emphasis should be on *rose*. At Sheffield that remark was disputed, but the Chairman of the meeting undertook to answer the objection. He said he was out walking and saw a man building a wall. Later the same day he passed again, and the man being still at work he said, "There, you are, building the wall again." "No," said he, "I'm only building it oonst." To take another instance, "Let there be light and there was light" should be read "there was *light*," not "there *was* light." Passing on to speak of pauses, Professor D'Orsey remarked some people stopped no more at commas than a steeple-chaser did at a fence or ditch, and said that the beautiful Church Service was murdered by a neglect of punctuation which deserved the reprobation of every bishop or bishop's chaplain. Besides commas there were rhetorical pauses where a slight check should be made—such as the pause between the nominative and the verb. Inflexions must also be observed. On the last division of his subject, the emotional, Professor D'Orsey said he would not pretend to teach his hearers, they must have heart in what they did. Sheridan Knowles told him "I have taught you all that I know. There is one rule that covers it all—be in earnest. One flash of the eye—one hearty stroke of the arm—is worth a dozen sentences."

ELECTROLYSIS WITH CARBON ELECTRODES.

IN pursuance of their researches on the electrolysis of various liquids by means of electrodes of carbon or graphite, Signors Bartoli and Papasogli have electrolysed solutions of hydrochloric acid, chlorides, hydrobromic acid, bromide, iodide and cyanide of potassium, iodide and fluoride of hydrogen, sulphide of sodium and of ammonium, arsenic acid, antimonide of potash, boric acid, mellitic acid, sulphuric acid, sulphates, nitrates, oxalates, formiates, acetates, hypochlorites, permanganates, chlorates, nitric acid, chromic acid, sodium-bisulphide, and pyrogallic acid. Referring to the original for an account of this extensive series of experiments, we give here the general results, which the authors sum up as follows:—

In all liquids, in which the electrolysis does not develop hydrogen at the anode, the gas carbon, wood carbon, or graphite used as positive electrode is not decomposed, and undergoes no perceptible loss of weight.

In those liquids, on the other hand, in which electrolysis produces free oxygen at the anode, the gas or wood carbon or graphite used as positive electrode wastes away, being partly decomposed; and there are produced carbon, anhydride and carbonic oxides (the relative quantity of which depends on the intensity of the current, and the surface of the positive pole), with other products which are different according to the nature of the carbon.

The graphite employed as positive electrode in these liquids produces no coloration of the electrolyte, whereas gas carbon and wood carbon, after they have been purified by chlorine at a high temperature, produce very intense dark colour in water, in alkaline solutions, and in those of some acids, and of some salts of those acids.

Gas carbon and wood carbon, used as positive electrodes in solutions of acids or of neutral salts, whose electrolysis develops oxygen at the anode, form principally, even exclusively (besides CO and CO_2 gas) a dark, solid substance, which has been called mellogen, the composition of which is represented by the formula $C_{11}\,H_2\,O_4$, or by a multiple of the same, and only traces of benzo-carbonic acids; and in the solutions of phosphoric acid, or hydrofluoric acid, or antimonide of potash, a substance similar to mellogen in properties, but containing phosphorus, or fluorine, or antimony, according to the electrolyte used.

On the other hand, graphite, used as positive electrode in the same liquids, produces, besides the gases CO and CO_2, chiefly graphitic acid, $C_{11}\,H_4\,O_5$, or a similar compound; but containing phosphorus, fluorine, or antimony, if the electrolyte be a solution of phosphoric acid, hydrofluoric acid, or antimonide of potash.

Further, gas carbon or wood carbon, as well as graphite, used as positive electrodes, give, in alkaline electrolytes, mellitic acid, $C_{12}H_6O_{12}$; pyromellitic acid, $C_{10}H_6O_8$; hydromellitic acid, $C_{12}H_{18}O_{12}$, and another acid, which is hydropyromellitic acid, or at least has the same percentage composition as that acid.

These researches are described in *Il Nuovo Cimento*.

PROFESSOR TAIT ON THE COMET.

IN an introductory address to the students of Natural Philosophy at the University of Edinburgh, delivered last week by Professor Tait, with the object of illustrating what natural philosophy had done in the past, and what it was capable of achieving in the future, he drew attention to the appearance of the comet now to be seen in the heavens. Of what materials, he asked, was this comet composed? It had been ascertained, as an absolute certainty, that in the head of the comet the metal sodium was present. They also found carbon and hydrogen present, and the existence of these gases had been proved by the prism. The second important question in regard to this body was—Where is it going, and is there any chance in the future of its coming unpleasantly near us? It required only six or eight hours' observation, he said, for an astronomer to calculate in what path it was moving, and the rate of speed at which it was going; and to be able to do this was the outcome of centuries of study, based on the observations of matter and its properties. It had therefore been calculated that the present comet was forty or fifty millions of miles away, and that its tail was from ten to twenty millions of miles in length. How did they measure this distance and this length? The answer was that these details were founded upon patient observation from the time of the earliest astronomers, whose labours gradually led to an accumulation of facts, from which there was found out the general form of the paths which the comets and planets described round the sun. After alluding to the laws laid down by Kepler, and the supersession of these laws by that of gravitation, the Professor said it was a singular result of their calculations, as based upon more accurate means of observation, that the comet in its path had either grazed the sun's surface, or, more probably, had passed through the upper part of it, without, so far as yet appeared, having suffered any sensible alteration of its course. But how was it possible that a body like the comet could pass through an apparently solid body like the sun? Philosophers had come to believe that the upper part of the sun, and very possibly the whole of it, contained no liquid or solid matter, but that it was merely a gaseous body. So high was the temperature of the sun that even at its centre, where the pressure upon its component parts must be enormous, it was merely a mass of hot gas kept together by attraction and gravitation.

Skates.—What chance there may be of skating this winter we do not know; but as there was none last year, and English winters seldom repeat themselves, lovers of the sport will do well to be ready. The skates advertised by Messrs. Drallim and Oliver seem well worth trying, the prices—either wood or steel—are remarkable, and the makers, confidence in their goods is sufficiently indicated by their offer to return money to all dissatisfied customers.

It is stated that in one week in September last, Mr. Edison lodged no fewer than thirty applications for patents in the United States Office.

SCIENTIFIC SOCIETIES.

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ROYAL MICROSCOPICAL SOCIETY.

THE first meeting of the session of this Society was held on the 11th ult., at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.), in the chair.

Mr. Stewart called the special attention of the meeting to Dr. Dodel Port's diagrams (in continuation of the series), which were not only executed with admirable effect, but were also exceedingly correct and of great use for the purposes of the lecture-room.

Mr. Beck exhibited a slide of *Bacillus tuberculosis* prepared by Dr. H. Gibbes, by the new process he had devised. The question of this *Bacillus* was creating great interest at the present time; and although proof might not yet have been given that tubercular disease was in fact produced by *Bacillus*, it had been clearly shown in cases of that disease, they were present in large numbers.

Mr. Beck also exhibited and described a new "Lithological Microscope."

Mr. Stewart thought that whilst there were many admirable points about the new microscope, it occurred to him that, in use, the movement of the polarising prism might work loose in course of time through being on a hinge joint; he suggested that it would possibly be found an improvement to have an arrangement shifting in a plane parallel to the stage.

The President said that the subject which Mr. Beck's microscope was intended to facilitate—now known as Petrology—was a branch of geology which was of extreme interest and importance, and which had made gigantic strides in recent years, so that there were now many men who did nothing else but examine rock sections. In the course of these observations, the constant shifting of the prisms was extremely tedious, and some remedy for this was indispensable. The important question was, Which of the various methods was the easiest? In looking at the instrument as it stood, he thought that the necessary movement could be effected more easily as Mr. Beck had constructed it than by a lateral movement as suggested by Mr. Stewart. This branch of geological study was, he thought, a most desirable one for the Fellows to take up. It involved a study of optics as well as of geology. He knew of nothing more wonderful than to knock off a piece of trap-rock, and, having got a section of it thin enough for the purpose, to examine it, and reflect that you were looking, as it were, into the heart of a nether millstone, and could see the crystals of which it was composed. There was an idea that these investigations could be done better elsewhere than in this country, where they first originated; but he thought that, with the aid of Mr. Beck's improvements, there would be no difficulty in showing that we were able to develop the subject, at least as well as it could be done anywhere else.

Mr. Crisp exhibited and described Gundlach's College Microscope; Boeker's Air-Pump Microscope; the Bausch and Lomb Optical Company's Immersion Illuminator, the latter, not, however, being 1·52 N.A. as marked, but about 1·20 N.; also a new achromatic spherical pocket lens, by Gundlach ("Globe lens"), which consisted of a sphere of crown-glass inclosed in an outer sphere of flint-glass.

Mr. Beck said it would be interesting to know how these lenses were constructed.

Mr. Ingpen said they were made by inclosing a sphere of crown-glass in two hemispheres of flint-glass. The principle was, as was well-known, one of the best methods of obtaining achromatism. Steinheil's lenses, which were made on this plan, were not entire spheres, but were rather flatter. The eyepieces, which were figured in a late number of the *Journal*, showed how they were put together. [Steinheil's eyepieces were figured in the ENGLISH MECHANIC, recently.]

Mr. Ingpen described a method of rapidly attaching objectives to the nose-pieces of microscopes which had been devised by Mr. E. M. Nelson, the idea having been suggested to him by the method employed by the French, for fixing the head-pieces of ordnance. Three equal segments of the threads of the screw, both of the objective and nose-piece, were cut away, enabling the objective to be fitted in its place at once to the full depth of the screw, one-eighth of a turn then sufficing to fix it firmly. The great advantage of the plan was that it enabled anyone to fix an objective in a few seconds, whilst it did not in any way unfit either the objective or the nose-piece for being used in the ordinary way. Messrs. Powell and Lealand had made a standard-gauge which could be referred to if desired.

Dr. Ondaatje, of Ceylon, was introduced to the meeting by the President. He exhibited a number of specimens of Echinoderms, Gorgonidæ, Algæ, &c., which he offered to the Fellows for mounting.

The President, in thanking Dr. Ondaatje for his communication, said that some of the objects exhibited were of great interest. The small specimen of *Echinus* was very curious, as it seemed to him it did not consist of the original carbonate of lime of the creature, but looked more like crystallised calcite, as if it had been concreted in some way.

Mr. E. W. Burgess's letter was read, accompanying specimens of diatoms from the Island of Lewis.

Mr. Crisp said it would be in the recollection of the Fellows that, at the April meeting of the Society, a note by Drs. Loew and Bokorny was read, as to the chemical difference between living and dead protoplasm, and that some remarks were made by Mr. Stewart as to the possibility of some of the effects being due to the remains of the citric acid used in killing the protoplasm. Dr. Loew had since written a note in reply to the criticisms, which he then read:—

"I learn from the June number of your highly-esteemed journal that the discovery of a chemical difference between living and dead protoplasm by myself and Bokorny has given rise to some discussion in the Royal Microscopical Society.

"Mr. Stewart has expressed some doubts in regard to our statement, believing that some residual citric acid (which we had applied in one case of killing the cells) might have been the cause that no silver was reduced. In regard to this I have to say that the acid was removed as well as possible by continued washing with distilled water, before applying the silver reagent. Besides, the *alkaline* nature of the latter would have neutralised any trace of the acid left. The reason why, after killing with citric acid, no more silver was reduced by the cells, was certainly a chemical change of the protoplasm itself.

"Whoever will take the trouble to study our publication, 'Die Chemische Kraftquelle im lebenden Protoplasma' (the chemical source of power in the living protoplasm), will find that every precaution was taken in all our labours to avoid errors and false conclusions. We have killed the cells in all possible ways: by starvation, by desiccation, by heating to 50° C., by mechanical action, by electrical sparks, by ether, alcohol, carbonic acid, kerosene, sulphuretted hydrogen, by sugar, tannin, by acids, alkalies, and salts; and in all these cases the protoplasm had become changed, so as to be incapable of reducing silver.

"In one case, however, death was produced by destruction of the structure and organisation *alone*, the chemical nature remaining unchanged; it was by the action of certain poisons, especially alkaloids. We have described these cases in minute detail in our publication. Life must be considered as the result of two functions:

"(1) Of a specific chemical motion—viz., the energy of the aldehydic groups in the molecule of the *active* albumen.

"(2) Of the organisation of the protoplasm—viz., the specific molecular construction from molecules of active albumen. If *one* of these functions is destroyed, death is the result. (See pages 25 and 77 of our publication).

"No thinking mind will doubt that the vital force is a mode of motion, like all other forces of nature. We have proved beyond a doubt that the vital force is the result of a specific *chemical* motion, as minutely explained in our publication. (See pages 19—25, and 88).

"It is true there are many objects which are so sensitive, that they die too quickly to give the silver reaction, which is only slowly developed, requiring many hours; we have described such cases, too, (see pages 60—62, of our publication).

"I have proved, furthermore, that the *quantity* of reduced silver corresponds with my theory (see pages 91, 92), and have arranged now to analyse the product formed by the action of the silver solution upon the living protoplasm; a product that is impossible to obtain with dead protoplasm.

"In regard to Mr. Stewart's remarks on 'silver-staining,' it is most essential to note that the silver-staining process is based *upon the action of light*; many organic substances will reduce silver, *if in contact with light. Our process, however, goes on in absolute darkness!* and is quite a different thing from the 'silver-staining process.'

"Recently some volatile aldehydes have been discovered in plants by Mori and by Reinke; but we must utterly deny that our observation has anything to do with such an aldehyde. Our objects were entirely free from any volatile or soluble aldehyde; hence our reaction shows conclusively *the aldehydic groups as constituent parts of the molecule of active albumen.* The albumen, passing from the active into the passive condition, loses the *aldehydic groups* by displacement of the atoms ('atomumlegerung') and the intense chemical motion has ceased herewith at once."

Mr. Stewart said that the remarks which he made on the occasion referred to were hardly offered as a matter of criticism, but rather as a matter of inquiry. It was clear that the experiments of the authors had been conducted with singular precision, and he was very glad that his observations had been the means of bringing out these additional particulars. He might also say that the original paper of Drs. Loew and Bokorny having been sent to him, he had laid it before Dr. Bernays, the chemical lecturer at St. Thomas's Hospital, who had been so much interested in the subject that he intended to thoroughly investigate it, and no doubt they would in due course hear the results of his experiments. Meanwhile, as a preliminary, he had received from him the following letter:—

"I have read the letter of Drs. Loew and Bokorny, and consider as proved by them that the power of producing alkaline silver solutions is an essential property of many forms of living vegetable plasma. I consider that a complete answer is furnished to your own suggestion about residual citric acid: that must be given up. The experiments of Drs. Loew and Bokorny have been made with a care and skill deserving of the highest praise.

"Of the nature of animal protoplasm little is known. The authors of 'Die Chemische Kraftquelle im Lebenden Protoplasma' admit as much; but they consider themselves entitled to the judgment that the reactions of aldehyde groups in active albumen are capable of equal application. The cases of chronic silver-poisoning do not seem to confirm the view, as we should certainly expect on the aldehydic theory a much more even distribution of metallic silver. And, in the case of man, alcoholic potations would have to be rigidly excluded in order to *assist* in the confirmation, or otherwise, of the aldehydic theory. Whether any, and what, differences exist between vegetal and animal albumens we cannot exactly say.

"The aldehydic theory is the most interesting attempt at explaining the distinction between living and dead protoplasm that has ever been offered. But, although the reactions discovered by Drs. Loew and Bokorny are similar, *in the one aspect of reducing alkaline silver solutions*, I do not see more in their most interesting statements of experiments and views than to confirm most successfully the difference between living and dead plasma. For myself, I say, with all deference to these distinguished scientists, that further proof must be offered of the view these gentlemen hold, before I would accept the aldehydic theory as more than an interesting attempt at explanation."

Mr. Crisp read a note from Mr. C. Stodder as to the Tolles ¼in. objective with tapering front, exhibited at the June meeting, in which the writer pointed out that the speaker at that meeting, who stated that "similarly tapered" objectives had been made as early as 1848 by Andrew Ross, and since by others, had not understood "the peculiarity or the purpose of the construction of the objective exhibited. It is not merely an objective of the usual form in a tapering or conical brass mount, but the front lens is itself a cone." No such objective had ever been seen in America previously to that first made by Tolles in May, 1870, and there is no record of any having been made in England or anywhere else. "The original design was to cut away the front lens or lenses of an objective as closely as possible to the cone of light admitted from the object, so as to permit the illumination of the opaque object at the highest possible incidence from above outside of the brass of the mount, i.e., with the least obliquity to the general surface of the opaque object, and with no injury to the performance of the objective with transmitted light. To protect the projecting cone of glass from injury, a thin sheath of metal was sometimes fitted about the cone. This case was also made to protect the front surface, which also was sometimes made slightly concave for the purpose. . . . I am perfectly well aware that pointed-nose objectives have been made by many makers in England. That is another matter."

Mr. Ingpen said he was now able to exhibit the objective he referred to at the last meeting by Andrew Ross. Its aperture was 60°, and the front lens, which was a triplet $\frac{7}{16}$in. in diameter, was coned down to an angle of 120°, reducing the front to $\frac{1}{16}$in. surface. Opaque objects could be illuminated at an angle of 30° from the level of the slide. The primary reason for coning this particular objective was the use of a very narrow Lieberkuhn, but objectives were also coned for the purpose of getting rid of "stray light," to which particular attention was afterwards called in an article by Mr. Wenham on angular aperture, published in 1874, after which many lenses were coned for that purpose. The practice had since been to a great extent abandoned, in consequence of the reduction of aperture caused by it.

Mr. Beck said it was quite preposterous for anyone to suggest that there was any novelty whatever about the objective referred to by Mr. Stodder. James Smith, who was a very skilful worker in glass, used to pride himself upon the way in which he was in the habit of coning down object-glasses. He used to fit them in a cell, and then turned them down in a lathe with a diamond, so that the front lens had no cell at all. A small brass cap was fitted over it to prevent any danger of its being injured.

Dr. Edmunds said that the Fellows always cordially welcomed communications from foreign microscopists. It was true that it had been demonstrated this evening that the idea of coning off the front lens of an objective had been tried long since by English opticians, and therefore that the plan communicated by Mr. Stodder was not new; but he thought Mr. Tolles was evidently entitled to the merit of an independent invention. These discussions over devices tried and lost sight of, only to be reinvented a generation later, showed the value of the figures and technical descriptions of apparatus which had been published in the Society's *Journal* of late years. He asked if Mr. Beck or Mr. Ingpen could give the meeting any references to descriptions of the method.

Mr. Beck said it was recorded in the catalogue of their firm; and if any other evidence was needed, it might be found in the fact that a large number of microscopists were in possession of similar objectives. Mr. Beck then examined the Society's Cabinet, and produced one of James Smith's objectives, made before 1847, the front lens of which was coned off in the manner described, and a small cap put over it.

Mr. J. Mayall, jun., said he understood Mr. Stodder's claim on behalf of Mr. Tolles to be that he originated the plan of reducing the front lens or lenses of an objective, as near as possible to the cone of light transmitted, so that the exposed surface of the front lens was the exact working diameter required for the aperture of the whole combination. By such acute coning no doubt the greatest range was provided for the use of Lieberkuhns, &c. He had examined many low-power objectives with tapering fronts, but the great majority were seen at a glance to have been coned with no other purpose in view than to improve their appearance. With regard to the Ross half-inch objective of 60° air-angle, exhibited by Mr. Ingpen, of which the body of the front lens was coned to an angle of 120°, it was evidently not Andrew Ross's intention to cone the front to the uttermost, or he would have cut it down to an angle of about 40° instead of 120°; 40° in the body of the crown-glass front being sufficient to transmit a pencil of 60° from air. Could Mr. Beck affirm that the objective he referred to, made before 1847, was coned in front so as to allow just the full aperture to be utilised? If so, he (Mr. Mayall) thought Mr. Stodder's case must fall to the ground.

Mr. Beck said that the one he held in his hand was done with the precise object of getting the front reduced to the smallest cone possible.

Dr. Dippel's note "On Correction Adjustment for Homogeneous Immersion Objectives," was read by Mr. Crisp. The following is a summary of the note:—

Dr. Dippel insisted that to use a correction-collar with homogeneous-immersion objectives was to abandon one of the most important practical advantages which the homogeneous-immersion principle had brought to histologists. He showed that the suggestions which had been made of the necessity for correcting the variations of temperature and the difference of accommodation in the eyes of different observers, were entirely imaginary, and that while there was no insuperable difficulty in the construction of objectives with correction-collars, yet that nothing was gained thereby except perhaps in the exhibition of test-objects. For histologists the correction-collar could only be regarded as a snare with such objectives.

Mr. Beck said that the paper seemed to him to be an apology for being content with inferior definition rather than taking the trouble to get the best that was to be obtained. He understood the course of argument to be that there was so much trouble in making the adjustment that it was better to do without it. He ventured to say that there was not anyone who had got over the trouble who would for a moment put up with what was inferior, if he had it in his power to get what was the better. He should like to hear some observations on this subject from Mr. Mayall, jun.

Mr. Crisp said that the author of the paper did not put the matter on the ground of trouble at all. What he said was that the advantages to be derived from the adjustment-collar were so infinitesimal in the case of unknown objects, that they did not compensate for the disadvantage.

Mr. Ingpen thought that even amongst those who were thoroughly familiar with the use of the highest powers, very few would be found capable of adjusting an objective to the same degree of accuracy as the optician, and therefore any one who had a valuable objective should be very careful not to disturb its correction. It was also, he believed, a matter of experience that with the particular class of objects referred to by Dr. Dippel, no two histological observers would agree as to the best correction. Prof. Abbe had met that difficulty by proposing a special test-object for the purpose, and as the description of this method would, he understood, shortly appear in the journal, he need not enter further into that part of the subject, except to say that the Professor's test-plate was not like the *Podura* scale or *Angulatum*, but showed beyond question what the best correction was, and made it possible for a person to pass a number of objects under the objective, and at once determine the best correction for each.

Mr. J. Mayall, jun., said he concurred in much that Mr. Beck had said, especially in his advocacy of all that tended towards the perfection of objectives. As regarded the application of the correction-adjustment to homogeneous-immersion objectives, he was obliged to express his disagreement with Dr. Dippel. The facts on which his own judgment on this question was based were briefly these: When Zeiss's homogeneous-immersions were first sent to England he immediately observed that certain dry objects, such as *Podura*, were very indifferently defined by the new lenses, precisely as he had previously found with water-immersions in fixed settings. These objects were always such as did not adhere very closely to the cover-glass. Knowing from experience that the correction-adjustment had, in many cases, met the difficulty with water-immersions, he took an early opportunity of pressing upon Messrs. Powell and Lealand to apply the adjustment to the homogeneous-immersions. The result fully answered his expectations. There could be no doubt, whatever, that the correction-adjustment increased the range of conditions within which the homogeneous-immersions would give fine definition. He might state, as a matter of repeated personal experience, that in testing a number of homogeneous immersions—fixed settings *versus* adjustment settings—whilst there were undoubtedly many preparations which were defined equally well by both systems, there were also many upon which no superficial structure could be discerned with the objectives in fixed settings, but which yielded well-defined images when viewed with objectives having the correction-adjustment. The differences in the lenses might not be so marked as those seen in comparing dry lenses with and without adjustment; but still they were unmistakable, and unquestionably in favour of the adjustment. In the best homogeneous-immersion objectives he had examined, the corrections were so sensitive that different thicknesses of cover-glass had to be compensated for by the adjustment; whilst different specimens of oil of cedar-wood so completely altered the character of the image, that unless the correction-adjustment were brought into use the objective might be condemned as defective. Even with the correction-adjustment, a marked variation from the normal immersion-fluid could not be compensated for. The objectives he here referred to were those having numerical aperture from 1·2 to 1·47. He could not agree with Mr. Ingpen that it was best for the amateur to let the opticians choose for him the best average adjustment, and there fix the lens-mounting. He considered the amateur should make himself skilled in the use of the adjustment. As to the difficulty of finding two persons who would agree on the best point of adjustment in attempting to interpret an image of an histological preparation, he thought the solution of the difficulty would be best found by insuring greater skill in making the preparation. When the *Bacillus tuberculosis* was first observed, it was only after great perseverance that anything could be interpreted from the confused mass of images; but the moment better methods of treating the preparations were found, the difficulties vanished, and what had formerly required hours of patient investigation to glimpse was now exposed to the eye at a glance. It would be interesting to the Society to learn that Prof. Abbe himself had so far wavered from his former opinion against the application of the correction-adjustment to homogeneous immersions that he now agreed with Mr. Zeiss that those objectives should be supplied either with or without adjustment; accordingly, in future, Mr. Zeiss would supply both kinds. He gave this on the authority of Dr. Zeiss. Prof. Abbe must therefore be regarded as partially, at least, opposed to Dr. Dippel's views. He might add that among the opticians who were in favour of mounting homogeneous-immersions with correction-adjustment, were Powell and Lealand, Ross, Tolles, Spencer, and Dr. Schroder.

Mr. Crisp said that Dr. Dippel did not dispute that a somewhat higher degree of accuracy might be obtained with the correction-collar, but it was only with known objects, such as the Abbe test-plate, and with the closest examination. With unknown objects, however, it was utterly impossible to determine the position of best correction, and the correction-collar had, therefore, in those cases, no advantage to compensate for its disadvantages, and should not be used by histologists at any rate.

Mr. Crouch said that in making the rough adjustments for students' microscopes, they had to bear in mind the purposes for which they were likely to be used. In ordinary cases they would have to provide for histological sections, and this was not an easy matter, being quite unlike the case of a *Podura* scale, where they could adjust properly, because they had a surface to focus upon. He found the best average results were obtained from an objective when it was adjusted for an average thickness of cover-glass. He had known cases in which objectives with correction-collars had been condemned and returned to him, because it was said that good definition could not be got, the same objective being pronounced satisfactory after being re-mounted in a fixed setting.

Dr. Edmunds thought that adequate weight had not been given to the difficulty of ascertaining what was the true image of a complex histological section when viewed under a high-power objective. The real question was whether that image could be most certainly fixed upon by means of a lens furnished with a correction-collar, necessitating its adjustment for each object. Microscopists who devoted themselves to the resolution of *Amphipleura pellucida*, or of Nobert's lines, often knew nothing of the difficulty of interpreting the structure of muscular fibre and other more complex histological objects. The *Podura* scale, though used as a test object for histological lenses by their makers, yet was an object whose structure had never yet been interpreted in any way which commanded general assent. Take, again, *Pleurosigma formosum* in balsam, which presented different appearances with every touch of the correction-collar and with every variation in focal distance, so that it could not be interpreted with certainty; were a skilled microscopist now to see this object for the first time, a correction-collar upon his homogeneous lens would only add to his difficulties in fixing upon what was its true image. With a water-lens and varying thickness of cover-glass, the case was different, and the correction-collar was indispensable. While, therefore, the correction-collar might be theoretically an advantage, he thought that in practice it would be a disadvantage; and that, instead of attempting to correct the objective, we should correct the object by mounting it always under conditions defined as those of homogeneous immersion.

Mr. Guimarnens called attention to a slide labelled "Pedicellariæ in situ, attached to the spine of *Echinus gracilis*," and sold, as illustrating a discovery that pedicellariæ are attached to the spines of Echini. He would be glad to know whether the pedicellariæ in question were naturally attached to the spine, or whether an imposition had been practised.

Mr. Stewart said that in this specimen the *Pedicellariæ* were undoubtedly adherent; but they could not have been so during the life of the animal.

The meeting was then adjourned to Nov. 8th.

PRACTICAL RECIPES.

Sheepskin Mats.—Wash while fresh in strong soapsuds, first picking from the wool all the dirt that will come out. A little paraffin, a tablespoonful to three gallons of water, will aid in removing the impurities. Continue to wash the skin in fresh suds till it is white and clean. Then dissolve a half pound each of salt and alum in three pints of boiling water, put into it water enough to cover the skin, which should soak in the solution twelve hours, and then be hung on a line to drain. When nearly dry nail it, wool side in, on a board, or the side of a barn, to dry. Rub into the skin an ounce each of pulverised alum and saltpetre, and if the skin is large double the quantity. Rub for an hour or two. Fold the skin sides together, and hang the skin away for three days, rubbing it every day or till perfectly dry. Then with a blunt knife clear the skin of impurities, rub it with pumice or rottenstone, trim it into shape, and you have a door mat that will last a lifetime. If it is to be dyed, have a shallow vessel as large as the skin in which to prepare the dye, so that the skin can be laid wool-side down smoothly into the vessel that all parts may be equally immersed in the dye. This should not be more than an inch deep, otherwise the skin might be injured by the hot dye. After colouring again stretch the skin to dry, and then comb with a wool or cotton-card.

Cheap Paint.—Professor Knapp, of the Iowa Agricultural College, recommends in the *New York Tribune*, a paint composed of three parts crude petroleum and one part linseed oil, with mineral paint for body. Five buildings and considerable fence upon the Iowa Agricultural College Farm have been painted with this preparation. Upon some of them it has been one year, and thus far it has appeared to be fully equal to more expensive paints, in body, in durability and in retention of colour. It is specially adapted to cheap outbuildings, covered with rough boards. If twenty-five pounds of white lead be added to each hundred pounds of mineral paint, the mixture answers a very excellent purpose for tenement houses. Many experienced painters have examined the buildings covered with this paint, and affirmed that it made a better covering than pure lead and oil. This is doubtless an extreme view. It may, however, fairly be considered as a reliable paint for protection of the fences and the cheaper farm buildings.

LIME slaked with a solution of salt in water, and then properly thinned with skim milk from which all the cream has been taken, makes a permanent whitewash for outdoor work, and, it is said, renders the wood incombustible. It is an excellent wash for preserving wood and for all farm purposes.

SCIENTIFIC NEWS.

OPINIONS still differ as to the great comet, and Mr. Neison is now credited with the dictum that it cannot be identical with the comets of 1843 and 1880. According to Mr. Hind, its position at 18h. G.M.T. will be—

	R.A.	N.P.D.
	h. m.	° '
Nov. 6	9 45·8	111 47
Nov. 10	9 38·3	113 9

Elements of Barnard's Comet (1882*c*) have been calculated by Mr. Hind, who gives the perihelion passage as Nov. 13, when it will be near Eta in the constellation Musca.

We have received the sheet containing the ephemerides of MM. Schulhof and Bossert for assisting in finding Pons's comet of 1812. There is much uncertainty, but those astronomers venture to predict the next perihelion passage for Sept. 3·65, 1884, Paris M.T.

Mr. J. A. Westwood Oliver has issued his pamphlet on "The Doomed Comet," in which he says that from what we know of the nature of comets, &c., we may infer that the "approaching celestial catastrophe" will be followed by nothing more than abnormal magnetic disturbances, displays of the aurora, or possibly, by nothing at all. In a postscript he expresses the belief that the comet's destruction will help to produce "good seasons" in the British Isles and Western Europe.

A private exhibition of Mr. J. E. H. Gordon's new dynamo was given last week at the works of the Telegraph Construction and Maintenance Company, Greenwich. The machine is of the alternating current type, and is the largest in existence. The total weight is about 18 tons, the revolving magnet-wheel weighing 7 tons. The machine is believed to be capable of supplying no fewer than 7,000 20-candle Swan lamps. The coils can be joined up in almost any desired manner; the E.M.F. is about 60 volts, and the resistance, when the fixed coils are connected in quantity, only ·00047ohm.

A tricycle, fitted with Ayrton and Perry's electro-motor, was recently ridden through the City by Prof. Ayrton. The current was supplied by Faure Accumulators, and was used to light two small Swan lamps as well as to propel the machine. The additional dead weight was about 1½cwt.

A method of signalling by means of electric balloons, was tried recently in Paris by MM. Mangin and Baudet. The balloon, made of paper rendered translucent, was about 8ft. in diameter, and was filled with pure hydrogen. A Swan lamp was fitted inside, and a light rope carrying two copper wires was attached. When the circuit was completed, the whole balloon appeared to be a globe of fire. By switching the current off and on the Morse code can be spelled out, and thus, captive balloons of this kind can be used for signalling purposes.

Bennett's tin-pot cell has been used as a secondary battery by Mr. T. Farrington. He uses rusty iron in preference to clean borings, and carbonate of soda instead of caustic soda.

The New York Steam-Heating Company will soon complete their first station. It contains sixty-four boilers of 250 horse-power each, and the steam is conveyed in 15in. wrought-iron mains, with 7in. returns for the water. Eight of the boilers have been at work some time supplying steam to customers; but when the arrangements of the company are completed there will be 640 boilers, developing about 100,000 horse-power, for there are altogether ten stations.

An organ, which is to have 120 speaking stops, is (according to the *Leipziger Zeitung*) being built by Walter and Co., in Ludwigsburg, near Stuttgard, for the cathedral at Riga. As it is to have all the most modern improvements, it will be the most elaborately-designed instrument there is. It will be so constructed that it can be played from an upper gallery or from below. The whole upper portion is to be blown by gas motors, and the lower part by hand. Thus two people will be able to play at the same time, one playing the solo, whilst the other plays the tutti. It will, according to the above-named journal, be the largest organ in the world, and is to cost 90,000 marks (say £4,500). The great organ in New York has 115 speaking stops.

It has been announced that Brazil will have four stations for observation of the Transit of Venus—viz., St. Thomas (under Capt. de Jeffé), Magellan (under M. Cruls), Pernambuco (under M. Lacaille), and Rio de Janeiro (under Captain Jacques). The four embrace an arc of 72°. The Magellan mission, in order the better to fix the longitude of the station, will have recourse (in addition to lunar culminations) to a chronometer chain connecting with Montevideo, and obtained by means of fifteen chronometers. A Government corvette will be provided for secure transport of the latter. Each station will have a 6in. equatorial, a 4½in. astronomical telescope, a meridian telescope with collimator, an excellent compensated pendulum and four chronometers, an electric chronograph and accessories, and a collection of meteorological instruments. The British observers for Barbadoes and Bermuda are now en route, and judging by the number of parties sent out, some definite result ought to follow.

According to *L'Electricité*, the great misfortune of the Munich Exhibition is, that it lacks the animation of a crowd. It resembles Bavaria itself, which is of vast extent, but has not a greater population than Belgium, though its surface is three times as great. The population of Munich is scarcely half that of Brussels, and is about equal to that of Bordeaux. Further, Bavaria is neither wholly Prussian, nor wholly independent. It has a king, but he is subject to an emperor. Berlin will never take Munich *au serieux;* Vienna tends too much to regard Munich with pity. It is only France that, notwithstanding the disasters of the terrible year, can sympathise with Bavaria...." But, from the scientific point of view, there are neither great nor small nations," &c.

The following experiment in the way of physics without apparatus is given by a correspondent of *La Nature*. A clay pipe is laid over the top of a large wine-glass, and a person is required to bring it down to the table, without touching either pipe or glass, without agitating the air or moving the table. The solution of the problem consists in taking up another like glass, rubbing it vigorously on your sleeve, then bringing it near the pipe stem, which is thereupon strongly attracted, so that the pipe falls. This experiment is a pretty variation of the electric pendulum, and shows that pipe-clay, a very bad conductor of electricity, yields readily to the attraction of an electrified body.

The question has been a good deal debated in certain circles, when and in what way movements occur in the hoof of the horse. With the measuring apparatus available, the existence of a movement of widening of the hoof could be demonstrated; but it was not possible to fix the moment at which the widening occurred: whether at the moment of heaviest weighting of the hoof (old view), or in release from the weight (new view). Professor Bayer has recently attacked the subject with the aid of electricity at the Veterinary Institute in Vienna. He fixed to the toe (as the least movable part of the hoof), near the wall, a metallic bow which extended back towards the quarters, and would be lengthened or shortened according to the size of the hoof. At its end this bow carried an adjustable style of platinum directed towards a small flexible metallic plate, fixed on the edge of the wall; or better, towards tinfoil covering the whole wall. The bow and the metallic plate or tinfoil were connected with a battery and a bell-signal actuated by the current. Thus even quite small movements of particular parts of the hoof wall were indicated by the bell, and the moment determined at which they took place. Professor Bayer's observations confirm the old view above referred to.

The disasters to German sea-going vessels in the year 1881 amounted to 225. On these ships were 1,562 sailors and 31 passengers; 214 of the former and 11 of the latter lost their lives. Of the ships referred to, 121 were stranded, 6 capsized, 35 sunk, 4 burnt, 39 went down in consequence of overloading, and 3 of collision; and 17 were never heard of. The greatest number of disasters was in the North Sea and on its coasts, where 110 ships were lost; 46 ships were lost in the Baltic, 39 in the Atlantic, 8 in the English Channel, 7 in the Pacific, 3 in the Indian Ocean, 4 between Great Britain and Ireland, 2 between East India Islands, and 2 on the coast of Norway. With regard to 4 ships the place of disaster is not given.

The introduction of plants, &c., into France is now no longer prohibited. Plants, shrubs, and various productions for nurseries, gardens, hothouses, and orangeries, &c., may be sent into the country by post. The packets must be accompanied not only by the usual customs declarations as to contents, but a declaration of the sender, and a certificate from the police authorities.

On the 8th of October a German-Italian railway conference met at Rome; it consisted of some 40 representatives of railways in the two countries, and its object was the fixing of arrangements for distribution of the traffic between Italy and Germany by the St. Gothard and Brenner routes. The receipts of the St. Gothard Railway from passenger traffic were, in June, 330,000f., in July, 423,000f., and in August, 594,000f.

In giving an address lately at the distribution of prizes in connection with the French Société contre l'abus de Tabac, M. Bouley, the president, mentioned that the state revenue from tobacco in 1881 amounted to 352,538,000f. He contrasted former times with the present, and blamed the weak compliance of ladies, for the great modern extension of smoking. The practice, he held, had gradually established an intellectual divorce between the sexes; after dinner, the men betook themselves greedily to the smoking-room, to talk of horses and dogs, while one or several cigars were being consumed; and when they joined the ladies, who had been talking together in a spiritless way, it was not only with a bad odour from mouth and dress, but with blunted faculties. The mild complaisance of ladies who waltzed with men who had been smoking, was also condemned. The society above mentioned has appealed to the Minister of Public Works to have the compartments for smoking in trains, indicated by letters painted on the carriage, and not by movable boards, which the employés often forget to attach in sufficient number; also for the absolute interdiction of smoking in compartments not bearing "*Fumeurs.*"

According to M. Pateau, who has recently made ingenious experiments regarding the strength of insects, the smallest of these animals are proportionally the strongest. A cockchafer can pull 21 times more, proportionally, than a horse, while a bee pulls 30 times more. (The animals were attached to a cord passing over a pulley to a weighted scale.) The horse draws 6-7ths of its weight, the cockchafer 14 times its weight, and the bee 20 times. A cockchafer thus develops, relatively, at least the same power as a locomotive.

A special mission has been appointed by the French Ministry of Agriculture to study the cultivation of the vine in Japan. It appears that in that country the vine is cultivated in regions nearly as high as the limit of permanent snow. The members of the mission are to inquire into the possibility of acclimatising in France those little-known vine species.

A convenient arrangement, whereby a Geissler tube is rotated electro-magnetically on a supported axle above a coil standing on one end, has been devised by M. Combettes (*L'Electricité*, Oct.).

Dr. Hase, of Hanover, has invented an electrical fire-alarm apparatus, in which a glass tube with two terminal bulbs at its upward bent ends, partly filled with spirit of wine, is supported horizontally with a brass ring at the middle allowing of slight rotation in a vertical plane. The system resembles a water-hammer, but one of the bulbs is blown larger than the other and has a thinner wall, so that it is very sensitive to changes of temperature. The (displaceable) brass ring is so placed that the end with the larger bulb preponderates over the other, lying on a rest. When a rise of temperature occurs, the liquid is forced into the other arm, so that the latter descends on a platinum style attached to a spring, making it dip in mercury, and so close a circuit and cause a bell to ring.

The telephone has made rapid progress in Mexico. The capital is now covered with a network of telephonic wires. Vera Cruz has not been slow to follow the example, and a telephone company has been founded there by MM. Ortiz and Co. A special line will soon unite Vera Cruz and Mexico: the distance is 372 kilometres. Several towns in the interior of the country have also adopted the system. At Mazatlan there are already 100 subscribers. At Aguascalientes, the different administrative offices are connected by telephone: in the State of Salisco, a telephone company has commenced operations.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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THE POLE OF THE HEAVENS—RAINBAND SPECTROSCOPE—ASTRONOMICAL SIGNS—PRIVATELY ENDOWED OBSERVATORIES—JUPITER "SQUARE SHOULDERED"—FOSSILS—TELESCOPE—RAINBAND SPECTROSCOPE.

[20683.]—LEST Mr. Firth should be misled by the concluding clause of reply 48174 (p. 167), I may tell him that the N. Pole of the Earth points not merely "approximately," but with absolute and rigid accuracy, to the Pole of the Heavens.

"G." (query 48278, p. 169) will assuredly fail in constructing a rainband spectroscope cheaper than he can obtain a proper one from the optician who makes them; and should he attempt to grind his own prisms, he will infallibly make a hopeless mess of it, to boot.

"J. T. E." (query 48289, p. 170) will find what he wants in Chambers's excellent "Descriptive Astronomy." Authors who use contractions and abbreviations for the names of astronomers generally give tabular explanations of them at the beginnings of the works in which they occur—*e.g.*, Crossley, Gledhill, and Wilson's "Handbook of Double Stars."

Reading the paragraph in your "Scientific News" on p. 181, with reference to the munificent endowment of the new Paisley Observatory by Mr. Coats, suggests the inquiry why, so far, no observatory has been founded by private liberality for the study of "Solar Physics"? Can it be that those noble men who so worthily devote their own means to the advancement of Astronomical Science take competent advice before parting with their money—or what? Probably, though, those whose wise liberality entitles them to the thanks of all true students of Science are about the last men in the world to be taken in by such a barefaced form of imposture as the promise that the weather can be foretold if we only watch sunspots long enough.

The observation of "C. J. R." (letter 20661, p. 182) is really one of considerable interest. It is not—as your correspondent implies—very easy to understand why the flattening of Jupiter's disc did not occur in a direction parallel to the horizon. The planet, however, would present a comparatively small disc with a power of only 88, and the direction of his major axis and of the belts may have unconsciously led the eye. I do not think so much of the distortion not commencing until Jupiter had attained a certain height above the horizon, because we know, from the phenomenon of the mirage, how oddly the air must be stratified near the earth. I can only fancy that the effect observed by "C.J.R." must have been an atmospheric one, after all. It seems incredible that an objective change of sufficient magnitude in the outline of so enormous a body can have taken place, and a reversion to its original figure have occurred, all within the space of some 30 minutes.

In reply to query 48390 (p. 193), fossils do appear in flints, but they are very common, and, *qua* flint fossils, of very little value. Of course, a rare cidaris or the like, infiltrated by silica, is valuable, but not merely because it is a flint fossil. Stones come from ancient beaches, and assuredly do not grow.

"Eleph" (query 48399, p. 193), had better buy a first class English 3in. telescope forthwith. It will do infinitely more than he will ever be able to effect with his plano-convex objective, spend what he may upon it.

I regret that my experience with the rainband spectroscope has been too limited to render my opinion of any value to "F. R. C. S." (query 48424, p. 194).

A Fellow of the Royal Astronomical Society.

FLATS — SILVERING — JUPITER SQUARE-SHOULDERED, &c.

[20684.]—ALTHOUGH letter 20665 is addressed to Mr. Brashear, I may be excused referring to it, considering that I originated the discussion. With respect to the colour test being an inferior one, "Prismatique" is now *hors de combat* all along the line; but nothing has surprised me more than his remarks this week, questioning Mr. Brashear's statement about flats altering in shape if worked in large pieces and cut up. Will "Prismatique" excuse me if I say that the strain in cutting up or breaking off has nothing to do with it. The result is owing to want of uniformity of annealing. *It is internal strains in different directions* which are altered by separating into pieces, and thus alter the surface. Some plate-glass is much worse than others in this quality, being very hard in places and very soft in others immediately adjacent; but no ordinary commercial plate-glass is quite uniform, and if "Prismatique" will test one or two pieces, I am sure *his* remarks will be modified considerably.

One other remark: "that if amateurs could make good o.g.'s, they would not bother about specula," I demur to. The comfort of using a Newtonian reflector is so great compared with the awkwardness of a refractor, and also the fact that a mirror can be made practically perfect and is certainly achromatic, while no refractor, not even the best ever made, even claims to be quite so, insures that the reflector will always be the instrument for the amateur. If two instruments of equal power could be had at equal prices, I think the easy position of the observer would insure the preference being given to the reflector. As the mirror is much the cheapest, that settles the matter. While referring to reflectors, I should like to revive attention to silvering processes. I have got about a dozen different ones, but all agree in one thing—I might say in two. They are about 12 times as costly as the commercial process, and do not give as firmly adherent a film. I think Brashear's process is as cheap as any, but it will cost about 10d. to silver a 6½in. mirror by it. Now the cost of silvering a 6½in. by the ordinary commercial process is not quite one penny. There is a vast difference. Again, the film of the cheaper process cannot be removed by wetting it, even if long continued, and mere rubbing with the finger does not easily fetch it off. Now it would add greatly to the favour in which the reflecting telescope is at present held, if cheaper and readier processes of silvering, giving also a better film, can be made available. I urge the attention of our correspondents to this matter.

Mr. Calver stated some time ago in the "E. M." that with him Brashear's process worked better with double allowance of sugar. Has anyone else found this so? A slight excess of sugar with me means a poor film.

Letter 20661, "Jupiter Square-Shouldered."—If "C. J. R." had to observe in London he would be able to see Jupiter all shapes, and would not doubt that the square aspect was the effect of our own atmosphere. Only on the night of October 23rd, Jupiter was round, oval, square, and all other shapes by turns, and nothing long. But what is the meaning of "dichotomised"? Does "C. J. R." mean to say that a power of 88 on a 2in. o.g. raises a disc on one of Jupiter's satellites of sufficient size for the same 2in. instrument to show half of one as it appears from behind the planet? I am open to correction on this point, but I should scarcely have thought it possible. I have reasonably good eyesight—in fact, I can see lines the 300th of an inch apart, and I am unable to find out that there is any difference in my two eyes, despite Mr. Lancaster's assertion that a pair of eyes does not exist: but if I were to see one of Jupiter's satellites dichotomised, or Saturn's ring divided with a 2in., I should think I was the victim of an hallucination.

Edwin Holmes.

TELESCOPES — CASSEGRAIN, GREGORIAN, AND NEWTONIAN.

[20685.]—Nature not having gifted me with any talent for mathematics, I can't pretend to deal with the matter in the style in which "Orderic Vital" has treated the refractor; but I think it may prove interesting and useful to examine the relationship between the three forms of reflectors above mentioned, as shown by diagrams drawn to scale, or, still better, of the full size.

To illustrate the mode of doing this, I will take the case of the Gregorian first, then the Cassegrain, and lastly the Newtonian.

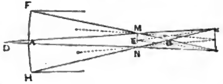
Let the focal length (for parallel rays) of the large mirror of the Gregorian, and also of the Cassegrain, be 18in., and the diameter 8in., and let the back focus be situated 3in. behind the vertex of the large mirror. Then we will assume the focus of Gregorian (concave) small mirror to be 6in. I choose these, not as being *good* proportions, but in order to avoid very acute angles in the diagrams.

Proceeding to construct the diagram, we have A B = 18in., A D = 3in., and B C = 6in., and, of course, F H = 8in.

From F and H, through the focus B, we draw lines, and produce them till thay reach the points K and L, when they are cut by an arc swept through C with a radius = B C × 2, as a first approximation. From these points, K and L, are then drawn the lines K D and L D. We thus have an outline of the Gregorian, with the paths of the rays from the points F and H, where they first strike the large mirror to their point of convergence at D.

Bisect the angles M K N and M L N by the dotted lines as shown, and where they intersect in E is the centre of curvature of the concave mirror, from which the curve itself may be drawn, and the positions of the points K and L more accurately obtained; this correction slightly alters the line K E and L E as well as K D and L D, and a correction may be applied to them also, but practically the difference in the curve by the assumed radius = twice the focus, and by that obtained from bisecting the angles is very small.

FIG. 1.

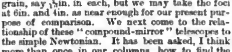


Next we come to the Cassegrain. It will be noticed that the rays F B and H B are intersected by the rays K D and L D in the points M and N; and these are points in the curve of the Cassegrain convex mirror. Bisect the angles F M D and H N D as by the dot-and-dash lines, and where these intersect in C will be the centre of curvature of the convex mirror M E N, of which E B will be the focus. Now this focus will be found to scale 4in. (approximately).

Then, in the Gregorian, the small concave mirror is theoretically considered to be a part of an ellipse whose foci are at B and D respectively, while in the Cassegrain the small convex mirror is taken as being a hyperbolic curve whose conjugate foci are all at these same points B and D.

It appears from the above diagram, that to obtain the *same angle of convergence* of the rays at D, we must use in the Gregorian a small mirror of 6in. focus, but one of only 4in. in the Cassegrain, and we may further notice that not only are the two mirrors much closer together in the Cassegrain than in the Gregorian in this instance, as 14in. to 24in. (thus, as is well known, giving a shorter telescope), but the small mirror of the Cassegrain is of less diameter, and, therefore, cuts off less light from the large mirror—a point which I do not remember seeing mentioned before. Before quitting them I may remark that the small diagram makes the radii of curvature of both the small mirrors equal 10in., but this (by calculation) would bring out the foci slightly too large in the case of the Gregorian and a little in defect in that of the Cassegrain, say $\frac{1}{5}$in. in each, but we may take the foci at 6in. and 4in. as near enough for our present purpose of comparison. We next come to the relationship of these "compound-mirror" telescopes to the simple Newtonian. It has been asked, I think more than once, in our columns, how to find the focus of a Newtonian equivalent to a given Gregorian or Cassegrain. This is answered by diagram, Fig. 2. It is evident that we want to find what focal length of a simple mirror will give the same angle of convergence of the rays at the focus, as is given at point D by the small mirror of the Gregorian or Cassegrain. Make angle at D in Fig. 2 the same as angle D in Fig. 1, and let K L and M N be the positions of the concave and convex mirrors in the proper position and of the proper diameters, as determined by Fig. 1. Produce D K and D L till they would give the diameter X X of a mirror of the same size as that of the Gregorian or Cassegrain; then the distance from D to such mirror would be its focal length. In this case the diameter of the Gregorian small concave comes out 2·7in., and the focal length of the Newtonian 80in.

FIG. 2.



Thus in a little dumpy Cassegrain of some 18in. long, we get with the same eyepiece as great a degree of magnification as with a Newtonian of 6ft. 8in. focus, and with differently proportioned foci in the Cassegrain mirrors, the equivalent Newtonian might have to be double this.

It seems, from this, that the usual formula F^2 / f = equivalent focus of Newtonian, cannot be true, as, if applied to the Gregorian, we get $18^2 / 6 = 54$, and to the Cassegrain $18^2 / 4 = 86$, of which the latter is, however, by far the nearest to the truth.

There is one point I ought to mention to avoid any misunderstanding. In the diagrams, I have assumed, for the sake of greater simplicity, that the focal image has no actual magnitude; but of course we may consider we are looking at the sun or moon, and may lay off on the diagram the diameter of its focal image at focus of large mirror, and draw the lines accordingly, instead of through the point B.

So, too, it is better in a large diagram to draw first a line to represent the axis of the mirrors, but I have purposely omitted it to avoid crowding a necessarily small figure with more lines than could be helped. There are several rules deducible from the properties of the curves employed, which can be used to check the results obtained by diagrams.

A. S. L.

MIRRORS OF REFLECTING TELESCOPES.

[20686.]—When I said, in letter 20566, that Tulley's remark was meaningless, it was not intended to express disrespect for the opinion of a distinguished optician, whose talent and skill I value quite as highly as "L. L. L."—I simply said what I meant. The curves which produce "the least possible aberration" are unquestionably those which produce none at all. The parabola does this for parallel rays; and in the Cassegrain, the small hyperbola reflects the converging reflected rays accurately to a focus. These curves must be rigidly the best, for when accurately worked no error exists. Hence, when Tulley advised "mathematicians, instead of concerning themselves with imaginary parabolas and hyperbolas," to devise a pair of curves to give the least possible error, he was talking about something that he did not thoroughly understand. Long practice, combined with a keen perceptive faculty, had taught him that certain methods of working produced certain results; and so long as the curve gave what he wanted, it was of little consequence under what mathematical designation it came. I am told by one who is certainly very likely to know, that very few practical men really know what curve they are figuring to—a surface, when satisfactory, being spoken of as "spherical," when, in reality, it is far from being so. This, of course, relates to refracting surfaces; but I fancy a similar remark is not altogether inapplicable to reflectors, especially regarding the small convex mirror. By what means are we to know when it is absolutely "spherical"?

I now come to the second letter of "L. L. L." Here he says, "he (Tulley) found that the same curve of the large mirror was *not* suited for the three varieties of reflecting telescopes." That is very probable; the introduction of the term *suitable* quite alters the complexion of the matter. Tulley spoke as a clever practical artist, and we do wrong to judge his remarks mathematically only. "Suitable" is a practical term, and though I maintain that the parabola and hyperbola are the only really correct curves, yet, for aught I know, some other curves may be much easier to apply and give a satisfactory result. I do not know what curves an optician finds it easiest to fashion in unison. All I say is this: For the large mirror of any or all of the three forms, a parabola is the only rigidly correct figure; it does its work unerringly, and any existing fault must be laid to the charge of the small speculum. Like our able and excellent friend, Mr. Wassell, I "go in" for the destruction of error *by removing the cause*, not by raising up one species of evil to obliterate another of an opposite character. Suppose I have a large mirror, which I wish to use either as a Newtonian or a Cassegrain. For the former, I find a parabolic figure gives all that is desired—that is, it is correct; now, if I take away the "flat," replace it by a "convex," and find the result unsatisfactory, which is the most rational way of obtaining a remedy? Am I to make two "wrongs" to produce one right, or am I to make the little one "right" also? The big mirror does its work correct enough in both cases; it sends the rays accurately, whether they come to a focus or not; why, then, should I spoil its face to please the younger brother? If we tamper with the parabola we must resort to the method of compromises, and make each surface sufficiently wrong to rectify the error of the other.

But, it may be asked, is not this system of curing error by error capable of yielding satisfactory results? There is no reason why it should not; but then the question arises—is it easier to make a surface truly spherical, than to fashion it to any other curve with equal truth? I believe, if we rest our judgment on the recorded experience of those who have tried it, we must say that it is not. Therefore, I contend, that if difficulty and uncertainty attend the production of the sphere, it certainly seems preferable to fashion the small mirror to agree with the standard parabola, which we know is right, rather than alter the latter to accord with the former, though there may be no perceptible difference in the two results.

From what your correspondent says, it appears that, according to Tulley's method of working, it was found easier to alter the large mirror; and he asks what curve this should have, to be "correct" for a spherical concave? I reason the matter out in this way. The "spherical" surface draws in the marginal rays too much, or causes positive aberration—that is, it is "under-correct," or has "centre focus long." To remedy this defect in the smaller mirror, we must have an opposite error in the large one. Now the parabola unites all the rays in a point; but if we overpass it and go on to the hyperbola, the marginal rays are thrown beyond the central ones—that is, we have negative error—it is "over-correct," or has "centre rays short." This is precisely the kind of error we want, so that we at once arrive at the result that the large mirror must be made *hyperbolic*, and the extent to which it is so, must be found by test, and by test only.

This, then, is the condition of things in a Gregorian, and it is evident that considerable alteration of the large mirror is needed to make it suit the sphericity of the smaller concave.

Let us now turn our attention to the Cassegrain form; and here we shall see how natural it was for a clever artist like Tulley, to come to the conclusion that parabolic and hyperbolic curves were unnecessary in this construction. The convex mirror is similar to a concave lens, it produces negative error, or the centre rays are "short." Hence, to produce a balance, the large mirror must be affected with positive error, or its centre rays must be "long." Now, the parabolic figure is "correct"; but if we go progressively back to the sphere, the surface is "under-correct." This is precisely the kind of error we require, so that if the small mirror is truly spherical, the large one will need to be nearly so. Tulley, most likely, had become aware of this, which led him to remark, that if approximately spherical curves, though not theoretically correct, would answer, they were more suitable to a practical man than any other species. There is a distinct difference, which must not be disregarded, between curves which by mutual action counteract each other's erroneous tendencies, and those which are correctly figured—each according to the special character of the rays it has to deal with.

Thus we may classify our results as follows:—

CASSEGRAIN.

	Large Mirror.	Small Mirror.	Result.
1.	Parabolic	Hyperbolic	Both figures correct.
2.	Spherical (approx.)	Spherical	Balance of error.

GREGORIAN.

	Large Mirror.	Small Mirror.	Result.
1.	Parabolic	Elliptic	Both figures correct.
2.	Hyperbolic	Spherical	Balance of error.

In each case the modification of the large mirror must depend upon test. We might say, in the Gregorian, it is extra-parabolic, and in the Cassegrain, intra-parabolic. Supposing that the rays left the small mirror parallel (really, they are slightly converging), the spheric error for each would be $y^2/8F$; so that if the ratio of focal length to aperture be the same for both mirrors, the aberrations are directly proportional to the apertures. But that of the small mirror is to a small extent increased by the convergence, so that the greater curve oscillates, as it were, between the sphere and parabola; its tendency either way being governed by the accuracy of the small spherical figure and the ratio between its focus and aperture.

I should like to hear the opinion of our practical correspondents, Mr. Calver, "A. N. H.," and "Hyperion," upon the matters I have here touched upon. Possibly my theoretical remarks may not be altogether borne out in practice. This letter has run to a greater length than I thought at first would be necessary; but I have desired to deal, as far as I am able, fully, and I should like to say, finally, with the theoretic treatment of reflective curves.

Oct. 23. **Orderio Vital.**

BOOT AND SHOE-MAKING.—IV.

[20687.]—HAVING got so far as the uppers ready for closing, we will proceed to the last. I think I hear some one say, "Not so fast, Jack. We should like to know how to make a thread and put on the bristles." Well, get two pennyworth of hairs, 1d. best small, and 1d. of closing (you can tie them both up together, and select as you require them); a 2d. ball of flax, Finlayson, Bousfield, and Co.'s No. 15: theirs is not specially good that I know of, but as that is what I am at present working, from having some on hand for a job, I recommend it, as it comes somewhat near the mark for size. Having your flax, take a strip of paper, the depth of the ball and long enough to go twice around it. With a little paste, paste the strip all over one side; now pass it, pasted side next the ball, and lap around it. When dry it is fit for use. When about to use it, place it in a marmalade jar—minus the marmalade, of course! Take a seat, and put the pot down upon your right side; put your finger in the hole of the ball, and pull out the end of flax—i.e., begin the ball that way, and it will not run about, and get in a tangle when casting off a thread. First take the end of thread, and pass to the left hand; take the end upon the right, breath upon your right hand, and roll the thread from you between hand and knee; pick up the end with the right-hand forefinger and thumb, and give it a sharp twitch, and the flax part, with a long, pointed fibrous end; retain the end that remains in the left hand, and, drawing the thread through the right, measure off a stretch, that is, extending both arms horizontally, and by breaking and rolling the continuation from the ball to the length required, and twitching it you will have two fibrous ends. Lay the one from the right hand with the left alongside the other: now take the two in the right hand, and with the left draw the two over to the left side again, and when arriving at the end turn the two round the forefinger of the left hand about 6in. short of end, and roll and break off as before, laying the ends alongside of one another, and repeat the same until you have as many cords as you require for the job. When you have enough draw through the hands backwards and forwards, to lay all straight and smooth. See the ends make a nice, long, taper point; then placing the end upon the knee, right-hand side, with the left extended out full length, take the thread between the hand and knee and roll from you, laying it up like a piece of whipcord, and every two or three strokes of the hand for rolling give it a slick down with the hand to keep all smooth and straight. When well laid, take the wax in the hand, between the thumb and hollow of the forefinger when clasped, and wax your thread. Pass it over a nail, and twist up both ends upon the knee, and rub down with a piece of upper leather between the thumb and finger. Part your thread, and run it through the hands two or three times to stroke the surplus twist out and keep it from kinking. Now make your ends, and take a hair from your stock; select a round, clean one, the best of course—small if for a closing job, and the strongest for sewing. Fig. 14 will give you an idea. 1 is the hair to be taken in the left hand—A being the thread, B the extreme point; draw the hair two or three times between the waxy thumb and finger to remove any grease or dirt; then lay the thumb of left hand upon the point B, upon the hair; pass A under and over B once or twice, keeping A tight that it may hold B fast: now hold the hair and B between the thumb and forefinger of left hand, letting the thread fall between the third and small finger, retaining it there with a little friction, keeping a tension upon it; take the hair by the point between the thumb and forefinger of right hand, and twist the hair from you (see the arrow), and the thread becomes laid on like D. When you have proceeded so far, take it in the left hand by the point and close up to the thread; break the hair—i.e., draw the hair between the point of forefinger and thumb-nail, which breaks the crystalline form of hair and makes it pliable; now, holding the point of hair between the thumb and finger of left hand as far as it is laid on, *which should not be to the extent shown*, take the end of hair, or I should say ends, as it is very likely that it is split up as shown between the thumb and forefinger of right hand, and roll up as tight as you can by drawing the thumb towards you, and lay the two together, as shown at 3, and make a hole for thread at C, with a small closing or stabbing awl, and bending over the point end, pass through this hole, and your hair is locked on. Now, if this is done as I have shown, it is a rare circumstance for it to come off. The main point to attend to in putting them on is crowding too much thread upon your hair, which is caused by not laying your thread at the proper angle, and not keeping enough tension on the thread between the third and fourth fingers; rather let it lay D instead of A—4 point of thread, and when twisted in the way of arrow—*i.e.*, from you, you will lay the same as the thread upon the hair. There is a right way for this as for other things. I have seen men put them on the opposite way, and the consequence is, as soon as the hair is taken through the hole, the twist in the thread takes the twist out of the hair, and off comes the hair. This is a lot about nothing, I was going to say; but I could have put on 300 or 400 hairs while I have been giving instructions for the same. Now we will proceed with the lasting of inner soles. The inner sole is the foundation, and should be good—*i.e.*, good for that purpose. It should be tough, and for that purpose some good, sound belly, crop, or shoulder should be selected for light work; men's, about an eighth of an inch thick, women's something less; for strong work $\frac{3}{16}$ of an inch. Taking a piece of crop, roughly cut out to the shape of the last, soaked in water until mellow, not too wet; place it upon the last to cover the bottom all over; put a tack in the waist, see Fig. 15.

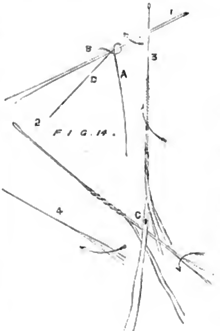


FIG. 14.

FIG. 15.

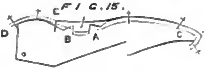
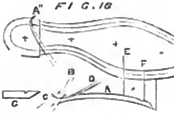
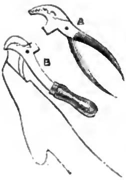


FIG. 16.



turn the last round, and catch hold of the other side with the pincers, and put a tack in, pulling it tight; take your knife and snip it (see A and B); then take the pincers and pull over the toe and tack C; then turn end for end, and do the same at heel D. Now put a tack in the centre of heel, centre of joint or tread, and another at centre of toe. Now take the pincers, and strain over both sides, and tap all level with the hammer, and put by a little while to get steady: when steady, proceed to round it up: this is not an easy job, unless your knife is sharpened properly. When your knife is presented towards you, the left-hand side should be kept as flat as possible, and the other side sharpened at an angle, thus presenting a face, and bevelled the same as a wood chisel, the flat face in this case being presented to the last. Keep your knife up square with the bottom of the last, and do not round it under. When rounded up, rub the back of your knife across at E hard, as a set-off for length of heel, as that is to be kept flush with the last, and upright. From there chamfer about $\frac{1}{8}$in., not down to a thin edge, but a bare $\frac{1}{16}$in.: then about $\frac{3}{16}$in. make a slight cut, and take a small shaving out by inclining your knife over the sole, and leaving a gauge line or channel to sew from (see Fig. 16). Below is section of sole through tread A E F: the lines from that refer to section, as shown at D, position of awl where it enters, B the upper, C the welt; this shows the position in sewing the welt on. G is the welt, which consists of a piece of

FIG. 17.



shoulder or belly, cross curried and dressed, known by the name of welting-in single. It runs about 3ft. long, and a good ½in. wide (that is a pair). In the double, it runs a full inch and 18in. long; that represents a pair likewise. The one edge on the grain side is chamfered, and the flesh side marked with a slight cut, see section at C. This is soaked in water before being fitted up, and worked when in a mellow state. Fig. 17, A, is a very good tool for many purposes, but it mangles the work so, and is a great strain upon the hands. B is a much better tool, and I believe American; the greater the purchase, the tighter the grip, and the fulcrum is a smooth bib, which does not mangle the work, and the strain upon the muscles of the hands is very slight.

Jack of All Trades.

THE LINK-MOTION.

[20688.]—Since the beginning of the month I have been examining the equations given at page 118, with the object of finding the conditions under which a straight line might be described.

I have found a class of curves in the particular case there referred to, when $l = l'$ and $r = r'$, which, for a considerable range, coincide with straight lines.

The condition for these curves is

$$d^2 = l\,(l + r)$$

They are all of the form Fig. 1; and in the case of $l = r$ they have the form of Fig. 2. Just as in the case when the ellipse becomes a circle, so Fig. 2 is the fundamental form of these curves, and the branches intersect at right angles, as will be evident by a mere inspection of the figure.

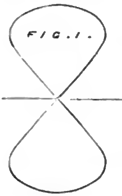


FIG. 1.

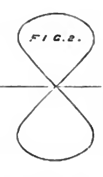


FIG. 2.

I would invite the attention of engineers and other practical men to this class of curves; and should they find them suitable for their purposes, I will then give some further particulars regarding them, and also regarding another class of curves which are of the same form, and which I at first supposed to be supplementary to them, and which may still, probably, be found to be the case.

To render them easily available for practical purposes, I have computed the following table. Assuming 10 for the value of l, the best values of r would then lie between 8 and 15; hence the values of d have been computed for integral values of r between these numbers.

In using the above equation, r should not be taken greater than $\frac{1 + \sqrt{5}}{2} \cdot l$; that is, not greater than 1·618 l, in which case $r = d$. For should we take r greater than this, we then come upon a class of curves of doubtful application; the limit to this class is when $r = 3\,l$, and then $d = 2\,l$.

The form of the curve at this limit is given at Fig. 3, which has been drawn on a scale of less than half that which was used for the other curves. Should we attempt to describe a curve with a value of r greater than l, we should find that it would no longer pass through the origin; we should then have two distinct closed curves, and the origin would become what is called a conjugate point.

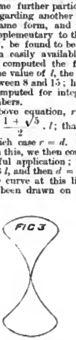


FIG 3

I have added to the table an angle, which I have called ϕ. This is the angle D C O′ (Fig. 4) which the line of centres O O′ should make with the line C D, in which a piston-rod ought to move.

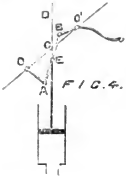


FIG. 4.

The angles have been computed for the different values of r from the equation,

$$\tan.\ \phi = \sqrt{\frac{l + r}{3l - r}},$$

which is a reduced form of the equation for the same angle given at page 118.

I have also computed a few values for the range in the straight lines of the loci. This would correspond with the length of stroke in the piston of a pump, &c., from the equation,

$$\text{Length of stroke} = 2\sqrt{l^2 - (d - r)^2 \sin.^2 \phi} - 2\,(d - r)\cos.\ \phi.$$

AE = BE = l.	AO = BO′ = r.	OC = CO′ = d.	Angle DCO′ = ϕ.	Length of Stroke.
10	8	13·416	42° 8′	10·612
10	9	13·784	43° 34′	11·952
10	10	14·142	45°	13·532
10	11	14·491	46° 26′	14·54
10	12	14·832	47° 52′	15·332
10	13	15·165	49° 18′	16·9
10	14	15·491	50° 46′	17·98

Milverton.

GRINDING CHISELS AND PLANE-IRONS.

[20689.]—My grindstone is one of those small ones in a cast-iron case with a small handle, which are commonly sold. The following method of maintaining a constant angle to the tool struck me the other day, and works well. I fix a small hand-vice on the blade of the tool being ground, at the requisite distance from the cutting edge, and one jaw of this vice bears against the under side of a kind of beard or lip which the iron case of the grindstone has (in common, I believe, with all this class of stones). This distance is easily determined, and remains constant throughout the grinding. I am afraid this "wrinkle" may be deemed too trifling for a letter; but others may be as stupid as I, and it is only recently that I have thus saved myself from the annoyance of the tool slipping to all kinds of angles, and thus getting a rounded facet.

Calculus.

A SIMPLE METHOD OF WASHING PHOTOGRAPHIC PRINTS.

[20690.]—In the house where I reside there is a lavatory with a stoneware basin and tap. The basin has a small waste-hole at the bottom, closed by a conical brass plug. Removing the latter, I substituted a perforated cork, in which is inserted a rather wide glass tube, which rises a few inches above the cork, and is then bent upon itself, and nearly reaches the bottom of the basin. Attached to the tap by a couple of inches of caoutchouc tube is another piece of glass tube, bent at right angles, and drawn to a point, having an orifice of about ⅛in., resembling one of the common brass blow-pipes of the shops. The water issues from this gently, but with sufficient force to keep the prints spinning round. As soon as the level reaches the bend in the siphon all the water is drawn off. The above took about ten minutes to make, cost insignificant.

Calculus.

MOTIVE POWER FOR TRICYCLES.

[20691.]—I see with much interest and satisfaction the efforts to perfect a steam tricycle which are being made in several directions, and the plan shown in your issue of the 20th October proves the possibility of carrying water and fuel; but I should like to ask, Why is water carried, when another fluid is more readily to be obtained? I refer to air. Of course, the same pressure we must not expect to be able to use, but if the engine is run at a high speed, sufficient power may be obtainable for the purpose, in which case, fuel only would require to be carried; and oil, no doubt, would be the most likely to be adopted. I might go a step further and say, that if gas oil was used, why should not the motive power take the form of a gas-engine?

I throw out these few suggestions in the hopes of bringing out some ideas, as many have been trying, and their opinions would, if published, at least help to stimulate to further exertions.

We will have to get an Act of Parliament to run them, I suppose; but that will come all in good time, if we only can get a really practical machine; and what a boon would this be for those who are unable to keep horseflesh, and yet are compelled to go daily over a very great deal of ground.

Perthshire. **M. D.**

"LOOPED FIGURES BY GEARING"—SPHERICAL SLIDE-REST.

[20692.]—I am very much obliged to "O. J. L." for his kind offer to let me see engravings of looped figures: if he will send them to the address beneath, I will return them carefully.

I desire to endorse "Traversing Mandrel's" request to Mr. Evans for a description of the spherical slide-rest. I hope Mr. Evans' valuable articles are not ended, and quite hope the spherical slide-rest, to which he has referred so often, may be the subject of the next.

If "Traversing Mandril" has Vol. XI., he will find a capital sheet of details, with dimensions of a spherical rest, by "W. H. N.,"—just the sort of sheet I should like to see oftener in the "E. M."

Has our friend, "F. W. G.," made a spherical rest? and will he or Mr. Evans say whether those who have slide-lathes might not obtain a spherical rest at two-thirds the expense, by making the lathe-bed and saddle cross slide take the place of the two lower slides of the spherical, taking off the metal-turning rest at the quadrant, and substituting the worm-wheel and upper slides of the spherical.

F. A. M.

32, St. James'-road, Tunbridge Wells.

SWING ECCENTRIC CHUCK.

[20693.]—If "C. E. L." (48363) will advertise his address in the Sale Column, I shall be happy to lend him the working drawings of a "swing eccentric chuck with rotary nose," constructed, and, I believe, invented, by me now eleven years ago (1871) for a 3in. self-acting lathe. I have had it in constant use, and find it a most useful tool; and as it is all *lathe work*, anyone possessing a good 5in. lathe and steady slide-rest, can make it. I have the patterns for the above-mentioned size (3in.)

Mechanicus.

ELECTRICAL MEASUREMENTS.

[20694.]—I am very glad to receive the criticisms of Mr. Moberly. As I am always seeking to learn, of course I start with the knowledge that there is room for progress in my knowledge; and there is nothing like discussion of our ideas to discover their value. As to the subject of measurement, Mr. Moberly says he knows "how obscurely the system is explained even by the best authorities." So do I; and I want, if possible, to clear the obscurity. But I can go a good deal further. It has never yet been my good fortune to meet with any one electrician who has made me feel he understood the subject thoroughly; or with any two who agreed in their explanations throughout.

Now, as to Mr. Moberly's review of my first article. The improvement he credits me with is due to his former discussion with me, which caused me to see that the form in which I expressed the relations among the units in my book, was likely to mislead some; therefore I have guarded against that possibility now.

As to my present articles, I do not think it is quite fair to complain that I make certain statements without advancing proofs: to furnish the proofs and go over the whole ground would have taken five or six articles. I only proposed to sketch certain leading points, to meet several requests which have been made to me. My whole argument will be found in the pages of my own book when it comes out: these articles are only such parts of it as I think will be valuable to readers of this paper But I had written what would have involved a couple of articles dealing with the very points now raised by Mr. Moberly; but I have sent that to the *Electrician*, because I have had some discussion there on the subject with some of the mathematical electricians. Also, I did not think I could occupy the leading articles here for several weeks over one subject; but, in view of the remarks made, I may find it necessary to go to some extent into the further matter. As to the force of gravity g, which I took, one must needs take some value, and I first took that used by Prof. Everitt, and I explained the variable nature of g, as to which I am now referring; and, as to the other point, mass, I was dealing only with units, and that, as, in fact, I said, includes the unit mass of 1 gramme.

As to our old difference, the effect of my former discussion was to make me examine my views more closely, and the result has been to show me that my statement that energy varies as the square of the force, and more especially that force (that is E.M.F.) is simply an expression for square root of energy is absolutely true, *from the point of view I take*, and, moreover, that the obscurity in which writers manage to bury the whole subject, can only be dispersed in that way. As to the differentiation in my mind, of force and velocity, it is very simple. Force is that which generates velocity; or, when we define it to constitute a unit by means of mass, it is that which produces momentum, which is velocity multiplied by mass. Therefore, force and velocity are, in a certain sense, only different expressions for the same value, and that value is the energy belonging to momentum, $V^2 \times M \div 2$ (not ½ mass as commonly said, though both mean the same value), and that energy expressed as its square root. I know perfectly well what will happen—I shall be told I am wrong, as Mr. Moberly tells me; then, that it is utterly contrary to received ideas; then, by-and-by, my point of view and its results will become "received ideas," and I shall be told, "Oh, yes, of course—we all knew that!"

For some time I have been teaching that the so-called "resistance" of electricians is a misnomer, and leads to all sorts of errors. I distinctly put this in a discussion three years ago on statements made by Dr. Siemens in his Glasgow lecture, and I showed that electrical resistance was a mere mathematical form—that it was really only the reciprocal of conducting capacity. In his address to the B.A., Dr. Siemens says, "The resistance or the *reciprocal of the conducting power of a conductor*, is properly measured in terms of a velocity." Presently, every one will say this, and then they will also declare that everyone always knew it. But it would be very difficult to find a single book or paper in which that definition of resistance is given. It is, of course, true that this statement is to be found often, which I take from F. Jenkin: "The conductivity of a given wire or conductor is the reciprocal of the resistance." It is also true that *arithmetically* two matters so related are of necessity reciprocals of each other. But mark the difference of meaning: in the one case, the resistance is the actual thing; the conducting capacity is calculated from it. But what I mean is, that the conducting power is the real thing which Nature gives to us, and that the so-called resistance has no existence—it is only a mathematical formula expressing the square root of the true resistance, the energy absorbed. I am quite aware of the obstacle in the mathematical mind: my views do not conveniently fit into the system of dimensions.

Professor Bayne objected to my views when he declared that potential was the square root of force; and I replied that if he substituted energy for force, he would express a truth. He replied that he could see no expression of dimensions that would cover my expression, and that it would imply that potential was electricity. I could only say that this did not give me any concern. All these ideas and systems are purely artificial. What I seek and wish to give to others is the truth, the natural facts: it is the business of the mathematicians to fit their system to these, not to squeeze the facts into their dimensions. Can there be any doubt as to which is the truth in these two statements?

A unit of current is that electric quantity which produces changes in, or motions of, or is transmitted by, one equivalent of a body.

A unit current is one that fits the dimensions, $C = L^{\frac{1}{2}} T^{-1} M^{\frac{1}{2}}$.

Mind, both are true; but the first is the truth of natural electricity, the other of the artificial electricity invented in the schools.

Sigma.

BREAD—F. C. S.—BLEACH AND DYE REFUSE—ACROBATS UNDER WATER—BUTTER.

[20695.]—To the query headed "Bread" (page 171, No. 48343) I am unable to give any definite reply, though I might hazard a guess. The practice of bakers is probably based on good grounds, the result of experience; but I must confess the exact rationale of the procedure is not clear to me. I have read Graham's lectures on the "Chemistry of Bread-making" without having my difficulties wholly removed. Possibly "Amateur" may be more successful, and I can at least promise that he will be amply repaid the trouble of perusal, even if he does not obtain an exact answer to his query. Graham's lectures formed the Cantor course delivered before the Society of Arts in November and December, 1879, and were published in the ENGLISH MECHANIC during the summer of 1880.

"F. C. S." (query 47780, page 94), the initials employed by Fellows of the Chemical Society, are not to be obtained simply as alleged by "E. M.," by getting "a friend to propose you, and a yearly subscription paid in advance." It is necessary that the candidate should be nominated by at least five Fellows of the society, and unless these include one or more chemists of repute he has a fair chance of being blackballed. Then the name of the candidate is submitted to two meetings, and at a third, the voting takes place. I believe at least two-thirds of the votes in a full house are necessary for election. If duly elected, the newly-fledged Fellow will be called on for an entrance fee of four guineas, and two guineas more in payment of his first year's subscription. The main object of the society is the advancement of chemistry, and the fellowship is not restricted to professional chemists, but is open to others interested in the objects of the society. Still, the candidate will require to have a sound knowledge of chemistry, and a special acquaintance with, at least, some particular branch or application of it, or he will not find Fellows who will become sponsors for him. If the querist is in search of a guarantee of professional competency, he will find it in the Institute of Chemistry, an association of those professionally engaged in the teaching or practice of chemistry. To become a member of this body he will require to pass a stiff examination.

I can quite imagine that "Bleach and Dye Refuse" (query 48090, page 98) might prove very injurious to a sewage-farm. Much depends on the proportion existing between the refuse and the other sewage, and more on the nature of the dyes employed. I am not a lawyer; but I fancy a sanitary authority can decline to receive injurious refuse—at least, under certain circumstances.

With reference to the article on "Acrobats Under Water," page 103, I may say that, a few months since, I saw "Lurline" perform at the Circus in Paris, and on that occasion she remained under water 2 minutes 40 seconds, by my watch.

"Butter" (query 48234, page 146) may be analysed in the following manner: Expose 5 grammes of the sample to a temperature of 105° to 110° C. in a weighed beaker for about an hour, or until no more globules of water can be perceived on looking at the beaker from below. The loss of weight gives the water. After weighing, the fat is remelted and filtered into a small weighed beaker kept in a warm place. The residual matter is rinsed on to the filter with petroleum spirit which has been redistilled at a temperature below 80° C., and washed with hot petroleum spirit till free from fat. The filter is dried at 100° C., and the contents scraped off and weighed. After weighing, the residue, which represents the curd and salt of the butter, may be examined under the microscope for starch, cellular tissue, &c., and then, if desired, treated with cold water, and the solution further examined. Usually, however, it is sufficient to ignite the residue in porcelain at a low temperature, and regard the non-volatile matter as salt, the combustible as curd. If 5 grammes of the sample was the quantity operated on, the weights found will require to be multiplied by 20 to obtain the percentages. The fatty matter may be determined indirectly by subtracting the sum of the percentages of water, curd, and salt from 100·00. It may be estimated directly by evaporating off the petroleum spirit from the washings of the curd and salt, and adding the weight of the residual fat so obtained to that of the main quantity. It is not advisable to mix the filtrate and washings together, as the last traces of the solvent are volatilised with difficulty if the quantity of fat is considerable.

The querist will find the foregoing, and much more information about butter, in volume II. of my "Commercial Organic Analysis."

Sheffield, Oct. 28. **Alfred H. Allen.**

LEGAL REPLIES.

[20696.]—LAUNCH—PASSENGERS (48359).—I do not think such a launch as is mentioned would require to be licensed to carry passengers, if only one or two friends were taken. Unless it comes under the definition of "passenger vessel," as given by the Act of 1855, as amended by the Act of 1863, and which includes any sea-going vessel carrying a greater number than in the proportion of one adult to every twenty tons where propelled by steam, and which I must leave the querist himself to decide.

RIGHT OF WAY—CHURCH—VICARAGE.—The right of way to the church is a way of necessity. But it only exists during the times, and for the purposes, of going to church, and is a common form of easement. Unless, therefore, it has been used as a way to the vicarage for over twenty years, and so a title by prescription has been acquired, the farmer is right in his contention that the right of way through his farm to the church does not give or imply a right of way to the vicarage simply because it joins the churchyard. But there may be other facts in the case with which I am not acquainted, and which would modify or alter this view.

WILL—LEASE—GROUND RENT (48373).—The arrangement made in the will was, of course, practicable as long as both properties remained in the hand of one trustee. But when they are sold to separate owners it will become impossible, because no freeholder can be compelled to release some portion of his property from ground-rent and look only to the remainder. If the landowner consented, then it could be done; but without that, it is a scheme that has become legally unworkable, and will have to be abandoned.

WILL—ADMINISTRATION (48391).—The querist, being apparently the residuary legatee, has the legal right of taking out letters of administration with the will annexed; for, there being no executor appointed, there can be no regular probate. But, before doing that, he must obtain possession of the will, and he will have to take the proper proceedings at the Probate Court to compel its production, should his stepmother hold it and refuse to give it up to him. In short, the querist will find he is obliged to consult a solicitor, and he had better do so at once.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

DIE-CUTTING.

[20697.]—THIS is a subject which, during the many years I have been a reader of the "E. M." I have never seen touched on by any writer. Yet I hope it is not one an amateur may not legitimately desire to know something about, and perhaps put into practice. For what could be a more enduring proof of skill and taste, than the cutting of your own monogram, crest, or initials, to be used for stamping your own letter paper and envelopes, &c.; or, if young and impressionable, some lady love's instead.

If anyone amongst our many good-natured correspondents can be found ready and able to give the instructions, I think he would find not a few interested readers besides myself. "Jack of All Trades" is busy on carpentry now. He gave, I think, some hints on engraving lately. Perhaps this too may come within his range; but if any competent person will take up the subject, I hope he will give us the whole "story from beginning to end," and thus add one more to the innumerable subjects which our "mirror" has shed light upon.

F. C.

VEGETARIANISM.

[20698.]—THE medical profession owe a debt of gratitude to "Polyglott" (letter 20674) for his recommendation of raw meat as an article of diet.

It will certainly bring more grist to the medical mill, and give us poor doctors a chance to live in ease and comfort; we are now having a hard struggle for existence; temperance societies, food reform societies, anti-tobacco societies, and anti-vaccination societies, with the addition of dress reforms, and many other reforms, are making people so healthy that we poor medicals shall have to turn our lancets into pruning-knives, or going on the distressed operative begging system, if these things last. We can well understand medical men not liking all these reforms, as each one is depriving us of one of our means of subsistence.

If people take to eating raw meat, then tapeworms will be common; we shall be able to study the ravages of the terrible trichinæ, and shall for ever be able to set at rest the number of diseases communicable to man from the lower animals. We know at present of seven which are communicable, but if raw meat comes into fashion the number will be legion.

"Polyglott" may answer in return, "but I mean people to eat perfectly wholesome meat." Now, who is to know what is good and what is bad in meat? Inspection does not reveal it, and, again, a terrible number of our animals are diseased; in London, it is said, 80 per cent. are so. In 1880, I think, the Jews killed 13,000 odd cattle, out of which more than 6,000 were rejected as unfit for the food of the Israelite race. Now, if the Jews reject this number, and they inspect cattle before they are killed, how much diseased meat can be found in the market? The meat which the Jewish inspectors reject, is not destroyed, but bought and sold to the Christians.

The digestibility is his second point—we will soon dismiss that. Animal food, or rather the nitrogenous part of it, is dissolved in the stomach, and got rid of in about three hours, but the stomach has to do most of the work. If vegetable food is taken, a certain part only is digested there, the rest being digested in the intestines. Thus, we find that vegetable food gives the stomach less work to do than does animal food. In gastric ulcer—i.e., ulceration of stomach—a diet of fruit will cure quicker than anything else; in fact, any sensible physician at once stops all meat foods except broths, which are absorbed almost as taken.

The practice of eating raw or cooked food is nothing more than habit, which will use us to anything. 'Tis said the Abyssinians actually cut a steak from the living cow and eat it reeking in its warm blood. Tapeworm is also very common amongst these people; a man did not consider he was in the fashion unless he had two or three of them. The raw oysters and eggs which "Polyglott" mentions take three hours to digest, whilst raw apples only take an hour. I shall be glad to hear from what complaints "Polyglott" suffers. I might like him as a friend, but I cannot help criticising his opinions as expressed in the English Mechanic.

October 30. **T. R. Allinson, L.R.C.P.**

"THE WIMSHURST INDUCTION ELECTRIC MACHINE."

[20699.]—In your issue of the 20th Oct. you give a description and engraving of what is called "The Wimshurst Induction Electric Machine." Will you give me a small space to make a few remarks thereon?

I am somewhat surprised at the claims—firstly, as to its originality, and secondly, as to its merits. I find, by the description, that it is nothing more nor less than our old friend the Holtz; the substitution of glass slips for the fixed glass plates being old, as also the placing of it under glass to exclude moisture and dust. True, the addition of a frictional machine in the manner illustrated may be new: but that, I venture to think, is not an arrangement that will find favour either on the score of compactness or economy. I am surprised, however, to find anyone going back to the Holtz, which requires priming, when we have so excellent an arrangement as the recent "Voss."

The writer of the description of Mr. Wimshurst's machine surely cannot be much acquainted with the "Voss," or he would not say that its power is limited by the difficulty of multiplying the plates. There is no difficulty in this way whatever. The Voss machine lends itself to the multiplication of plates as readily as any other. The great merit claimed for Mr. Wimshurst's machine is the connecting of all the armatures on the same side. I should think that anyone making a multiplate machine would, *of course*, connect them thus. I have made a number of double-plate machines, and have always connected the armatures on the same side. I showed one so made last June at the Physical Laboratory, South Kensington. A friend of mine made a six-plate machine, Voss principle, substituting glass slips for the fixed plates, and the whole is under a glass case; *his* is, of course, connected in this way.

I fail, therefore, to see anything new in Mr. Wimshurst's machine. Indeed, I must say I consider it a step backwards; and this view is confirmed by the reported performance of the machine. For a machine with 32in. plates, 7in. sparks are short. It ought to give 10in. at least; and for 12 plates the discharges ought to be in very rapid succession. Four or five sparks of 3in. for each revolution of the driving-wheel is poor. I will undertake to get the same from a double-plate machine of 12in. diameter, of the Voss pattern.

In conclusion, I may say that the "Voss" is everything that can be desired, save in the fact that it, like others, is *not* workable in any state of the atmosphere, though some makers claim this for it. Putting it in a glass case, with dryers, is an obvious way of curing this defect; but it renders it cumbersome and costly, and is not so effective as would seem.

There still remains something to be done in this way, and if this be accomplished for the Voss, the machine will be simply perfection.

A. R. Molison, Science Teacher, Swansea.

MEDICAL REPLIES.

[20700.]—Accumulation of work during my autumnal absence from London has prevented my replying as usual to various queries, which I much regret.

Gout (48275).—Gout is a disease manufactured by the sufferer, or inherited from progenitors who had manufactured it prior to the sufferer's existence. If both parents come of a gouty stock, so much the worse. If a patient inheriting the gouty diathesis continue the process of manufacture, he will produce the worst and most inveterate manifestations of the disease. If he live carefully, in such way as to neutralise the gouty tendency, and if he espouse a mate not subject to the diathesis, he may not only survive the diathesis in himself and escape gout altogether, but his children will get a new start in vitality, and the diathesis may die out. But an inheritor of the gouty diathesis always has the tendency somewhere in him, and even if he never rouse it, he still transmits the tendency to his children in proportion as they inherit his blood, and resemble in person the manufacturer of the diathesis. How, then, may we best neutralise an hereditary tendency or prevent the manufacture of the diathesis? The gouty diathesis is a worn-out condition of certain excretory organs, probably complicated with a damaged power of assimilation for food, and of oxidation for refuse. Its cause is almost always the prolonged use of alcoholic beverages. Indeed, I never saw gout in an abstainer, unless he had well marked gout in his family history. Some months since a man came to see me at the hospital with bad feet, which he said was due to "gout," for which he had been treated for several months at other hospitals. On asking about his habits, I found that he had always been an abstainer, and that his parents had been healthy. Thinking that I had before me a case which refuted my convictions on this point, I put him aside to get his boots and stockings off, in order that I might examine his feet. I found that he suffered not from gout but from *flat feet*, and his business keeping him standing many hours, he suffered from painful straining of the weak ligaments which support the arch of the foot. My advising him to sit at his work so as to take the weight off the arch of his foot, enabled him to avoid the suffering and gradual aggravation which he had long been undergoing. It is possible that by gross gourmandising without alcohol, gout may be generated, but I never saw an authentic case of the kind, and believe them to be extremely rare. The effect of large indulgence in alcoholic beverages, and especially if combined with an excessive use of sugar, and other fattening foods, is to throw upon the oxidising and excretory organs of the body undue work, in order to keep the system free from being clogged with redundant material. And the result of undue work is premature decay. Thus a man in middle age, when the best and most fruitful part of his life should be to come, finds that his liver, kidneys, and other vital organs cannot be kept up to their work, sallowness, headache, and indigestion occur, attended with a thick deposit of imperfectly oxidised refuse in his urine whenever he gets a little chill, or whenever he commits any further indiscretion in eating or in drinking. In this stage, should the kidneys not be able to clear off the imperfectly-oxidised matter, it will be deposited, not upon the sides of the vessel into which the urine is passed, but in the lining membrane of his joints, and firstly in those joints which are furthest from the centre of the circulation, and from which the blood returns with the most difficulty. Hence the deposit in the small joints of the feet, and in the hands. This deposit furs up the inside of the joints, causes the joints to inflame, and makes motion a source of excruciating agony. This, then, is gout in its primary form. Later on the gouty deposit finds its way into the walls of the arteries, and especially into the arteries of the brain, making those arteries inelastic and brittle, very much like a tube of adulterated vulcanised indiarubber when it has been some time in use. Such degenerated vessels, of course, burst under mental excitement when their decay has arrived at a certain point, and the consequence is an escape of blood upon the brain, ploughing up the soft nervous tissue, and causing death by apoplexy, or paralysis of various limbs, according to the nervous centres which happen to be broken up by the effused blood. This is the cause of those sudden deaths in port-wine-faced country squires, as well as in the red-nosed mechanics who, for years have been good customers at the public-house. The slow degenerations caused by the gouty diathesis not only invade the joints of the blood-vessels, but they invade and damage all the organs of the body, and stone in the bladder and kidney is, probably, only another form of secondary or tertiary gout. So well is this fact known among vital statisticians, that life assurance officials always charge an extra premium upon persons with the gouty diathesis, and altogether refuse men who have marked evidence of gouty damage. Such being the cause and nature of gout, how can those who suffer from it best avoid its more serious development? In answering this practical question, it must be realised that a man's working-power is limited by the amount of food which he can continuously pass through his system, just as the power of a steam-engine is limited by the amount of fuel which its furnace can oxidise. Should the furnace be worn out, the engine is like a man whose stomach and assimilative organs have been damaged by drinking. Should the draught, or the chimney, or the ash-pan, be at fault, and the furnace become choked, the engine is in the condition of a man whose oxidising and excretory organs are inefficient, and you get a cold smoky fire, when the man gets an impure and gouty blood. Just as a casual excess of fuel would choke up such a furnace, so a casual excess of food or drink, or of overwork in the man, will bring on an attack of gout, by throwing into his blood more refuse than the excretory organs can get rid of. Such a furnace requires sparing and careful supplies of fuel; its work must be cut down to the measure of its capacity; and great care must be taken to keep all the flues swept. Now, a gouty man must manage himself on the same principles. Alcoholic beverage he should abstain from altogether. His food must be simple, well-cooked, and so sparing in quantity as to keep him in slim, spare condition. His clothing should be light, warm, and permeable, so that the action of the skin may be utilised to assist the internal excretory organs as much as possible. Then such a man must cut down his work to such measure as can be accomplished well under these conditions, and he must avoid sudden bursts of mental excitement or of physical effort, inasmuch as these bursts are followed by a profuse discharge into the blood of effete material, and a consequent blockade of his imperfect excretory organs. Now a gouty man living under such conditions may live a long and happy life, and may never have a twinge of gout unless by some indiscretion he runs over the line which should be observed. But a valuable aid to such men is a half-pint draught of hot water directly they wake in the morning. Such a draught runs at once into the blood, and in half an hour will pass out through the kidneys, rinsing out the system, carrying off all effete residue, and enabling the patient to eat his simple breakfast with unusual zest and profit. If, nevertheless, the urine continues to be overcharged with solids—as is shown by its depositing a sediment as it cools—the quantity of morning hot water may be increased, and the supper should be limited to a basin of thin meat broth and a slice of dry toast. Should the urine still deposit, a seidlitz powder with a pinch of ginger may be taken occasionally with the morning draught of hot water, and, generally, that will suffice. If the man has not the sense or the nerve to live according to the measure of the capacity of his excreting organs, then he must be purged and cleared out occasionally by mercurial and other remedies, such as colchicum, &c., which act violently upon the bowels and other excreting organs; and, possibly, are a smaller evil than his allowing renewed attacks of gouty deposits to ruin his joints and vital tissues.

The Turkish and other forms of bath, with what is known as hydropathic treatment, is often a useful auxiliary in attacks of gout. Soaking the affected joints, or the whole body, in a hot bath containing a handful of washing soda, is often very helpful by neutralising and eliminating the gouty material. During gouty attacks rest in bed and very sparing diet should be adopted.

Baby Holding Breath (48299).—This baby is suffering from "laryngismus stridulus," and will suddenly "gag" or hold its breath, or make a crowing noise when startled or when cold air blows upon the face suddenly. The disease is a dangerous one, and often causes suffocation in a child apparently perfectly healthy. Get the baby change of air if possible. Feed it with extreme care, so that it gets no flatulence or indigestion to distend its stomach and excite the attacks. If living in a cold, low, or damp place, send the baby to a warm, dry, high atmosphere, or to the sea-side. Clothe the child very well, and let it be carried out into the open air in the sun every day once or twice. When the attacks come on a few drops of brandy put into its mouth will generally arrest or mitigate the severity of the spasm. A little ether or chloroform dropped on to a little cotton-wool or into a handkerchief and held over the baby's mouth is better than the brandy, but practically the latter is so much more handy and manageable that it should be used if it will suffice. Should the child appear what nurses call "fitty," give it a little calcined magnesia and ginger, which the druggist will mix. If the disease continues, ask your doctor to advise you.

Glandular Swellings (48320).—I think that I have already dealt with this subject in a back number.

Weakness of Knee-Joint (48360).—Not eligible for useful reply without personal examination.

Catarrh (48368).—This patient is suffering from a chronic catarrh of the upper passages of the nostrils. The secretion accumulates in the recesses of these passages, and makes the patient odious by an offensive smell from the decomposing accumulations. These must be raked out of the recesses of the upper passages by means of a loop of brass or steel piano-wire, lashed whipthong-fashion over a wooden penholder or other suitable handle. This loop of wire (or a long, slender hairpin) should be passed well up into the recesses, and be used so as to clear out all the decomposing accumulations; and this must be done every morning. The passages being thus made permeable to air, the proper and vigorous use of a pocket-handkerchief will enable the nostrils to be kept clear. If the odour is offensive, inject a solution of Condy's fluid and water, made strong enough to be of a claret colour, but not to give pain to the nostrils. In some of these cases the cause is simply that the patient does not use a handkerchief properly. In others, there is a diseased condition of the mucous membrane, which needs constitutional treatment.

Dreaming and Unsound Sleep (48264).—This raises large questions, which are of wide interest, and I will find time to write upon it next week.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

JERK ON RAILWAY TRAINS.

[20701.]—I cannot agree with Mr. Stretton that the jerk described by "S. J." not in the direction of the engine, but in the direction of the guard's-van," is caused by the carriages "righting themselves." Such a motion of the carriages would cause the passengers to jerk towards the engine, but "S. J.'s" jerk is caused by the *passengers* righting themselves. That is to say, when the brake is in action, the inertia of the passenger tends to make him topple over, particularly if he be standing. This toppling is unconsciously resisted by appropriate muscular or balancing action, which, as soon as the train comes to rest and the reactionary brake-force no longer exists, naturally throws him in the opposite direction. I have seen a very portly and would-be dignified New York dame go out through a tram-car door like "greased lightning" from this very cause, which, so far as I see, could not be avoided in any quick stopping of trains, and indeed, might be taken as an index of the high power of the brake; but if passengers will sit quiet, and "wait until the train stops," they would not experience any inconvenience.

J. Brown, Belfast.

ERRATA.—In letter 20659 (p. 164), the passage, "being incapable of making one revolution per second," ought to read "incapable of making one revolution *per se*," or of itself; and further down, it should have been "never be capable of sucking the water up out of the bellows F," where the F was left out. In the ninth paragraph of letter 20656 (p. 165) the stop following "it is not legitimate to perform a short one in it," ought to have been a full stop. I mention this, because the comma does not mark the end of the presumed argument of Mr. Slooke's, nor make a proper division between that argument and the remarks that follow.

G. B. T.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47239.]—**Vegetarianism.**—I do not know that anyone denies that man was originally a frugivorous animal; what is contended is that he was omnivorous, which includes fruit-eating. Man's ancestors were no doubt pure fruit-eaters; but whilst those from whom the man-like apes are descended kept on the main line, those who became man's immediate ancestors took the branch line, and acquiring, perhaps from the necessities of their environment, omnivorous habits, developed into Man. I have no means of knowing, but I think it possible that it is partly because man does eat all kinds of food that he is what he is, and is enabled to live on all parts of the earth between the Arctic and Antarctic circles. No one disputes that he can exist on a purely vegetable diet; but as to thriving, that is another matter, and depends much on "where" he thrives. The exceptions mentioned by Mr. Stooke simply prove the rule that man is a flesh-eating animal as well as a devourer of vegetables. Possibly the next step in development will be a race who can thrive on the members of the mineral kingdom!—NUN. DOR.

[47380.]—**Steam-Boiler.**—Do not tar it, but give it a coat of vegetable-black, with one of boiled oil and three of turps. See that all the warts of rust are rubbed off, and the compo not plastered on, but rather go over thinly, and when dry, go over again.—JACK OF ALL TRADES.

[47380.]—**Steam Boiler.**—My remarks on cleaning egg-end boilers often were not intended to apply to such small boilers as "Nemo" intends to lay down, 3ft. × 2ft. With moderately clean water, eight to 12 weeks would be often enough. A coating of hot tar would be of no use, as it is accumulation of deposit which is so mischievous, causing overheating. If "Nemo" is quite sure there is little or no sediment in water, the boiler will require seldom cleaning; but if it were my own boiler I should wash out at least monthly for safety, cleanliness, and economy.—BOSWELL.

[47772.]—**Henley's Discharger.**—I have to apologise for not writing in answer to Mr. Lancaster (who is good enough to answer my query). I thought you had received a letter from me before, but I suppose it was lost somehow or other. My coil is 7in. long and 2½in. diam., it has about ¾lb. of No. 18 wire (cotton-covered), and about 6oz. of 35 silk-covered wire, but does not answer as I thought it would, so I am going to make another one of 10in. long by 2in. diam. at ends, and 3½in. (or thereabouts) in centre. If Mr. L. would kindly let me know how to make the discharger for the last-mentioned coil on a separate board, and also the best way to fix the contact breaker to the coil (I should also like to know the sizes of wire best suited for the coil), he would oblige.—CHAPMAN.

[47921.]—**Brake Trials on the Midland Railway.**—The following table will give your correspondent the information he desires relating to the continuous brakes, which have been in use in ordinary working between Bradford and Leeds, &c., and between Bedford and London, showing the date when each system commenced and ceased to work upon the trains in question, also the numbers of the engines specially appointed and intended to work them. It should be explained that in some instances the regular engines have been under slight repair, and others having a similar brake have been in use for a short time. In the case of Barker's hydraulic train, it has upon some occasions happened that the only two engines fitted (Nos. 132, 135) have both been under repair or out of order at the same time, when, of course, the use of the brake upon the train was necessarily suspended for a few days.

[COPY.]

DETAILS OF CONTINUOUS BRAKES worked on the Midland Railway under ordinary circumstances between Bradford, Leeds, &c., and between Bedford and London.

Local Train stationed at Bradford. Working trips.

Between Bradford, Leeds, Skipton, &c.

Name of continuous brake.	Commenced to run.	Ran until	No. of engine appointed to work the train.
Westinghouse air	March 27, 1873	November 7, 1871	156
Westinghouse air	August 12, 1875	June 16, 1876	156
Sanders Bolitho (original)	February 2, 1878	August, 1879	170
Sanders Bolitho (M.R. "Modification")	September, 1879	Still in use	170 and 172

Passenger Train stationed at Bradford. (As above.)

†Barker's hydraulic	September 9, 1875	January, 11, 1876	135

Passenger Train stationed at Bedford. Working the morning up slow train (at various times between 7.0 and 7.45 a.m.). Returning from St. Pancras at 4.40 p.m.

Between Bedford and London (St. Pancras.)

Name of continuous brake.	Commenced to run.	Ran until	No. of engine appointed to work the train.
Westinghouse air	May 7, 1873	November 7, 1874	238
Westinghouse air	January 26, 1875	July 15, 1875	238
† Westinghouse automatic	July 16, 1875	June 3, 1876	134
† Barker's hydraulic	June 3, 1876	May 31, 1880	132 and 135
Barker's hydraulic	October 11, 1880	December 31, 1881	132 and 135
Sanders Bolitho (M.R. "Modification")	January 1, 1882	Still in use	*

† These trains were two of those tried at Newark, June, 1875.
* No engine specially appointed, and one set of vehicles is not now reserved for the train.

—CLEMENT E. STRETTON, Brighton.

[47922 (U.Q.) and 48388.]—**The Parker-Smith's Brake.**—With permission of the Editor I shall be ready to give a short description and diagram of this brake, but cannot spare the time for a few days. It has been working under my supervision for some time, and has been tested on about 2,500 occasions, and has never failed to act satisfactorily. The pressure is obtained from the momentum of the train, and the brake on each coach is complete in itself—the pressure on any coach being that due to that coach only. But the power can be applied, released, or graduated as desired, and can be put on in from two to three times the length of the circumference of a wheel, or with a speed of 60 miles an hour, in, say, 30ft. to 40ft. The entire weight is about 4cwt. I may say this brake will be discussed at the next meeting of the Institution of Engineers at Manchester, on 3rd November.—J. S. H.

[47950.]—**G.W. Engines.**—The broad and narrow gauge engines are not numbered separately; 2217 is the highest number to which they run, but a lot of new engines are being turned out which will make the number higher.—W. NORRIS, Ealing.

[47979.]—**Various Locomotives.**—Great Western: Swallow, broad gauge, Great Britain class; drivers, 8ft.; cylinders, 18in. by 24in. 385, drivers, single 7ft.; leaders and trailers, 4ft.; cylinders, 17in. by 24in. 520 four-coupled wing-tank; leaders and drivers, 5ft. 716, six-coupled goods, 5ft.; cylinders, 17in. by 24in.; weight, 30½ tons. 1271, six-coupled saddle-tank, 4ft. 6in. 1401, four-coupled driving and trailing, 5ft. wing-tank; cylinders, 17in. by 24in.—W. NORRIS, Ealing.

[47994.]—**Tinning Iron.**—Certainly not. You seem, however, to have made up your mind that tinning is better than nickel-plating. You most decidedly will not get an equal polish after a little wear, and the coat of tin will not last so long as the "veneer" of nickel. The very fact that nickel-plating is adopted will show you that it is better than tinning, for there is competition enough to test anything of the kind.—T. P.

[48003.]—**Gas-Engine.**—I don't think a model gas-engine could be made to work. That is, if by model is meant very small. A half-man power gas-engine is a tolerably large thing, and I am afraid that any attempt to make a little model would end in dissatisfaction. Still, there have been plenty of illustrations and descriptions in back volumes, from which a design could be got. Perhaps "Jack of All Trades" could oblige.—ESSAR.

[48006.]—**Starch and Blue Manufacture.**—If it is only starch that is required, rice would be cheapest, but the fact that you speak of wholemeal indicates that something more than starch is required, probably the gluten to hold the blue in suspension during the manufacture.—E. G. M.

[48012.]—**Diabetes.**—The doctor named is, I believe, a resident of Paris, but I am not sure.—M. D.

[48016.]—**Mechanical Engineer's Certificate.**—This querist should explain what the certificate is. I never heard of it. I know the marine engineer's, but that can only be obtained by sea-going engineers who pass the examinations of the Marine Board.—NUN. DOR.

[48017.]—**Coating for Pipes.**—Try pitch thinned with naphtha and put on hot. Pipes to be hot too.—T. P.

[48018.]—**Brass Casting.**—You do not vent your moulds. See p. 19, last volume, or if you want to learn the art get one of the handbooks.—G. T.

[48020.]—**Steam Jacket.**—When not working the engine, of course you do not want steam in the jacket; but it should be supplied with live steam and kept thoroughly drained whenever the engine is running. The use of the jacket is to keep up the temperature of the steam within the cylinder as much as possible by supplying heat to it. Steam entering a cylinder and doing work by expanding and driving a piston loses heat, and consequently cools the sides of the cylinder; then when live steam enters to drive the piston back it is chilled, so to speak, by the cooler sides of the cylinder, and parts with part of its heat, thus losing so much of its power. The object of the jacket, then, is to keep the cylinder as hot as possible and to supply heat to the working steam.—ESSAR.

[48030.]—**Hardening Taps and Dies.**—There is only one way of doing it: heat to a cherry-red and dip into oil, or salt water. The secret of doing it well can be learned only from experience, the heat being a most important point. For this reason it is as well to always examine your metal in the dark, in order to be certain of the colour. In back volumes you will find a long discussion about tempering and hardening.—ESSAR.

[48036.]—**Shells.**—You should have said what "shells." Some are cleaned by immersion in a solution of hydrochloric acid, brushed with sand, and polished in the usual way with rubbers and different powders.—J. T. M.

[48011.]—**Cleaning by Dry Process.**—No mention is made as to what is to be cleaned. The dry process is generally understood to be dusting on flour, French chalk, &c., and beating out again.—T. P.

[48044.]—**Minerals.**—Some member of the Mineralogical Society could possibly say where the papers referred to are to be found; but in the absence of any hint as to author, it is a case of hunting for them.—G. T. P.

[48047.]—**Cork Fender.**—I do not think you will find a better way than to put it into a couple of thicknesses of canvas, which should be well dosed with paint and nailed on to boat with copper nails, clenched on inside. If you cut the canvas to shape you can nail a bit up complete at a time, and then stuff it full of cork cuttings, putting in small quantities, and ramming as hard as possible. For the most exposed parts you could get some common pieces of cork and cut them to about shape, ramming cuttings in between them and the boat's side. When finished you could put some bands of hoop-iron, or sheet brass, at intervals, securing them firmly to the sides through the timbers.—Nauticus.

[48050.]—**Hardening Cast Iron.**—There is only one way. Pack them in an iron box with leather cuttings, hoof-parings, charcoal, &c. Put into a furnace: make red-hot through, and when you think the coating is deep enough, open the box, and shoot the contents into water. You can put just a hard skin on by rolling the red-hot articles in powdered yellow prussiate of potash, and quickly tipping them into water.—Essar.

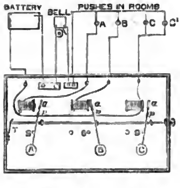
[48055.]—**Range of Fire-Engines.**—About 200ft. If the hose is straight, loss from friction is very slight. The fact that the engine has to draw its water from a distance has nothing to do with the length of the throw.—W. J. T.

[48068.]—**Eyesight.**—I am much obliged to Mr. Lancaster for his kind reply, and beg to send some more particulars for his consideration in answer to his request. With my right eye I can read your answer at a distance of 5in. With my left eye I cannot read it at any distance; and yet it is the eye with which alone I can see the surrounding objects and those at a distance. But I think that my left eye sees double; I have a small pocket-telescope, the object-glass of which has a diameter of 1¼in., with a focal distance of 5in. It is plano-convex. If I hold it between the left eye and the print, so that I can see the words distinctly and magnified, my right eye being closed, then I see on the right side of each letter its grey shadow at a distance of about one thirtieth of an inch. My opinion is that this overlapping of images causes the detrimental blurr, and I am anxious to know if I am right, and if it can be remedied.—Nigel.

[48129.]—**Steam-Boilers.**—The water you are using is very pure, and causes the corrosion; it would be better for the boilers if it contained a little impure water from a mine, which might deposit a thin layer of lime or other scale on the boiler-plates, to prevent the oxygen in the pure water penetrating it. The water being soft, contains a fair amount of free oxygen, which causes the corrosion. Why one boiler is not attacked and the other is, must be from one of two causes—either difference of material, or the good boiler has a layer of deposit on the plates, which may be too thin to be noticed, except specially looked for. With water used as stated by "Steam User," good qualities of iron and steel are more readily attacked than the commoner iron. This can be seen in several boilers I have examined in Glasgow, where similar water is used. To prevent corrosion, use a little soda daily in the feed-water—say, about ¼lb. dissolved and passed in with feed-water.—Boswell.

[48132.]—**Bacteria in Beer.**—Mr. Heron, p. 187, asks me if I have ever seen the phenomenon of disaggregated protoplasm of torula escape from the sac as bacteria. I reply, Yes, very frequently. I find it a normal process in mal-nutritive media for saccharomycetes of vegetable and animal origin, but it is more clearly seen in the larger parasitic fungi, saprolegnia (already alluded to), and peronospora. I am quite willing to believe Mr. Heron's statement that his experience points to a contrary conclusion; but I hesitate to agree with him when he includes every other person who has really worked at this subject. Passing home and Continental authorities, who hold the view that the lower forms are free components of higher forms, I find the following paragraph in the *Brewers' Journal* for 15th October, two days after my statements appeared in these pages:—"One of the most curious influences of sulphites on yeast is evidenced by its apparent incapacity to remain any length of time in a stable condition, when removed from the beer in which it has been cultivated. The yeast, microscopically, may be pure and bold in physical outline, but in a very short time putrefaction appears to set in, and this is undoubtedly due to the escape of yeast plasma." But my statements are founded entirely on my own observations of torula in flour barm, stale beer, and on another variety of torula not publicly alluded to, which I have been cultivating and experimenting with, from the swarming granular matter of the ptyalin cells of my own and others saliva. On the second or third day, depending on temperature and elements in the medium, they reach maturity, when, if a pinhead drop of fluid containing them is placed on a drop of pure olive oil, already slightly spread on a glass-slip, and powers multiplying 2,500 diameters are used, with a fine natural light, the phenomenon of disaggregated protoplasm, escaping as bacteria, will be beautifully seen. In twelve to twenty-four hours only, an isolated cell or two will be found entire, and the free contents will have sunk through the oil to the surface of the glass. Further development takes place after, but that does not concern us at present. I find also in the cells of hairs of damp potato leaves, just now, the same seething bacteria; on other leaves, not so damp, the protoplasm has resolved into oval cells, which, so far as form goes, are the same as torula. Bacterium and vibrio remain such just so long as they remain in fluid. Removed from fluid on a thin strip of sterilised pure sponge, and the sponge suspended in the middle of a clear bottle by a string through the cork, and the bottle, with a little distilled water in the bottom, and a bent glass tube through the airtight cork, exposed in a window to strong sunlight, bacterium and vibria lose their linear form and become spherical. In two months they have lost their septic property, and a trace of the matter on the sponge, added to a sterilised malt infusion in glass tube, made airtight and then inverted, will produce an abundant crop of pure torula. Mr. Heron, with more or less kindness, concludes with an expression of his belief that had Mr. Thoms been conversant with the researches of the last few years on the lowest forms of life, he could not possibly have made such blunders. With all deference to Mr. Heron, in writing thus he seems to me to be writing to the gallery.—W. A. Thoms.

[48133.]—**Indicators for Electric Bell.**—I fitted up some indicators for a house last spring at a comparatively trifling cost, and as they have ever since acted very well, I can confidently recommend you to make a similar arrangement. I inclose a sketch of an indicator for three rooms; but any number may of course be added. Three bobbins, wound with thin (about 30) silk-covered wire, are fixed horizontally to the back of the case. One end of the wire on each bobbin goes to its respective push and the other end to the bell. An armature *a* at the end of a lever is balanced about the point *p* in front of each bobbin; at the other end of lever is fixed a paper disc bearing name or number of room. Care must be taken in making this lever so that it is a trifle top-heavy, and with a gentle push will fall to the right or left. The action is as follows:—When a current passes through the bobbin it attracts the armature towards it, and causes the paper disc at the other end of the lever to move to the right, and so appear in an opening made in the indicator front. The servant replaces the disc by pushing back the button on outside of the case. This button forms the end of a brass rod, which has three projections on it to catch against the levers and replace them. *s s* are stops to prevent levers moving too far. A steel spring T keeps the brass rod in its place. I may add that, with the exception of buying the bobbins (1s. each), and binding screws (4d.), I made the rest of the apparatus entirely, chiefly out of sheet brass and brass wire. The levers should be suspended so as to move with great freedom. I am about to add a relay to my indicator to ring the bell from a separate battery, and expect by this means to make it absolutely certain in action, even when only a momentary pressure is put on the pushes. In the sketch the room C contains two pushes, which is a convenience in large apartments. The push in room B is supposed to have been pressed.—Cantab.



[48191.]—**Sulphate of Copper.**—You might manage to obtain a small quantity of copper-oxide by intense ignition and free access of air. Why not try some easier method? It can easily be obtained by heating copper to redness in the air, when it will become covered with black scales of CuO. It may also be obtained by igniting cupric nitrate. Cupric oxide is insoluble in water. It contains 79·874 per cent. of metallic copper.—J. C. Belcher.

[48197.]—**L. and N. W. Engines.**—1437 is now, I believe, at Crewe. It used to be at Manchester. Engines of the same class are used at Manchester, Holyhead, and other places besides Crewe.—Diomed.

[48226.]—**Truss.**—Uncover the spring at the back, and heat it over a gas-flame, then let it cool. This will weaken the spring. You should wear the truss constantly, only removing it at bedtime, and if the rupture is a recent one it might heal up in a short time. It is extremely dangerous to go about without it.—T. M.

[48232.]—**Bennett's Battery.**—I am astonished at the results obtained by "Glen" and "H. B. A." (queries 48232 and 48339). I have one which I made last March, and which has been standing aside and open ever since, and covered with soda bloom. I had no instruments to measure its power, nor any use for the cell at the time; but the other day I put some caustic soda solution in the cell, just 1in. from the bottom, and put a hot poker in to thaw it, and it deflected the needle to an angle of 50°, quite lively; it was made after Mr. Bennett's dimensions.—Vo Am Ohm.

[48234.]—**Butter Analysis.**—Determination of the water: Weigh out about three grm. (not more) of the sample, transfer to a shallow platinum dish, and allow it to remain in the water bath till it ceases to lose weight. The loss of weight multiplied by 100 and divided by the quantity of butter taken, gives the percentage of water. It is true that not only water is volatilised in this process, but also free butyric acid, if any be present, as is the case in rancid butters; this error is, however, not considerable. The butter, thus freed from water, is again fused and dissolved in about 10cc. of ether (benzoline will also do). The ethereal solution of fat is now filtered through a weighed filter, to separate it from the casein (or curd), and salt, which are to be washed with ether, until a drop of the filtrate evaporated on a glass slide no longer leaves a greasy spot. The perfect removal of the fat is not very easy, and a comparatively large quantity of ether has to be used. The filter is dried in the water-bath, and weighed between two watch-glasses, so as to prevent any absorption of moisture from the atmosphere. The weight of the watch-glasses and filter is to be deducted, when the residue, multiplied by 100 and divided by the quantity of butter taken, equals the percentage of casein and salt. The filter and contents are transferred to a platinum dish, and ignited at a low red heat, till perfectly white, when the ash is allowed to cool and is weighed, consisting in genuine butters, practically of salt only. The weight of the dish is then subtracted from the ash, and the latter from the total residue, which then equals the curd. Where accuracy is required, the salt should be estimated by a standard solution of silver-nitrate. The ethereal solution obtained in the estimation of casein and salt may be evaporated down in a small weighed flask, and dried in the water-bath till the weight is constant. The weight of the flask is now deducted, and the above calculation made, when the percentage of fat is arrived at. I am sorry I did not notice your query before, but happened to do so when looking on that page for something else.—J. C. Belcher.

[48242.]—**Fishing-Rod.**—The following recipe for making black japan, would be of use to you, I have no doubt. Boil together a gallon of boiled linseed oil, 8oz. of umber, and 3oz. asphaltum. When it is cool enough, thin it with oil of turpentine.—W. Henley Richmond.

[48268.]—**Potash.**—The CO_2 may be estimated by decomposing a weighed quantity of the potash with dilute HCl. The querist will have an idea of the modus operandi by which CO_2 is estimated, on reference to my reply to "Manganese," No. 47757. Potash may be purified from sulphate and carbonate of potassium by digesting with alcohol, by which means the KHO is dissolved and the K_2CO_3 and K_2SO_4 is left insoluble. The solution is filtered, the alcohol distilled off, and the potash thus recovered. I do not know the exact quantity of chlorides and sulphates present in KHO. I can give method for estimating, if required. K_2CO_3 is the correct formula for potassium carbonate. If you take a solution of KHO and pass an excess of CO_2 through it, you get potassium bicarbonate ($KHCO_3$) which is an acid-salt ($KHO + CO_2 = KHCO_3$); but if you heat this to dull-redness you obtain carbonate of potassium (K_2CO_3) the following reaction taking place:—$2\,KHCO^3 = K_2CO_3 + CO_2 + H_2O$. The CO_2 present in caustic potash would be in the form of carbonate.—J. C. Belcher.

[48274.]—**Watchwork.**—"E. H. E.," can easily open hole by using a small opening broach, until it is large enough to pass spring through—the collets are cut through and fit moderately tight, so as to alter when requisite. Use "Lemoine's Essence" for cleaning, obtainable at tool-shops. I doubt whether "E. H. E." could manage escape-wheel job. Has he done less delicate matters with success?—J. B.

[48274.]—**Watchmaking.**—If the only fault the collets have is that they are drilled too small for springs, they can be easily opened with a pivot broach to required size. Good benzoline answers well for cleaning parts of watches. Fitting an escape-wheel to Geneva watch is a stiffish job for an amateur, and he must have some good tools.—Sussex Horologist.

[48291.]—**Softening Steel.**—I have softened some kind of steel in the following way:—Heat the steel to a blood-red, then put in lime till cold. The lime I have used in a powdered state, such as is used in gas-works. When that would not do I have put it in an iron jar, filled with bone-dust; then heated for seven or eight hours, and let it cool slowly.—P. G.

[48294.]—**Concrete Floors on Upper Stories.**—Concrete floors may be laid level on the underside, or cambered if the load on the floor demands it. Iron joists are the best, connected with tie-rods to take any thrust on walls. "Clerk of Works" does not give any description of building, so it is not possible to describe the best method. Determine the load likely to be put on the floor, and select rolled joist of sufficient section to carry same, including the weight of concrete, and arrange them in the best manner to suit the dimensions and general arrangements of the building.—Another Clerk of Works.

[48295.]—**Pyrogallic Stains.**—I am afraid there is no effectual remedy which would not prove worse than the disease; but you might try citric, or strong acetic acid, if the stains are simply pyro. or cyanide of potassium, if the stains contain any silver.—W. Robinson, Jun.

[48296.]—**Photography.**—Using a fairly quick-acting lens and extra rapid dry plates, you should have no difficulty in obtaining sunset effects, that is so far as the sun, sky, and outline of the horizon are concerned; but, except over water, you would hardly be likely to obtain more than that, the sun being usually very deficient in actinic power when near setting, and it would therefore be advisable to include as little of the foreground as possible. Instantaneous photographs of cascades are also readily obtainable under favourable circumstances, but everything depends upon that.—W. Robinson, Jun.

[48298.]—**How to Clean an Oil Vessel.**—Try rinsing out a few times with a warm solution of caustic soda.—J. C. Belcher.

[48300.]—**Geneva Watch.**—The set-square of a Geneva watch fits through the centre pinion, and then the "cannon pinion" is pressed on the other side; if fitted properly, it is easily removed by a tap with a small hammer; if very tight, place square in a hollow stake placed in vice and then strike; a brass-headed hammer will be preferable.—J. B.

[48300.]—**Geneva Watch.**—First look with your eyeglass and see if the square is pinned to the arbor at the back; if it is solid, take a small hammer, or a small pair of pliers, and give the end of the arbor (where the minute-hand goes on) a smart tap. This will drive the arbor out behind. First remove lock-plate, next balance, then hands and dial; then take a piece of brass with a hole in the middle, same size as a ratchet (or dog) wheel, and place this said brass on the ratchet; then put your thumb firmly upon it, and with a pair of pliers unhook the dog and let the spring down; now remove barrel-cover and barrel, next pins from pillars, and with your tweezers prise the top plate up a little until you can poke the escapement out. When this is out you can remove upper plate.—A Fellow-Workman.

[48308.]—**Zinc and Iron Soldering.**—Dip the articles in chloride of zinc, heat, and touch them with solder which has been dipped in the $ZnCl_2$; by this means the solder sticks, and, I think, you will then manage what you desire.—J. C. Belcher.

[48311.]—**Watch-Dial.**—Scrape off the enamel inside the dial lightly with the corner of a coarse file until you find the copper; put some solder on it, and hold it over a methylated lamp; get it gradually hot, until the solder runs.—A Fellow-Workman.

[48312.]—**Watch-Dial.**—The best way would be to do away with such devices and have new dial fitted.—J. B.

[48312.]—**Watch-Dial.**—See that the articles are perfectly clean. Moisten with chloride of zinc, and heat, before applying the solder, when it will stick.—J. C. Belcher.

[48322.]—**Lens.**—Fix the lenses with the flat or concave surfaces towards one another and about 1in. apart. I should imagine the combination would cover quarter-plates; but as the focus will be rather short, a small stop will probably be required.—W. Robinson, Jun.

[48330.]—**Timepiece and Watch.**—The pendulum or balance (you don't say which), most likely vibrates further when fully wound, and strikes against or fouls some part. Remedies: clear obstructions or weaken the spring. Boston levers are horrible things, as a rule. The fault you speak of may be caused by large holes or defective guard-pin—i.e., loose, not close enough to edge of roller, or, perhaps, missing.—Sussex Horologist.

[48330.]—**Timepiece and Watch.**—I suppose your clock has a very strong spring and a short pendulum. Can you make the pendulum longer and the bob lighter? If not, you must make the spring at top of pendulum very weak, or hang pendulum on a piece of silk. Several reasons for your Boston throwing over: too much end-shake in balance; or one of the banking-pins wants closing; or, more likely, guard-pin on escapement wants bending towards roller.—A Fellow-Workman.

[48338.]—**Photography.**—Most likely the thin negatives could be utilised as proposed; but, of course, no one could say for certain without seeing them. See also letter 20643, p. 160.—W. Robinson, Jun.

[48340.]—**Locomotives.**—L. and Y. R. 177, June, 1880; six coupled, wheels 4ft. 6in. dia.; inside cylinders, 17½ by 26; inside bearings. Wheel base: leading to driving, 7ft. 3in.; driving to trailing, 7ft. 9in.; total wheel base, 15ft. Weight in working order: on leading wheels, 12tons 4cwt.; driving, 12tons 10cwt.; trailing, 11tons 16cwt.; total, 36tons 10cwt.; built by Kitson and Co. L. and Y. 608, Jupiter. This engine is in the E.L. division, and was constructed at the Company's works at Bury, May, 1876. Six wheels, 4 coupled trailers, outside bearings, inside cylinders 16 by 20; driving wheels, 5ft. 6in. dia. Both engines have flush boilers, but the dome of 608 is of polished brass.—R. N. H.

[48340.]—**Locomotives.**—Midland.—No. 261 is a 6-coupled goods engine, built by Stephenson, 1852. Driving-wheels, 5ft. 2in.; cylinders, 16in. by 24in. It was rebuilt in 1876, and the cylinders enlarged to 17in. by 24in. No. 546, same class, bent framings: cylinders, 16½in. by 24in., built by Stephenson, 1866. No. 698 is 6-coupled goods, built at Derby in 1870; cylinders, 17in. by 24in.; driving-wheels, 5ft. 2in. No. 721, same class, built by Neilson and Co., 1869. No. 1135 is a shunting-tank, built by Vulcan Foundry Company, 1876; cylinders, 18in. by 24in.; coupled-wheels, 4ft. 6in. No. 210 is a 6-coupled, double-framed shunting-tank. It is a rebuilt, but I do not know date or dimensions. N. E. R. Engines.—No. 77 is a single-wheel engine, rebuilt at York in 1880. It has inside bearings to driving-wheels, and outside to leading and trailing; driving-wheels, 6ft.; cylinders, 16in. No. 251 is a 6-coupled goods, built at Gateshead in 1881; cylinders, 17in. by 24in.; coupled-wheels, 5ft. diam. No. 281 is a 4-coupled bogie-tank, built at Gateshead, 1882; cylinders, 17in. by 22in.; driving-wheels, 5ft. 6in. It is like No. 1000 at the Stephenson Centenary. Nos. 400, 434, and 557 are 6-coupled, double-framed goods; wheels, 5ft. diam.; cylinders, 16in. by 24in. (?). No. 400 was built by Railway Foundry Company, Leeds, 1857; No. 434 by Manning, Wardle, and Co., 1861; and No. 557 by Railway Foundry Company, 1866. No. 434 has lately been rebuilt at Leeds. Great Northern.—No. 200 is a mixed traffic engine; leading and driving-wheels, 5ft. 6in.; cylinders, 17½in. by 24in.; built at Doncaster, 1870. No. 504 is a bogie-tank, built in 1873; dimensions same as 200. No. 679 is a 6-coupled shunting-tank, built in 1882; cylinders, 17½in. by 26in.; coupled wheels, 4ft. 6in. L. and Y. R.—No. 177 is a 6-coupled goods engine, built by Kitson and Co., 1880; cylinders, 17½in. by 26in.; driving-wheels, 4ft. 6in. diam. There is another engine, No. 177. It is a 4-coupled goods engine, built in 1852, rebuilt 1869; leading and driving-wheels, 5ft. diam.; cylinders, 15in. by 22in. No. 608 is a 4-coupled, double-framed, East Lancashire engine, named "Jupiter." It was rebuilt in 1876; cylinders, 16in. by 22in.; driving-wheels, 5ft. 6in. or 5ft. 8in. Last week, I noticed in your columns a request to correspondents not to ask questions of this nature, as being of limited interest only. If "C. H.," or any other correspondent, will address E. A., 8, Mornington-villas, Bradford, Yorks., I should be very glad to answer him as many queries on locomotives as I am able.—Meteor.

[48344.]—**Softening Lime.**—Try soaking a portion of the mass in water. Perhaps sufficient water was not added when the eggs were laid down.—J. C. L.

[48345.]—**Geneva Cylinder.**—Same way as the bottom; it is put in from the outside.—A Fellow-Workman.

[48348.]—**To "Alfojoe."**—Will answer to 48330 ("Timepiece and Watch") suit you?—A Fellow-Workman.

[48349.]—**Gasholder.**—The loss of weight, (when weighed in air), is caused by the gas in the holder being lighter than the air it displaces. If "T. H." could weigh the gasholder in a vacuum, he would find it was not lighter when filled with gas than when empty; but heavier by exactly the weight of gas it contained.—John C. Gill.

[48350.]—**Tricycle.**—I quite agree with Mr. Grainger's remark in respect to a tricycle being worked by springs; at the same time, I think many people make a mistake in purchasing tricycles with large wheels. Large wheels look fine, and go very well on a level track: but for ordinary road work, I should recommend a 5ft. 6in. man, of slight build, to try a 40in. wheel, geared level, properly fitted with ball bearings, with a good brake that will act equally on both wheels at the same instant; have everything properly fitted and lineal, avoid plain bearings, as they soon get shaky and loose on the roads, and cannot be tightened. I like the open-fronted, rear-steering machine best; but don't have the backbone too short, or back wheel too small, 20in. to 22in. being a good size. Such a machine as described will mount any ordinary hill, and ride down any hill that a carriage will travel: will do 60 miles per day; and I consider that good work for ordinary riders, say of 10 hours riding, all hills.—Monkhouse, Exeter.

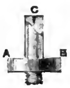
[48355.]—**Silver Printing on Opal or China.**—For printing by development you can use the collodion wet process, or the collodio or gelatino-bromide dry processes, artificial light (a paraffin-lamp or gas-flame) being used in preference to daylight. For printing without development, you can use either collodio or gelatino-chloride. For toning, also, there is plenty of choice: the chlorides of gold, platinum, and mercury, the latter being followed by hypo. or ammonia; also sulphuret of potash.—W. Robinson, Jun.

[48357.]—**Verge Watch.**—I presume you mean balance; if so, your bankings are wrong. If the banking is on the cockplate, you must put in another pin nearer the front of cockplate, so as to prevent the balance swinging too far. If the bankings are in the potence, you must draw them a little for the same reason.—A Fellow-Workman.

[48361.]—**Plating.**—Read "The Theory and Practice of Electro-Deposition," by George Gore, 1857, published by Houlston and Stoneman, 66, Paternoster-row, and W. Orr and Co., Amen Corner. "Costumier" will find the principles of electro-deposition clearly explained, recipes for every purpose, and instructions how to avoid and correct faults in his batteries.—J. McIntosh.

[48361.]—**Plating.**—I would certainly advise "Costumier" to get all his discs punched out of copper and brass; he will find it cheapest in the end. The sheet-tin will have to be coppered, as it is made of iron. It is probable, however, that it might be silvered or gilt without. It would be worth trying if the querist does not mind the expense. The lead can be plated with silver direct, and if it is to be gilt it would be better to silver it first, as the coating of gold being very thin will stand better on silver than lead, but by all means use copper, brass, or German silver for the discs—that is, if you wish to do them yourself, as these metals and alloys can be gilt or plated with facility. For silver-plating see No. 866, 868, 869, 874 of Vol. XXXIV. English Mechanic. For gilding solution see "Replies to Queries," two or three weeks since. Gilding solution should be used in a basin which fits about half-way into an ordinary saucepan; put hot water under the basin in the pan, and keep it on a gas-stove. The colour can be varied from dark to light by using the solution hot or cold.—Os.

[48363.]—**On the Production of "Looped" Figures by Gearing.**—In reply to "C. E. L.," the central pin should be of steel, screwed in tightly and riveted by spreading the end with a hammer. The riveting might be dispensed with if the screw is slightly conical, so as to jamb very tightly when screwed quite close. Countersink the back of the hole into which it juts, so that when riveted, the head thus formed may fill the countersunk recess and not project above the surface, as the latter has to be made quite level. This pin must be turned true when in its plate, the brass plate being done at the same time to insure the two being strictly at right angles to each other. The pin should be as stout as the brass nozzle of the chuck, which is to be the counterpart of that of the mandrel, will allow. It should be of shape shown; the dividing-wheel must have a recess turned to fit over A B, and rest on the plate in which this pin is inserted. C is drilled and tapped to take the large flat-headed screw, which, with a washer below, keeps the dividing-wheel and the screw-nose firmly down. For 6in. lathe I should use ⅜ plate for the foundation and ¼ plate for the upper one; the chuck will then be strong and serviceable. The chuck-nose and dividing-wheel are to be cast in one solid piece; but for a chuck for a 6in. lathe the pin certainly should be steel or, at least, iron—not of brass.—O. J. L.



[48366.]—**Lathe Flywheel.**—Supposing the wheel to be bored and turned, and the crankshaft turned, then your simplest plan is to fit a "feather" in the shaft; with a keyway in the wheel. You can slide it as far as the "feather" goes without the wheel running out of truth. It is advisable to have a collar at each end of "feather."—Labor Omnia Vincit.

[48366.]—**Lathe Flywheel.**—I should either have the flywheel squared on shaft, or a solid key formed on shaft, also a clutch-fork and quadrant, notched to suit the speeds, with a lever like reversing-gear of an engine, if you don't like a screw. In this way you could bring any speed in line with mandrel by moving the lever in the different notches, when once properly set out. It will not make any difference to the truth of wheel if you have a good long boss, which you will want to form the groove for clutch-fork, and have it bored true. You can have two keys if you prefer.—G. Sumner.

[48369.]—**Varnish.**—Use naphtha in preference to methylated spirits, and chrome instead of ochre. You cannot use anything to hasten the drying but heat.—Jack of All Trades.

[48370.]—**Threshing-Machine.**—I should think the fault of the wheel not getting up to its proper speed is because the friction in the bearings is too great. You cannot get any more by changing the gearing for a pulley, except what may be absorbed by friction, which seems probably great. The waterwheel ought to be examined, to see if the bearings, buckets, &c., are in good order. May I suggest that you give all the bearings a thorough good cleaning, and run some petroleum into them to wash the dirt out, afterwards lubricating with good oil. Put some grease into the teeth of the gear-wheels, and then have another try, and report the result.—Labor Omnia Vincit.

[48371.]—**Fixing Water Colours.**—First give your articles a coat of clear parchment size, with a little alum or sulphate of zinc in; size made with the latter will keep any length of time, or acetate of lead may be used. In some instances the chemical used may disagree with the most delicate colours; try them upon a slip of wood and mark them for reference, alum, zinc, lead. Your size must not be strong, but just as it will run, and you can work it cold.—Jack of All Trades.

[48372.]—**Staining Elm.**—Perhaps "Spex" would be kind enough to let us know what colour he requires it. If walnut with black border, see that it is free from grease; line out for border or panels, and stain with some good ink; fill in the panels with umber and linseed-oil; when dry, give one or two coats of oak varnish.—Jack of All Trades.

[48375.]—**Blower.**—In my opinion quite right as shown, narrower at the circumference. Both sides of the blades have a conical diaphragm, which I have shown, made fast to lugs upon the blades and come down to the eye. The efficiency of a fan, I believe, depends more upon the dimensions of the whirlpool-chamber than the fan. The outlet at circumference between blades should be three or four square inches larger in area than between blades at the eye. See Prof. Perry upon Hydraulic Machinery, in the "E.M.," No. 917, page 156. I have every reason to believe the same rule would hold good in every way in pneumatics.—Jack of All Trades.

[48377.]—**L. and N.W. Engines.**—No. 1 has driving-wheels 7ft. 6in. diam., and cylinders 16in. by 24in. Ambassador 490, May, '55; Byron 1516, Nov., '66; Columbus 1530; Cromwell 1531, Nov., '66; Cygnet 139; Dalton 1486; Diomed 821, May, '63; Euxine 485, Oct., '74; Gamont 394; Eden 724; Franklin 1520; General 1170, Nov., '78; Hecate 848, Oct., '51; Hardwicke 790; Henrietta 814, Jan., '66; Hotspur 631; Linnett 150; Locke 762; Marlborough 1523, Nov., '66; Mazeppa 234; Martin 793, Feb., '64; Nightingale 367; Newcomen 1483, May, '66; Narcissus 604; Outram 719, Feb., '63; Penguin 148, Nov., 53; Planet 935; Roberts 737; Rowland Hill 1008; Rose 223, Nov., '57; Star 165; St. Patrick 434; St. Arnaud 353, March, '58; Sunbeam 42, Dec., '56; Scott 1514, Oct., '66; Tubal 828; Tennyson 1747, Nov., '69; Theorem 792; Tartarus 628; Terrier 738; Vampire 885; Woodlark 794; Zamiel 635. The other six names are extinct. Sorry I cannot give more dates.—Thunderbolt.

[48377.]—**L. and N. W. Engines.**—To "Dublin."—Saracen is a single engine, outside cylinder, diameter of driving-wheel, 7ft. 6in. Cylinders 16½ by 24. Æolus 849, Oct., '51; Ambassador 490, May, '55; Byron 1516, Nov., '66; Caithness 1199, Nov., '61; Columbus 1530, Nov., '66; Cromwell 1531, Nov., '66; Cygnet 139, Nov. '61; Dalton 1486, May. '66; Diomed 821, May, '63; Euxine 485, Oct., '74; Eamont 394, Aug., '70; Emperor 217, Nov., '57; Eden 724, Feb., '64; Franklin 1520, Nov., '66; Locke 762, Nov., '62; Marlborough 1523, Nov., '66; Mazeppa 234, Nov., '61; Martin 793, Feb., '64; Terrier 738, May, '63; Woodlark 794, March, '64; Nightingale 367, June, '55; Newcomen 1483, May, '66; Narcissus 604, Sept., '73; Outram 719, Feb., '63; Penguin 148, Nov., '53; Planet 935, Jan., '66; Roberts 737, July, '64; Rowland Hill 1008, Oct., '61; Rose 223, Nov., '57; Star 165, Nov., '60; St. Patrick 434, Oct., '74; St. Arnaud 353, March, '58; Sunbeam 42, Dec., '56; Scott 1514, Oct., '66; Tubal 828, Aug., '64; Tennyson 1747, Nov., '69; Theorem 792, Feb., '64; Tartarus 628, Feb., '64; Vampire 885, Oct., '74; Zamiel 635, Sept., '73.—Diomed.

[48379.]—**Gower-Bell Telephone.**—"Verax" does not say whether the instrument has spoken well at any time or not. If it has, then the fault may lie in one of three places: the magnet may have lost its power; the carbon contacts may bind; or the battery become exhausted. The Fuller bichromate is the nicest for telephone work; but they want constant attention. If the instrument has never spoken well, it may still be from one of these causes, and should be thoroughly examined in all its parts. The coils should be as near as possible to the diaphragm, without touching, when it is depressed on the poles of the magnet. Try three or four cells. I have known the "Gower-Bell" to require six cells on the microphone.—W. H.

[48380.]—**Steam-Boiler.**—I have had charge of boilers of various kinds, but never heard before that a coating of hot tar inside prevented scale. It would be more likely to put you to the expense of a new boiler. There are various compositions in use for preventing the formation of scale. Couldn't you use a longer boiler than 3ft.?—Labor Omnia Vincit.

[48383.]—**Retouching Negatives.**—Lead-pencil will usually take well enough on the gelatine surface, the only drawback being the danger of injuring the negative. Varnish, however, unless specially prepared for retouching, should first be roughened, which can most conveniently be done as follows:—Take an old plate and rub the varnish over with a piece of fine sand or glass-paper; then take a little of the fine powder thus produced on the tip of a finger, and rub it gently over the part to be retouched. Too much, however, must not be expected from retouching in the way of lightening deep shadows; the better plan is to use a reflector when taking the portrait.—W. Robinson, Jun.

[48384.]—**Pump.**—You omit one important particular, i.e., what quantity of water is required to be raised in any given time. Also, what pressure can you work your boiler at? I shall be happy to advise you on knowing your requirements.—Labor Omnia Vincit.

[48384.]—**Pump.**—Fix a chain-pump, which requires very little fixing, and has no leathers or valves to get out of order, and gives a constant stream; and will also deliver any amount of sand or other thick matter with the water. I have fixed many of these pumps, and they have always given general satisfaction.—Chas. Hosken.

[48385.]—**Cement for Blotting-Paper.**—If "Ethel" will make some clear well-boiled starch, and when cold, having her paper cut off the length, lay one over the other, short of one another, about ¼in.; wipe them over with the starch, and let dry; turn over, and serve the same; when dry, lay them about a full ½in., and with moderately stiff gum stick them over ends; when dry, if you just damp them, and lay over upon the other starched surface, you will make a job of it. Starch must not be weak for the paper to absorb it.—Jack of All Trades.

[48387.]—**Soap-Making.**—If "Dandie Dinmont" will obtain some first-class soft-soap, made from cotton-seed oil and potash, he will then possess a soap free from rosin and lime, and containing the glycerine of the oil. Potash makes soft soap, soda hard; glycerine is incompatible with a good hard soap, as is also lime; that is merely used for making the soda caustic, and *is not* introduced to the soap-pan, except by carelessness.—London Stone.

[48390.]—**Fossils in Flint.**—There are a good many microscopical ones. If they have any value I should think it simply that of interest.—John Alex. Ollard, F.R.M.S., Enfield.

[48390.]—**Fossils.**—(1) Large quantities of fossils, including many varieties, do occur in flints, some of the commoner being the sponges, *echinoderms* and *Terebratulæ*. They are almost entirely valueless, unless very perfect specimens of the rarer kinds. (2) There is, of course, not the slightest ground for the supposition that the quantities of stones in the ground grow. They are, as the correspondent supposes, often the remains of ancient river and sea-beaches, caused by the washing and wearing away of rocks.—John Hale.

[48392.]—**Lathe-Bed.**—The pattern is made with the flat (or top of bed casting) loose, so that when in the sand it can be drawn easily.—Labor Omnia Vincit.

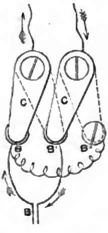
[48393.]—**Scraping Cast Iron.**—The querist could not do better than visit an engineering works and watch a fitter getting-up the slide-bars, valve, &c., of an engine. An hour's watching will teach him more than a page of advice. A worn-out smooth file makes an excellent scraper for many jobs. The size of a scraper is like the shape, variable, according to circumstances.—Labor Omnia Vincit.

[48393.]—**Scraping Cast Iron.**—Get a piece of Stubbs' steel ¼in. wide, ⅛in. thick, and about 6in. long; make taper to go in file-handle one end, make bright blood-red heat the other end, and for 1in. up flatten out to $\frac{1}{16}$in., and about ¼in. up at the same heat; and grind for scraper.—Jack of All Trades.

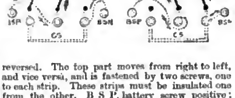
[48396.]—**Cistern.**—For emptying small cistern automatically, you cannot do better than siphon it out in the following manner: Fix a siphon pipe on the side of the cistern near the bottom; when the water reaches the top of the cistern it will also fill the siphon pipe, when at once the water will commence running to the large tank, as desired.—Chas. Hooker.

[48398.]—**Regulating Clock.**—You can regulate clock by the screw at bottom of pendulum-bob. To make it go faster screw bob up; if it gains lower it. Clocks with horizontal lever-escapements are regulated like watches. If they go beyond the control of regulator they either want the hair-spring letting out or taking in a bit. Take in the spring if you want the watch to go faster, and the reverse to lose. You must unpin the spring at the stud and twist collet round. To calculate length of mainspring divide the barrel into three parts, one part arbor, one space, and one spring. Wheels are cut with a tool designed for the purpose, called a wheel-cutting engine, costing something like £14. Use Kelley's oil, at any tool-shop. There is a book advertised in this paper treating on watchwork and tools, by F. J. Britton, price 5s.—a most useful book. Further information if desired.—G. Sumner.

[48401.]—**Commutators.**—"B. H." is right concerning the "movable shunt kind of arrangement." Here it is. The brass pieces C C being connected to terminals of primary, the brass screws S and S'' are joined. One terminal of battery is brought to S', the other to S and S''. It will be evident that when C C are moved into position of dotted lines, the current will be reversed. Mind you have the three screws and underside of C and C quite clean.—Conrad.



[48401.]—**Commutators.**—In reply to "B. H." I have the pleasure of sending two sketches of a shunt commutator—the second one with current reversed. The top part moves from right to left, and vice versâ, and is fastened by two screws, one to each strip. These strips must be insulated one from the other. B S P, battery screw positive; B S N, battery screw negative; I B, ivory, bone, or other insulating material; C S, copper (or brass) strips; X to or from coil. . . . . inside or underneath connections with battery screws, contact screws, and coil (or condenser). By the thin arrows you will see the current enters and leaves the battery screws alike in both instances.—S. E. Kelf.



[48407.]—**Creation of Power.**—The question is answered at p. 76 of my Electricity. The magnetising of the bar is effected by energy expended by the muscles; it takes just so much more work to move the magnet over the steel as is represented in the magnetism stored, besides that lost in friction as heat. Now, when steel needles are attracted by the new magnet, and magnetised thereby, the same thing occurs, but not so obviously. The steel is really magnetised by absorbing energy from the magnet and its external field; it becomes, *pro tem.*, an integral part of the system of the magnet. No external energy is introduced in thus magnetising the needle, but it is introduced in the act of separating the needle and magnet, and the magnet, by its inherent power or condition, reabsorbs it.—Sigma.

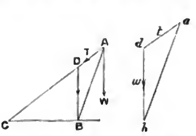
[48410.]—**Solvent for Marine Glue.**—Try bisulphide of carbon.—J. McIntosh.

[48410.] —**Solvent for Marine Glue**. —This marine glue is a mechanical combination of shellac and rubber; the rubber is dissolved in mineral naphtha, and the shellac in wood naphtha, and then well agitated when mixed. Try the above solvents. —Jack of All Trades.

[48410.]—**Solvent for Marine Glue.**—"S. S." has got a bad sample—it ought to dissolve easily in benzol or chloroform. It is said to be made of 1 part indiarubber, 12 mineral naphtha or coal tar, and 20 of shellac; but I can't vouch for the accuracy of this formula. It deteriorates by age; a bit I have had for about 14 years seems to be quite brittle and useless now.—Jonah.

[48410.]—**Solvent for Marine Glue.**—I think coal naphtha would dissolve it, with aid of warmth probably. There is no secret about the material. It is composed of a solution of caoutchouc (1 part to 50) in coal naphtha. One part of this solution and 2 parts shellac are heated together. No doubt a solution could be made which would result in the same material, by dissolving the shellac in any solvent and mixing the two solutions, stirring together when to be used.—Sigma.

[48411.]—**Derrick.**—The simplest method of calculation is the graphical. Let A B be the spar, and C the holdfast for back guy. The three forces in operation are: Tension of back guy = T; weight = W thrust on heel of spar. Take *bd* parallel to B D, making it = W on any scale you please. From *d* draw *da* parallel to C A; from *b* draw *ba* to meet it parallel to B A; then the three forces are represented by *da*, *db*, *ab* respectively. Hence *da* measured off on same scale as *bd* will give T. In the case of a heel of 5' T = 1¼ ton.—S. G. H.



[48414.]—**Gelatine Plates.**—The brown spots are owing to your having used the negatives for printing without varnish, which should never be done, unless only one or two copies are wanted. There is no remedy which would not also damage the negatives.—W. Robinson, Jun.

[48418.]—**Wheel-Grease.**—Mix with a quantity of hard tallow; make the tallow just hot enough to melt, and well agitate with a stick when pouring it in.—Jack of All Trades.

[48419.] — **Drilling or Working Chilled Cams.**—This will depend upon what metal you have to deal with. If ordinary cast iron the chill is only skin deep; but if of white iron and chilled, I am afraid it is a case, as they will want some hours' annealing.—Jack of All Trades.

[48421.]—**Battery for Bell.**—One part bichromate of potash in ten parts water, to which add one part of sulphuric acid.—W. H.

[48421.]—**Battery for Bell.**—Saturated solution of bichromate of potash, with $\frac{1}{10}$th bulk of sulphuric acid.—Glen.

[48421.]—**Battery for Bell.**—It is a bichromate of potash battery; the solution consists of 3 ounces of the salt dissolved in one pint; when dissolved and cool, add 2 fluid ounces of oil of vitriol, and an equal quantity when the action becomes weak; when again exhausted, replace with fresh solution. —Sigma.

[48421.]—**Battery for Bell.**—The battery you describe is a bichromate battery, the solution for which is made in the following manner:—To a saturated solution of bichromate of potash, add when cold, one part of sulphuric acid to seven parts of the solution.—W. F. K.

[48422.]—**Carbon Binding-Screws.**—See letters 20103, p. 284, and 47292, p. 410, both in last volume. Melted paraffin wax prevents acid creeping.—Glen.

[48422.]—**Carbon Binding-Screws.**—If "A Dabbler" will refer to letter 20283, July 14, 1882, page 430 of Vol. XXXV., he will find all the information he requires.—Holmes Bros.

[48424.]—**Rainband Spectroscope.**—Can confirm "F.R.C.S." in so far, that I never see the rain-*band* and the rain-*lines*, with the same adjustment of the rainband spectroscope slit. When the rain-*band* is seen, upon narrowing the slit the rain-band appears to me to resolve itself into the rain-lines (some times slightly shaded off) and then upon widening the slit diffuse again into a band. The actual lines appear to me to be the true guide. These remarks apply only to the spectroscope mentioned; with a larger one many other atmospheric lines and bands appear between C and D and elsewhere; but these seem only to complicate the matter, and the spectroscope in question is best adapted for these highly interesting observations. It is best to always observe with a slit of the same diameter, which can be easily done by marking the slit, adjusting-ring, and the tube. The exact focus should also be marked on the inner sliding-tube, so as always to work with the same adjustments.—R. P. G.

[48425.]—**Dynamo-Machines.**—All the currents generated in the coils are used. From the question, I presume reference is made to the machines made on the Saxton type or the Siemens armature, in which the currents are alternate in direction in the wire. The ends of the wires are connected to the two plates of the commutator; as these rotate under the collecting springs, they are alternately in circuit with the opposite terminals, and the change is effected at the moment of change of direction of current.—Sigma.

[48426.]—**Electric Light.**—This is one of the class of questions I never care to answer. I have no actual experience of these details, and have too much to think of to calculate them out. Besides, no answer can be given to the actual question. The size of wire depends upon the kind of lamp to be used, and I doubt if any could be worked from an armature of the size described.—Sigma.

[48427.]—**Indicator to Block.**—Gerald Harley may construct his semaphore with magnet placed vertically, if he pleases, but would give no better result. H is an adjustable weight, which raises the arm to danger when the armature is released. —Block.

[48429.]—**Garden Path.**—This has been struck out with the line and pegs, as is generally done by gardeners. Divide the plot through the centre of length with three equal lengths, and drive a couple of stakes in. Now strike a line at right angles to them through the centre of bed, and drive stakes in. We will say the first are fore and aft; now take a piece of cord and pass around the stake fore and aft, and over the one to the right, and tie your rope or cord; this will form a triangle. Now take a stick pointed, and slipping the cord off the right peg, place the stick inside, and strike the radius from the two stakes at centres, and it, if not right, will give you some idea how to compass what you require.—Jack of All Trades.

[48130.]—**Electrical Resistance.**—I have not seen the instrument "J. P. E." mentions, but he will find an explanation of the principles, together with instructions how to make and work resistance coils, in No. 117 of the 1867 edition of "Cassell's Popular Educator," price 1½d.—J. McIntosh.

Electric Cables. —The Electrical Trading Company, Limited, of Victoria Mansions, Westminster, send us a number of samples of the cables made by the Berthoud-Borel process. The copper wires are covered with wrappings of perfectly dry cotton laid on in two or more envelopes as may be required, the direction being reversed with each layer. Thus prepared, they are plunged into a bath of melted paraffin and colophane (rosin), and kept there at a temperature of over 350°. The wires thus insulated are then made up into cables and passed into a machine which coats them with a homogeneous sheath of lead, as stout as required, the process being very rapid, and the product all that could be desired for telegraphic and electric lighting purposes. The cables can be laid in a great variety of sizes from one conductor of 36 wires (·058in.), weighing 7,260lb. to the mile, to the small "cable" having one wire (·0273in.), and weighing 177lb. to the mile. The larger sizes are sheathed with two coats of lead, a layer of coal-tar being placed between. Samples of these cables will be exhibited at the Aquarium and the Crystal Palace in the forthcoming exhibitions.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47746. Terra-cotta Painting, p. 580.
47762. Osier-growing and Basket-making, 580.
47764. Greenhouse, 580.
47774. Cutters for Use in Lathe, 580.
47777. Clouds in Negatives, 580.
47782. Confectioners' Oven, 580.
47790. Mechanical Lantern Slides, 581.
47792. Staining Glass Green, 581.
47796. Electrical, 581.
47806. Chemical Lung or Sanitary Punka, 581.

47995. Margate, the Grotto or Cavern, p. 74.
48000. Discharge of Pipes under Water, 74.
48004. Shaping Machine. To W. S. Brown, 74.
48005. Compressed Air, 74.
48007. Boiler, 74.
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48027. Squeezer Rollers, 75.
48028. Floor-cloth Making, 75.
48029. Friction Brakes, 75.
48036. Small Dynamo, 75.
48049. Lathe, 75.
48062. Endless Rope Haulage, 75.
48066. Japanning Buttons, 74.

QUERIES.

[48441.]—**Case Clocks.**—Will "Alfojoe" explain the reason why some of the old-fashioned case clocks, after being cleaned and put in beat, go right for a minute or two, and then suddenly get out of beat, and after a few jumpy kinds of beats stop altogether? I feel sure that a few papers on cleaning and repairing such clocks as are to be found in most country homes from our old friend "Alfojoe," if not asking too much, would be thankfully welcomed by many besides—Blue Gown.

[48442.]—**Liquid Fuel, &c.**—Where can I find out the steam pressure corresponding to different degrees of temperature? If not too much, I should also like to know about what the dimensions should be, of a liquid fuel boiler (like used on tricycle) to run a vertical engine, cylinder 2in. bore, 4in. stroke. Is there no danger of heat in burner (liquid fuel boiler) generating too much gas, or forming an explosive mixture with the air? Are A A, Figs. 2 and 4, page 153, tubes?—Tom A. Hawk.

[48443.]—**Tension of Coil Spring.**—Will some reader tell me how to find the tension of a coil spring as fitted on safety valves of a locomotive at a given pressure, say, 10cwt., dia. of steel ⅜in., dia. of spring 4½in., number of coils 7?—Jumbo.

[48444.]—**Lamp-Light Photography.**—I shall feel obliged if any of your readers will kindly answer me the following questions as to taking photographic portraits in an ordinary room with magnesium light. I use one of Messrs. Lancaster and Son's lamps, dry plates requiring an average exposure of one second, and a good Ross portrait lens. I have used from 3in. to 4½in. of ribbon in the lamp, and short and long exposures, but have only succeeded in getting weak and badly-lighted negatives. (1), What is the best position for the lamp relative to the sitter and camera? (2) How am I to avoid a shadow of the head and shoulders on the background, which spoils the picture, and why do the light portions of the background print dark? (3) What is the best colour for background? (4) Are the plates rapid enough? (5) Is the gas-light injurious during the exposure? The negatives give the faces with the detail very sharp, but with very strong cast shadows, the upper part of the head and the dress from the throat downwards being almost invisible. To remedy the above defects I have tried the lamp in various positions—the gas turned down to a spark, to a medium flame, to a full blaze, and also turned out entirely; but the magnesium light is so powerful, that in every case the shadows are too intense. I have tried a footlight against the background to prevent shadows, and which was carefully arranged to keep the light from entering the lens.—Foiled.

[48445.]—**Engine for Boat.**—What size of engine, and what diameter and pitch of screw, shall I require for a boat 3ft. long, 10in. beam, and 10in. deep? Whether will an engine of two cylinders, or a larger one with a flywheel, be better? The boiler is of copper, 10in. long and 5in deep, the dome is 3in. square. I am going to use spirits of wine for fuel.—Model Engine.

[48446.]—**Colzaline Oil.**—Will Mr. Allen or other reader favour me with information as to the nature of the above, and by what process it can be tested to show whether it is a vegetable oil, as its name implies, or merely a mineral spirit?—Oilman.

[48447.]—**Bichromate Crystal.**—Can any one tell me how to make the bichromate crystal that you get ready for use in bottles?—A. B. J.

[48448.]—**Dynamo.** —To Mr. Tolman or Fred Walker.—I wish to make a dynamo with a Gramme armature to run at 700 to 800 revolutions per minute. Will you please give me size, shape, and number of layers of wire of field-magnets? Will you also give a little diagram, showing, supposing I were sending a current from a battery through every coil on the armature in the same direction, which way their poles would point? Also, how the ends of coil on armature are brought down to commutator, and lastly, shape of commutator? A drawing of the machine, with all the parts in place, will materially help the explanation.—Nil Desperandum.

[48449.]—**Electrotyping.**—Will some correspondent kindly describe what kind of hot building tool is used by printers' electrotypers for running the melted wax round the moulds? and oblige—An Amateur.

[48450.]—**Legal.**—The street I live in is a *cul-de-sac*, at the closed end of which a school, in connection with the district church, was erected a few years since. As the boys attending this school persist, in spite of continual complaints to the master, in making a playground of the street, to the great annoyance of myself and the neighbours, I shall be glad to learn if there is any remedy at law for the nuisance.—C. P.

[48451.]—**Galvanic Belt.**—Will Mr. Lancaster or some other reader tell me how to make a galvanic belt that can be worn in the daytime?—Inquirer.

[48452.]—**Book-Edge Marbling.**—Can any reader inform me (1) What is the cause of colours breaking up spotty and rugged on being combed, and how to remedy the fault? I use gum tragacanth, and grind my colours with sour ales, and regulate them with gall and methylated spirits? (2) What is the best kind of red to use? (3) The best method of grinding colours and keeping them?—F. F. Cass.

[48453.]—**Softening Tone of Harmonium.**—Will one of your readers who knows kindly say what is the best method of subduing the tone of some of the stops of a large harmonium? I have tried cotton wadding placed inside the instrument. Is there anything better? The Flute and Bourdon are "fuller" than I care for in a drawing-room, where soft music is desired.—W. E. B.

[48454.]—**Railroads.**—Will any reader inform me which is the highest railroad in the world? What is the height of the Orio Railroad, Peru? And what is the greatest incline for the travel of a locomotive?—Glaswegian.

[48455.]—**Bath Boiler.**—Having a splendid bath with shower cistern above, I am desirous of taking full benefit of it daily; but it is not provided with any connection for receiving hot water, without which, during the winter, the bath is useless. I would consider it an obliging favour if any who may read this can suggest an idea for my requirements. Perhaps a tin or sheet iron boiler may be fitted in bath-room, heated with gas or oil, if such would be good metal. What is the simplest form so as to utilise the greatest amount of heat?—Glaswegian.

[48456.]—**Legal.**—To Mr. Wetherfield.—I have to give six months' notice to leave a house which I took at the half-quarter between Lady-day and Midsummer. Should the notice be given so as to expire on the 24th of June, or on the 9th of May, the half-quarter?—C. B. B.

[48457.]—**Electro-Plating.**—I do a little electro silver-plating on a small scale, but have great difficulty to deposit sufficient metal. I get a nice white coating, and then the action seems to stop. The anode soon becomes coated with a dark-coloured skin (which, I think, cannot be right). This coating becomes dissolved when the anode is alone immersed—i.e., the articles to be plated being taken out. I make solution by the battery process and cyanide of potassium. I have tried different battery powers—from very weak to very strong—with much the same result. I have very little difficulty in electro-gilding (gold). Will someone please help?—A Sussex Horologist.

[48458.]—**Finishing Wrought-Iron.**—Would any reader kindly enlighten me how to put a nice smooth skin on the surface of wrought-iron workings? I have been several years at this sort of work, making studs, nuts, and other small articles, but never yet could I discover the way in which I could finish them as some I have purchased.—Paddy.

[48459.]—**Legal.**—To Mr. Wetherfield.—I am one of three apprentices serving our time in the plumbing and gasfitting line, and our time, according to our indentures, is 10 hours a day: 6 to 5.30, Saturdays excepted, which is ordinary working time in our trade. Now ordinary working time in our shop is 6—12; all mechanics leave at that time, but we are kept until 3, 4, and often 5 o'clock, but never getting away at our proper time, and allowed no dinner-time. Does our case come under the Factory and Workshop Act? If not, what can we do in the matter?—W. J. S.

[48460.]—**Fontainmoreau's Alloy.**—Can small articles be cast in this alloy in plaster or copper moulds? Can it be melted in a crucible or ladle over ordinary fire? Also, what is the best proportion of zinc to copper suitable for fine impressions?—White Brass.

[48461.]—**Telephone.**—Will "W. H." (see replies 48031 and 48162) be so kind as to give the drawing he has promised, for I want to try and make one; but my distance is not so far as "Cantab's"? The longest distance with me will be about 50yd.—S. E. S.

[48462.]—**Elastic Web Folding Machine.**—Having several hundred yards of elastic web to fold daily from the looms, which has to be folded up about 18in. long, suitable to place in hampers to travel by rail, &c., I should be glad if any able writer would assist me in making a machine for that purpose. The web varies in length from 20 to 70 yards, and from 2½in. to 9in. wide. A rough sketch would greatly oblige—J. B., Leicester.

[48463.]—**Measurement of a Degree on the Earth's Surface.**—Newton's theory of the flattening of the earth at the Poles was proved to be correct by measuring a degree first in the tropical regions and then in the polar regions. It was found that the degree measured in Lapland was 1,012 yards longer than that measured in the tropics, and from this we are told that the flattening or depression at the poles was proved; but it has always puzzled me to understand this; indeed, it seems to me that the degrees should get shorter near the poles, owing to the flattening. If we draw a circle and flatten it at the poles and "bulge" it at the equator, then from the centre draw radii making equal angles at the centre, the portion of arc between two radii at the poles must be shorter than the same at the equator. How is this to be explained?—M.I.C.E.

[48464.]—**Pain in Heel.**—Will someone kindly give me advice? I have been suffering for the past two weeks from a severe pain in my heels. I don't suffer much when at rest, but when I stand or move about the pain is most unpleasant. I am 22 years of age, and of temperate habits. Some say it is rheumatism.—Rosadale.

[48465.]—**Gas-Tar.**—I have some wooden-roofed houses which I require to give a coat of gas-tar to occasionally. As it is liable to run in hot weather and get soft, I would be glad to know of something to give it a body and make it set hard. I do not boil it, as this drives off the oils, and makes it liable to crack, I think. What is the best way to apply tar on tarpaulins?—Rosadale.

[48466.]—**Egg-Preserving.**—Would "Confectioner" kindly describe his plan for preserving eggs in lime and water, and say how long will they keep good?—I.B.O.S.

[48467.]—**Salt Butter.**—Would some reader give a good plan of preserving salt butter, about two firkins of it, so as to keep good during the winter and up to the end of April; of course, the quantity will be diminishing, owing to the supply of the weekly consumption having to be taken out of it?—I.B.O.S.

[48468.]—**Real Estate.**—Would Mr. Wetherfield kindly give me a little information concerning the following?—A. had two separate lots of freehold property which he left by will to B. and C. in the following manner: one lot was left to B., and the heirs male of his body for ever; the other lot was left to C. and her heirs; but in case C. died without issue, her portion was to go to B. and his heirs. Now both B. and C. signed the will as witnesses, and thereby, as I understand, debarred themselves from participating in the will; but, however, there was no one to oppose them at the proper time, and as they have each held possession over twenty years, I suppose they have a title to it; but this is the query—Does the fact of B. having signed the will as witness debar his heirs from taking C.'s portion at her death in case she dies without issue, as there is a nearer relative to A. living, that is the son of an elder brother of B., who would have been heir-at-law if A. had died intestate.—W. A. R.

[48469.]—**Musical Box.**—I have a musical box to repair. About a dozen tongues are gone from the comb, and many of the steel pins in drum are broken off or bent; the other parts are in good condition. Will some reader kindly say which is the easiest way and best to repair same? and oblige—A Fellow Workman.

[48470.]—**Enlargements.**—In enlargements with the gelatine plate, I find it difficult in focussing the image at night with a paraffin-lamp, as recommended in Mr. Stanley's directions. I invariably get a spot of light from the blaze of the lamp, which causes this spot to act more quickly than the other portions of the sensitive surface. Will some reader kindly oblige me by telling me how I may surmount this difficulty? I find it easier to work with the lamp, as I put my lamp into a box, and then exclude all actinic light.—Semper Fidelis.

[48471.]—**Legal.**—Will Mr. Wetherfield advise on the following point?—A. and B. propose to join as partners in carrying on a business under the style of A. B. and Co., each putting £1,000 into the concern. If, after a certain time, losses are incurred by the firm over and above their capital of £2,000, are A. and B.'s private effects and property liable for the debts incurred by the firm? If so, is there any way of drawing up deed of partnership by which the liability can be limited to the amount of capital subscribed other than by the Limited Liability Co. Act?—A. B.

[48472.]—**Harmonium Pedals.**—I have a Chappel harmonium, to which I want to attach my set of pedals. Will some of your readers very kindly advise the simplest method to the attainment thereof? I have tried a tape method, which works too hard, and, therefore, makes the notes stick. Attaching the tape to the end of the clavier underneath by means of a button screw I screwed into the wind-chamber to tiny pulley-wheels—one directly under the note, the other directly over the pedal, I then ran the tape under the first-mentioned and over the second do., and, as I say, they do not work properly.—J. B. Burston.

[48473.]—**To Mr. Wetherfield.**—A niece of mine 32 years old was induced by a brother who returned from New Zealand four years ago to go back with him to New Zealand to nurse an older invalid brother. This she did; and while there the invalid died, leaving her £6,000. The surviving brother induced her in the colony to make her will, leaving everything to him. After having done so, she stayed some twelve months with friends, and then returned to England. Her brother has recently returned, and is residing with his mother and this sister. She informs me they use her very badly, and threaten to put her in an asylum—of course, to prevent her making another or altering her will. She is an intelligent, sound-minded woman; but being in the brother's hands, she is afraid she will be placed away surreptitiously, as he will not allow her to communicate, should he know it, with anyone. My wife, her aunt, is anxious for me to interfere; but being a working mechanic with a large family, I cannot afford money for such a purpose. Perhaps, sir, you will advise what to do providing she is taken away.—Keyrino.

[48474.]—**Model Cutter Yacht.**—I am about to built a model cutter yacht, length over all, 5ft. Will any reader kindly inform me how to fix the ribs to the keel? Also, what woods would be the best for the different parts? and greatly oblige—G. F. L.

[48475.]—**Legal.**—Can I charge for making out the two copies of bill of items required by County Court? In my business the items are very small and rather numerous; and when an account has run for some years it is a hard tax to have to make out two bills in full besides the one already supplied to the debtor, unless the debtor is made to bear the expense thereof.—Gualtaare.

[48476.]—**Metropolitan Railway Locomotives.**—Can any correspondent give dimensions and particulars of the locomotives of the Metropolitan Railway, and also of the tank locomotives of other lines (G.W.R., G.N.R., M.R., L. & N.W.R., &c.) which work over portions of the Metropolitan Railway system and other local lines?—E. E. R. Tratman.

[48477.]—**Screw Propeller.**—Would any of our readers kindly inform me how to make screw propellers from 12in. to 18in. dia., pitch from 18in. to 30in., blades to put on with stud-bolts, and say whether two or three blades is best?—Coquet.

[48478.]—**Galvanometer.**—I want to figure my galvanometer in ampères. Can I do it with a Wheatstone Bridge and an ohm resistance, or how should I do it? My galvanometer has a resistance of 0·25 ohm.—Yo Am Ohm.

[48479.]—**Protecting Zinc From Sulphuric Acid Fumes.**—Can any of your numerous correspondents tell me of a cheap means for protecting zinc sheets against the fumes of sulphuric acid?—W. R. L.

[48480.]—**Calculating Weight of Copper Leads.**—To "Sigma."—Can you give a rule for calculating the weight of copper leads, for say, 120 incandescent, or 18 arc lamps, lighted by dynamo, or storage batteries, or by the two combined? Such a rule, would, I feel sure, be of great value to others besides myself, interested in electric lighting.—Yosm.

[48481.]—**Rigging Boat Yawl.**—I shall feel much obliged to any nautical reader of the "E. M." who will inform me of the most approved way to rig a boat-yawl 25ft. long—one mast preferred. Is there any kind of screw which could be attached permanently to the ends of the stays to haul them down to the gunwale, so that they could be removed or tightened quickly? Could a small steering-wheel be put in the stern, and could india-rubber bags be got cheap for water ballast? Any further information will oblige—S. S.

[48482.]—**Legal—Rating Appeal.**—Will Mr. Wetherfield please say whether I am liable to payment of rates under the following circumstances?—I gave notice of appeal against the assessment in April last, since which I have paid one rate; now another is demanded. Should not the assessment committee have heard the appeal at once, or am I justified in refusing to pay rates till the appeal has been heard?—Ratepayer.

[48483.]—**Henry, Lord Clifford.**—In a work I have come across entitled "Rosa's Summer Wanderings," mention is made of one Henry, Lord Clifford, who lived above 20 years disguised as a shepherd boy, until the accession of Henry VII. enabled him to assume his hereditary dignities with safety. . . . He built Barden Tower in Yorkshire for the "study of astronomy, in which he did exceedingly delight" (Pembroke MS.). Can any further information be obtained about this Lord Clifford? Is he known to have made any observations, and where are the Pembroke MS.?—S. J. J.

[48484.]—**Wool Skins.**—Being a waste dealer, I have bought a quantity of bits of skin with wool on. The wool clings so tenaciously to the skin, and clipping off with the shears is such a slow process, that unless I can find an economical method of getting the wool off, I shall suffer a great loss. I will thank any of our readers to help me in this matter.—Waste Not.

[48485.]—**Stockbroking.**—Will you favour me with the titles of any books on this subject? I have seen Playford's book, published in the forties, but would like one giving full details of practice at the present time?—Gair.

[48486.]—**Mercantile Dictionary.**—Kindly refer me to a book or books giving concise, yet thorough, explanation of all terms used in business—a clerk's dictionary, in fact.—Gair.

[48487.]—**Value of Insurance Policy.**—Please explain how to work out such a question as the following: Life policy, age 61, for £100, with £47 10s. profits already vested, on which no further premiums payable. Life policy, age 45, for £1,500, annual prem. £40 2s. 6d., bonus additions £292 10s. Is there any book on the subject?—Gair.

[48488.]—**Transfer Tracing-Paper.**—I believe there is such a thing made whereby tracings may be made and transferred to glass. How is it prepared, or where can it be had?—Gair.

[48489.]—**Connecting-Rod End.**—Can any correspondent oblige me with the names of railways companies using a solid bushed end for the little end of the connecting rod? Also the size of the bearing surface in contact with cross-head gudgeon?—Guida York.

[48490.]—**Bell Indicators.**—To Mr. Lancaster.—I am only going to fit up two or three pushes, and shall not do much in the way of pulling up floors; but should be very glad if Mr. Lancaster would be kind enough to describe them.—Zu.

[48491.]—**Magnesium Lamp.**—Mr. Lancaster promised an inquirer a short time ago that he would give instructions how to make his magnesium lamp. He would very much oblige Zu if he would do so.—Zu.

[48492.]—**Swan's Lamps—Gas Engine—Accumulators.**—Supposing a 1h.p. (nominal) "Otto" gas-engine to be available for the purpose (which Messrs. Crossley say indicates 2·26h.p.), am I right in supposing I could use it to run a Siemens "S D_2" dynamo (which is represented as actually requiring 1½h.p.) to light 12 of Swan's 20-candle lamps or 24 10-candle ditto? Could such an engine be used to charge the requisite number of accumulators for Swan's lamps, of which I understand at least 24 are required, and could more lamps be illuminated every night in this way?—S. H. Salt, 96, Regent's Park-road, N.W

[48493.]—**Gas-Stoves.**—Will any of your correspondents who can speak from actual experience, inform me whether Ritchie's "Lux Calor" gas-stoves are of any use in a small conservatory or outdoor workshop? The cold weather is approaching, and I want to keep some tender plants alive during the winter in a conservatory which at present has no heat. With reference to warming and lighting my workshop, I have tried a small gas-stove in a flue, and gas-jets, or ball and socket joints for lighting my work; but the moisture generated by these renders all my ironwork rusty, that all my time is occupied in cleaning instead of working. I hear that Ritchie's "Lux Calor" stoves condense all the aqueous products of gas combustion, but I should like to hear the opinion of one who has actually tried them.—Hayling Island.

[48494.]—**Microphotography.**—Will some reader who is experienced in the above, kindly inform me what is the most approved plan of finding and registering the difference between the chemical and visual focus of any given objective? Also, are there any objectives made in which the two points are identical? And further, is a direct or an oblique light best for transparent objects? I wish to use ¼in. power.—Shutter.

[48495.]—**Sharpening Hard Steel Points.**—I have some emery and corundum wheels. I want to use them for sharpening up hard steel points. Would some of your correspondents tell me if they should be used wet or dry, and if wet, what is the lubricant? I use them in the slide-rest.—J. F. E.

[48496.]—**Enlargement of Bowels.**—Can any of ours, or Dr. Edmunds, give me any information as to home treatment of enlargement of bowels, such as most suitable diets? Are charcoal cakes eaten for this disease, and if so, why are they eaten? Or any information will oblige.—Boswell.

[48497.]—**Plating Brass.**—I am desirous of plating small brass discs ¼in. in dia. and 5-16in. thick, with tin or some metal that will not tarnish easily when subject to damp. Will any of our experts kindly give me a simple method and cheap?—T. F. C.

[48498.]—**Hardening Brass.**—Having to use small brass wire shafts perfectly straight, I have to soften them to enable me to straighten them; but, unfortunately, it makes them too soft. Can any of our experts inform me how to harden them after being straightened? It is impossible to straighten them singly, owing to the quantity being so large; therefore, I rub them in the same way as needle-makers do.—T. F. C.

[48499.]—**Legal.**—I have lent £150 upon a small house here. Being so small a sum, I have taken a note of hand on demand, and a deposit of deeds, with a stamped mem. that they are deposited with me as collateral security, and promise of legal mortgage if desired. Am I legally bound to allow income-tax off interest? If not, am I morally bound to do so?—Ajax.

[48500.]—**Analysis of Animal Charcoal.**—Will Mr. Allen or other able chemist describe the simplest but best reliable method for the complete analysis of animal charcoal.—Juxion.

[48501.]—**Scale in Boiler.**—Will any friend give me further information on crude petroleum as applied to boilers. In "Useful Notes" recently was given certain quantity, but no size of boiler is given. I have a 60 h.p. Galloway boiler—the tubes are making scale fast, and would like to try it if I knew the quantity to be used.—J. O. E.

[48502.]—**Astronomical.**—Can any contributor kindly help me in resolving the following questions. (1) Being given a joint on a star-map of stereographic projection, to find its R.A. and Dec. It is supposed that on the map are delineated the arcs of circles representing the meridians and parallels of the sphere. The right ascension and declination of the joint called centre of projection are also supposed to be given. (2.) The mag. of a star being *m*, what will be this mag. at a distance of times greater?—T. R.

[48503.]—**Eyepieces.**—Webb in "Clestial Objects," p. 6, says "Browning's achromatic eyepiece, Horne and Thornthwaite's aplanatic, and the Kellner construction (for large fields) are all excellent in their way." Would some correspondent kindly explain the construction of these eyepieces, and state the advantages each possesses. In optical text-books, the Hughenian and Ramsden combinations are described.—X. Y. Z.

[48504.]—**Roman Candle Stars.**—How are these made to stick together? Mine all crumble up. My compo is, meal powder 2; camphor 1; sulphur 1; and coloured fire (of whatever kind) 1; moistened with turpentine and a little gum.—Glen.

[48505.]—**M. R. Engines.**—Wanted the size of 38, 50, 111, 177, 890—828.—J. L. F.

[48506.]—**G.E.R. Engines.**—Wanted dimensions, and particulars of the new engines working the new North line trains to and from Doncaster.—J. L. F.

[48507.]—**Sky-Rockets.**—I cannot get my sky rockets to ascend. The compo. I used was meal powder, 64 parts. N 16, S 8, C 4. For small size rockets, is it necessary to have a choke? I have tried both ways. Also should there be an inner case, empty; and if so how is it secured?—Glen.

SCRAPS.

Hardness in water implies one grain of bicarbonate or sulphate of lime in each gallon of water. Each degree of hardness destroys 2¼oz. of soap in each 100gals. of water used for washing. Soft water is therefore, commercially, of more value than hard water in proportion to the worth of 5oz. of soap to each 200gals. for each degree of hardness.

Stumps of trees are often a great and costly nuisance to the agriculturist and gardeners. An American method of dealing with these troublesome blocks is as follows: In the early winter bore a hole one or two inches in diameter, according to size of the stump, and about 8in. deep; put one or two ounces of saltpetre in the hole, and after filling with water plug it tight. Next spring unplug and pour in a gill of kerosene oil and ignite. The stump will smoulder away, without blazing, to the extremity of the roots, leaving nothing but ashes.

England imports some 10,000 tons of cork per annum, and the quantity is yearly increasing, notwithstanding the introduction of many stoppers and substitutes for corks, such as plugs of wood whose fibres have been specially softened for the purpose, indiarubber, and other materials.

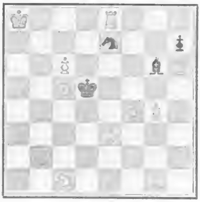
Dr. Meredith, in the *Birmingham Medical Review*, recommends oil of peppermint as an external application for allaying the neuralgic pain so often complained of in cases of *Herpes zoster*. He has used it with great relief to the patient even when the eruption was out in a fresh, florid condition.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXCV.—By T. B. Rowland.

Black.



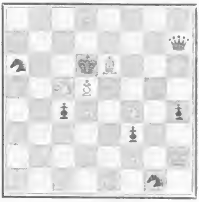
White.

White to play and mate in two moves.

PROBLEM DCCXCVI.—By A. C. Pearson.

From "One Hundred Chess Problems."

Black.



White.

White to play and mate in three moves.

Solution to 791.

White.	*Black.*
1. Q to Q 5	1. P to Q 7 (a)
2. R to K 5	2. Q to K 8
3. Q to Q 6 (ch)	3. Kt to K 3
4. R mates	
	(a) 1. Q to B 7 (b)
2. R to K 5	2. Q to Kt 6
3. R to Kt 5 (ch)	3. Q takes R (ch)
4. Q takes Q mate	
	(b) 1. Q to Kt 6 (c)
2. P takes Q	2. Kt to K 3
3. R takes Kt (ch)	3. P takes R
4. Q takes P mate	
	(c) 1. P to Q 7 or Q to B 8
2 R to K 5	2. Q to K 6
3. R takes Q, &c.	

Solution to 792.

White.	*Black.*
1. Q to K R 4	1. Either R moves
2. Q to K sq or K 8	2. K moves
3. Kt mates	
	(a) 1. K moves
2. K to R 5	2. Anything
3. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 789 and 790 by "Schmucke"; to 789 by "Hazeldean"; to 789, 790, 791, 792 by "Celsus."

J. P. T.—Thanks for corrected versions.

"Hazeldean."—The problem has only *one* solution, but three *variations*.

"Celsus."—We would willingly comply with the request of our esteemed correspondent if it were in our power.

F. F. B.—Thanks for the address.

The following wine is said to be refreshing and strengthening in sickness. Pick ripe grapes from the stem, wash them, put them in an enamelled iron kettle, and boil; strain the juice, boil this, and bottle. When wanted for use dissolve sugar enough for one pint of the juice to make it pleasant to the taste. Keep the bottles in a cool place.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 1, and unacknowledged elsewhere:—

Rev. F. T. Salmon.—G. R. Miles.—J. Wood.—Molesworth and Son.—J. W. Grimshaw.—E. P. Alexander.—R. Lee and Son.—Crossley Bros.—Penzance Scientific Exhibition.—D. Benson.—Britannia Co.—H. King.—F. A. Cobbold.—J. W. Queen and Co.—F. A. Johnson.—W. Grimshaw.—J. Roberts.—G. Plant and Son.—J. B. Peterkin.—C. J. E.—Cross.—Enquirer.—Auld Reekie.—Ohm.—J. Brown, Belfast.—Onward.—Steam Engine.—H. G. B.—W. W. W.—Porcupine.—A Fellow Workman.—W. H. Richmond.—Angulus.—Devonshire Squire.—One Puzzled.—Rydal Mount.—C. J. R., Ventnor.—A Constant Subscriber.—B. B.—Hopkin Thomas.—J. Wallis.—Amateur.—Delta.—S. Calton.—Jack of All Trades.—E.—Orderic Vital.—Firer.—W. H.

W. H. (Coat the wall with coal-tar, or, if that is objected to, with Portland cement.)—Rev. G. C. B. (There is the Brayton hydrocarbon engine, p. 612, No. 624, which is, we believe, worked by crude petroleum. We do not know of any engine worked by benzoline.)—Amateur. (You would like a few hints on watch and clockmaking? We think you will find them if you look through previous numbers.)—H. H. Cormack. (No details can be required. The discs revolve close to the glass strips, and it is similar to the Holtz, the gap between the two strips answering to the window in the Holtz. Eight discs about 18in. in diameter will make an excellent machine, which, protected by an ordinary glass case, will be ready to work at any time.)—C. P. E. S. (Answered last week. See p. 256, Vol. XXIX., and pp. 471, 529, Vol. XXX.)—Twig. (You will find suggestions in recent numbers.)—Gunner. (You will find all about it in Vol. XXIV.)—Jones. (The so-called "extract of indigo" is made by adding finely-powdered indigo one part to five parts fuming sulphuric acid, or eight parts of oil of vitriol. The vessel containing it is to be surrounded with cold water, and after frequent stirring the mixture is allowed to rest for a couple of days, when it will become a pasty mass of an intense blue colour.)—Strathaven. (Most opticians supply them; for cost, see their lists. 2. You can dissolve gum copal in strong alcohol, linseed oil, or turpentine. The gum should be crushed small, and the spirit or turpentine be heated in a water bath. In the case of the oil solvent, the gum should be fused and the oil added in a boiling state.)—F. Gladstane. (For oak graining, see p. 510, No. 902.)—Tam. (A swindle, from beginning to end.)—Draughtsman. (Some instructions on wood-engraving will be found on pp. 117, 118, No. 915. We know of no good book on the subject.)—Walter Wilson. (We cannot think borax would produce the effect mentioned.)—Edward M. Nelson. (You are right, but has not the absurd forecast of the 23rd ult. been many times equalled, and is it worth while occupying space again with the vagaries of the weather prophets?)—W. A. D. (Try a liberal application of paraffin.)—Iron Steed. (We think the machine would answer all your requirements. It has been illustrated, described, and discussed in back numbers.)—Wm. Bailey. (Any of the large towns. Apprenticeship is practically unknown.)—H. (You will not be allowed to do it. Your cheapest plan is to rent a private wire.) Jonathan. (The wife, unless the property is her own and separately settled on her, is liable to the extent of the property left her; the second husband is liable to the extent of the property he receives with his wife.)—Tinsmith. (You want some gold-coloured lacquer, which you can buy cheaper than you can make. There are, however, several recipes in back volumes.)—Mr. J. Goggins. (1. Cotton, indiarubber, and several other things. 2. Certainly, if she pleases. 3. Several in back volumes. 4 Depends very much on the cause. 5. Dandelion tea is a favourite remedy.)—Medicus. (We gave all the address we know of.)—G. M. P. (Half inch or three-quarter inch inside diameter will suit. Look through the indices, under heads "Air Pump," "Vacuum Pump.")—Geo. Wilson. (No, if there were, it would be generally adopted. Something is done to mask it, by adding powerful scents, and we have given one or two patents for the same in back volumes.)—C. P. E. S. (The fish-hooks would need a woodcut. You can find them in books on fishing—Cholmondeley Pennell's "Modern Practical Angler" (Warne and Co.), for instance. 2. Recipes for dubbin in many back volumes, but as something of the kind is wanted now, here is one: Black rosin, ½lb.; tallow, ¼lb.; crude cod or train oil, 1 quart. Boil until of a suitable consistence.)—Ravodeach. (The queries are simply examination questions, answered in most textbooks. They are of no practical interest.)—W. P. Kelly. (We do not know. The translator took the note from the *Comptes Rendus*, and it is doubtful if "full details" have been published.)

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 10, 1882.

EPICYCLOIDAL CUTTER.

In making an instrument of this character, it is the best plan to get all the parts together, both castings and forgings, and also either the working drawing or an instrument to copy. I will endeavour to explain as fully as possible the best way to proceed. Having made several of them myself, I have found out from practical experience some useful hints; and by explaining them I hope to help any one who has sufficient courage to commence one. Having all the parts before you, the square stem A, Fig. 1, will be the first thing to begin. Let this be filed up to the standard size $\frac{9}{16}$ square, and it must be perfectly true all ways. When this is done it should be centered as accurately as possible, and the front part, where the fitting works must be rounded off to fit into a boring collar, the opposite end being rounded off at the corner also for the same purpose. When centred it should be drilled through from each end, and finished with a half-round bit $\frac{5}{16}$in. diameter and then broached out with a long taper broach so that a long taper fitting may be made. As the spindle which fits into this hole does not revolve beyond what is required for adjustment, there is no necessity whatever to put hardened steel collars in the stem, or to harden the steel spindle. When this is so far ready the steel spindle which passes through it must be fitted. Being a very long bearing, it may be cleared slightly in the centre, as one inch actual bearing at each end is quite sufficient. It will be observed

FIG. 2

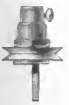


FIG. 3

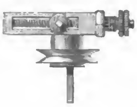


FIG. 4

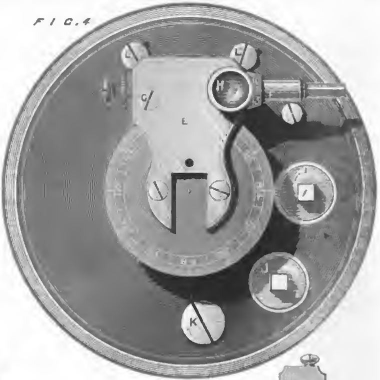


FIG. 6.

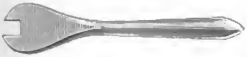


FIG. 1.

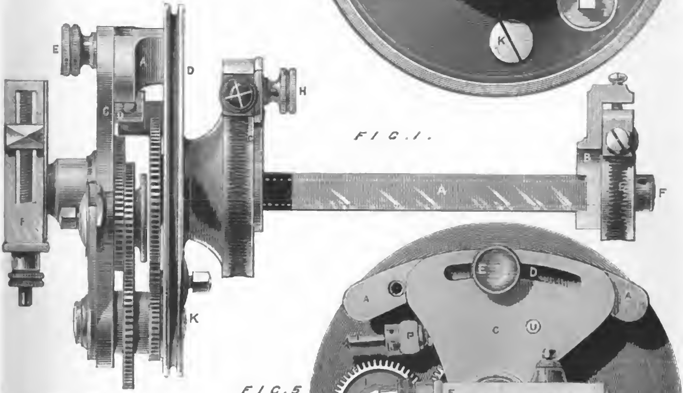


FIG. 5

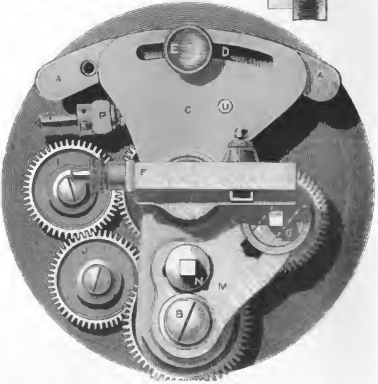


FIG. 7

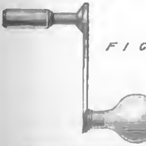
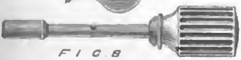


FIG. 8



that it must be long enough to pass through the tangent wheel E at the rear end, and it is fitted to this wheel by the end being filed hexagon, to correspond with the hole in the wheel made by a drift of the same shape. The end of the spindle is tapped to receive the screw F which has a lever hole through it. The frame B is fixed against the stem A by two screws and two steady-pins, which will be one at each corner of the square. The screws and pins must be well fitted to prevent the possibility of the frame moving by the working of the screw by the winch handle, which is required when setting the figures in different directions. To adjust the tangent wheel to its proper bearing upon the screw, there are two screws with countersunk heads, and two with round heads, which press against the top of the frame, when the other two are adjusted to set the screw. By the pressure of one pair of screws against the other the frame is held securely when the screw works properly.

Having got the steel spindle in its place, the tangent frame, screw, and wheel, fitted, we will proceed with the front plate which carries all the work, or nearly so. This plate D is 6in. in diameter, and must be very carefully chucked by its edge in A, and the centre turned out to receive a steel collar about ¾in. diameter. This collar must, of course, be hardened and driven in as tightly as possible. The hole in the metal should be slightly taper. Before hardening the collar it is better to make a channel from end to end for the oil to pass into. The collar in its place, it must be ground out perfectly clean and true: the best material for this purpose will be a piece of brass turned to fit it and charged with fine cutting emery. If it, the collar, is turned out as it should be, true and clean, and does not go out much in the process of hardening, it will not require much grinding out.

To proceed, it must now be fitted on to a short steel mandrel, or the stem itself will do. I prefer a short one, however, to turn the metal upon, which must be now turned all over. If well turned it will save a deal of time in the ultimate finishing of it. I think, before proceeding with the front wheel work, it will be better to fit on the tangent wheel C. I may here mention that this part is an improvement I made in this instrument, and it is for the purpose of rendering the tool capable of cutting deeper figures than it can without it. It will be remembered that when describing the rose-cutter, I gave an illustration of a small drill-stock for the same purpose in the rose-cutter; that same instrument is applied to the Epicycloidal cutter now under consideration, and the tangent movement I am about to describe is for the purpose of moving the cutting tool over the same ground slowly, while the drill runs at a high speed. I have found it an immense advantage, and I presume many more have, from the numbers that I have added it to, to make this article as complete as possible. I now give a representation of the drill, Fig. 2—Fig. 3 being a further improvement in the shape of a small eccentric cutter which is placed in the tool-box of the large one, the same way as the drill, Fig. 2, is.

This little addition I also find of excellent service in producing a grand variety of patterns of a deeply-cut nature. By way of example, to show what the eccentric cutter does in excess of the drill, we will presume that a 3, 4, or 5-loop figure has been cut with the ordinary fixed tool; by placing the eccentric cutter in the tool-box, and setting out a slight eccentricity, or I may say what amount the operator may fancy, a series of circles may be cut entirely round the figure by dividing with the tangent screw of the wheel C; if so arranged, it will cut what is generally termed the barley-corn pattern in the complete form of the pattern traced, whether it is 4, 5, or 6 loops, or any other number. I will call attention to the fact that this addition would not be used with any advantage where what are called circulating patterns are being cut, as the number of intersections would detract from its effectiveness, but for varying the appearance of loop figures it is a very valuable addition.

To proceed with the instrument, when the tangent wheel is fitted to its place, it can be removed and placed on a chuck to be cut; it has 120 teeth and is 2½in. diameter. It will be seen that a steel piece E, Fig. 4, is fixed to the collar of the stem A, Fig. 1, by two screws, it being first fitted over the square. The upper part is extended above the wheel sufficiently to admit of the frame that carries the screw being fixed to it by the screw, the screw being placed in the corner as seen for the purpose of its being thrown in and out of gear, and it is fixed in either position by the milled head H. The tangent screw has a square on the end on to which a winch-handle is fitted when in use. The screws and washer, I and J, are those which hold the two carriers in the front which carry the wheels for reversing the direction of the figure cut. The front of these will be seen in Fig. 5, I and J.

We will now proceed with the front part, wherein most of the work lies, and the first part will be to set out the centres and drill the hole into which the steel pin is fitted, forming the centre from which the radius is obtained from base to under surface of the plate. This pin is ¾ deep; it will be seen that upon this is fitted a metal bush, which has on it a wheel of 32 teeth at the bottom and another of 60 teeth at the top: these wheels are permanent and never changed. When this pin has been fitted the metal flange A, Fig. 5, must be fixed to its place, which it is by the two screws and steady-pins seen in Fig. 4, marked L L. It must be so fixed that it can be turned perfectly true from the opposite centre into which the screw B is fitted. To turn this properly it will be necessary to make a chuck for the purpose. I always use a steel one for such a job. The front is turned down to fit the hole in the large plate, and it is then fixed with a nut and washer. When so arranged the radius can be turned perfectly true; it is quite necessary to steady-pin the metal, in order to be certain that it always returns exactly to the same place. When the arc has been turned and surfaced to precisely the same depth as the shoulder on the pin, the front plate C, Fig, 5, must be fitted to the projection on the pin; and when this hole is made it must be fitted on to a chuck, the same as the plate, and the radial slot D cut out with a rose-ended cutter, running in a drill-spindle; it could, of course, be drilled and filed out, but the former is the correct way of doing it. When this is done, the milled-head screw E, Fig. 5, is fitted, and has a loose washer under the head. This done, the radius of the front plate and the support A must be both turned together; to do this great accuracy must be observed, and the steel pin being in its place, a chuck must be made for the purpose. It is on this edge that the divisions are made for adjusting the patterns. When this is turned and got up quite smooth the zero line must be made across both. We now come to the most particular part of the instrument, upon which the truth and accuracy of it will depend—that is, to turn out the hole to receive a steel collar in which the eccentric cutter works. To do this there are two ways. First, when it is altogether it can be fitted on to a chuck by the hole, which is fitted to the bearing on the end of the square stem A, Fig. 1. Perhaps to rough it out this will be the best way; but before I consider it ready to receive the steel collar, I always see that the instrument is carefully put together, and then fit up a block to the lathe—a wooden one will do, although we keep one in iron for the purpose—and fix the instrument on to it, and finish out the hole with it running on its permanent bearing, with the slide-rest fixed in front of it. This is easily done, and it is, of course, then perfectly true. The collar can then be fitted, and this must be well done; the least error in any part will, when there are so many bearings, multiply at every turn. The large face can be driven by the overhead motion, by the groove turned in its edge.

In the front of the flange C, Fig. 5, will be seen a projection, which is part of the same casting, and so made that it is central to the axis of the instrument, when the zero lines are together. By this I mean that, when no radial eccentricity is given, the hole turned out is always concentric to the axis upon which the whole thing works. Into this part is fitted an eccentric cutting-frame F, Figs. 1 and 5. This part is made in a precisely similar way to the ordinary eccentric cutting-frame, as far as the front is concerned; but the hinder part is different, inasmuch as it is fitted to the steel collar referred to above, and upon the rear end of it is fitted a wheel of 40 teeth, this being steady-pinned and screwed as firmly as possible. I should advise in all cases to turn the front of steel collar out to a chamfer, a corresponding one of course being left on that part of the eccentric cutter that fits into it. The wheel of 40, which is fixed to the end of it, is connected to the wheel of 60 that works upon the steel pin or stud B by two change-wheels fitted to an extra arbor O, Fig. 5, which slides in the small steel radial arm M, Fig. 5. This radial arm is fixed wherever it is required, according to the wheels used, by the screw with a square head and a loose steel washer. This screw is marked N, Fig. 5. The centre upon which this arm works is the end of the stud upon which the flange is fitted; it is made to work just freely between the face of the flange and the large steel washer under the screw B, sufficient adjustment being given by the radial slot for any of the changes that are effected by the various wheels, which are 12 in number—viz, 30, 32, 34, 36, 38, 40, 42, 44, 46, (2) 48, and 60. By these may be obtained looped figures of 2, 3, 4, 5, and besides the straight line and ellipse, many others, up to 80 or 90 circulating loops. But to return to the making of the instrument. When the wheel of 40 teeth is fixed, and all the work done that is likely to require the use of the centre, the front part must be fitted up; and it is scarcely necessary to say that the screw which actuates the tool-box is a multiple thread, the movement of which is equal to a screw of ten threads to the inch. At the suggestion of Mr. Bazley, whose excellent work everyone should possess, being of great value especially to those interested in mechanical pursuits—as I say, at this gentleman's suggestion, the face of the eccentric cutting-frame was divided into tenths; this is a most decided improvement, as the settings can be read by what may be called inspection, and save a vast deal of twisting and turning of the screw—consequently, wear and tear. The tool-box is fitted to hold the ordinary size eccentric cutters—these answering the purpose in every respect, there is no necessity to have an extra 3 or 4 dozen tools when purchasing an instrument. The two carriers marked I J are for the purpose of reversing the direction of the figures. They are fitted to a steel stud, and should have hardened steel collars. The wheels have 44 teeth, and are made to revolve between the flange on the stud and the head of the screw, which keeps them in their places. They are fixed to the main-plate D, Figs. 1, 4, and 5, by a square-headed screw, with a large loose washer under the head; and the holes into which they go are made sufficiently large to admit of the changes being made without coming in contact with any part of the body of the instrument.

When making the movable arbor which carries two wheels, very great care must be taken as to the distance, as the first wheel gears into the wheel of 40 teeth, which is fixed to the rear of the eccentric cutter, and the lower one gears into the 60 wheel on the main stud. Having only one change to make when adjusting, the instrument is a great advantage, and renders this tool less complicated than the elliptical cutter, in which latter instrument, to effect a change, the front flange has to be removed, and the eccentric cutter taken out, so that the wheel which fits on the end of it can be replaced by another of different value; this, of course, takes time, and is a tedious job.

We now pass on to the screw and fittings by which the flange is actuated. P, Fig. 5, shows the bearing into which the plain part fits; R is a small gun-metal collar, pinned across to hold the screw in its place, and so form a bearing between the collar of the screw and the gun-metal; T represents the end of the main screw, which is made square to take the ordinary key used for the eccentric cutting-frame; the bearing, P, is fitted into the plate D, Fig. 1, and is made to move between the two surfaces, a screw being fitted to the under-side to jam tightly on the end of the metal-bearing, and so form a fitting between it and the shoulder on the other side. The object of its being made to move is, because the nut U, seen in Figs. 1 and 5, differs in its actual position whenever the screw is moved to give eccentricity to the flange C.

On the top edge of the flange and the bar which supports it, will be found the divisions for reading off the settings. The divisions are engraved upon the bar, and the reading line upon the flange. There must be 100 divisions; which are marked 10, 20, 30, 40, and at every five a long line to facilitate the reading. The screw which works in the nut U is made the same pitch and value as that in the eccentric cutter—not that its value is of any importance, the settings being taken from the scale on the bar; the screw is merely for the sake of moving the flanges from one end to the other. The spanner, Fig. 6, is necessary to adjust the various square-headed screws where the ordinary square-hole key would not go. The winch handle, Fig. 7, may be used to adjust the flange, but the straight key, Fig. 8, is the best for the purpose. The winch handle, however, is absolutely necessary when turning the tangent-screw F, Fig. 4, to work the extra tangent-wheel for cutting deep figures, as a continuous motion must be given to the instrument by that means, the small cutters, Figs. 2 and 3, whichever is in use, being driven at high speed with the overhead band. With regard to the working out of the various patterns to be produced by this instrument, I cannot do better than advise anyone possessing such a tool to study the work by Mr. Bazley, which gives an elaborate and easily-understood description of the capabilities of the instrument, which would occupy too much space in these columns. The work is published by Messrs. Trübner and Co.

J. H. Evans.

THE ACHROMATIC OBJECT-GLASS.—XI.

By W. Bradbury.

(*Continued from page* 80.)

ASSUMING that the first and third lenses are convex, and the central one concave, we obtain three equations: first, that of the foci; second, the chromatic variations for the first pair of selected rays; thirdly, those of the second pair.

$$\frac{1}{\phi}=\frac{1}{f_1}+\frac{1}{f_3}-\frac{1}{f_2}\ \ldots\ldots\ldots\ldots\ldots(1)$$

$$\frac{1}{f_2}\cdot\frac{d\mu}{(\mu_2-1)}=\frac{1}{f_1}\cdot\frac{d\mu}{(\mu_1-1)}+\frac{1}{f_3}\cdot\frac{d\mu}{(\mu_3-1)}\ \ldots(2)$$

$$\frac{1}{f_2}\cdot\frac{d^1\mu}{(\mu_2-1)}=\frac{1}{f_1}\cdot\frac{d^1\mu}{(\mu_1-1)}+\frac{1}{f_3}\cdot\frac{d^1\mu}{(\mu_3-1)}\ \ldots(3)$$

By $d\mu$ we denote the corresponding dispersions in each lens for the first selected rays, by $d^1\mu$ those for second pair; and as there are three equations, each of the foci may be determined.

To satisfy the condition of achromatism, it is not necessary that either two or three lenses should be placed in contact. When their foci are in a certain proportion, it may exist when they are separated. This fact may be utilised in comparing the optical properties of various glasses. For, if a convex and concave lens can be so adjusted, as to be achromatic at a certain distance asunder, they furnish the data for finding the requisite foci to produce this when in contact. The concave lens must have a negative focus, not very much greater, but it may be less, than that of the convex.

Therefore, in proceeding to determine, experimentally, the foci requisite for contact achromatism, the lenses may each be ground to the same curves—that is—the concave may be formed on the counterpart tool of the convex. Their foci will then be in a suitable proportion sor permitting them to achromatise when feparated.

The compound focus of two lenses, separated by a distance a is given by the equation—

$$\frac{1}{\phi}=\frac{1}{f_1-a}-\frac{1}{f_2}$$

As before, the chromatic variations must not disturb the compound focus. Hence our second equation* is:—

$$\frac{d\mu}{\mu-1}\cdot\frac{f_1}{(f_1-a)^2}=\frac{1}{f_2}\cdot\frac{d\mu}{\mu_1-1}.$$

It is usual to express the ratio of crown and flint dispersive powers by δ, and our result in a slightly different form is—

$$\delta=\frac{(f_1-a)^2}{f_1 f_2}.$$

And as δ is the proportion of foci for contact achromatism: to determine it, adjust the lenses until achromatism is attained, and measure the required separation; then knowing the foci, δ is easily computed.

Conversely, if we know the dispersive ratio, we can find what amount of separation will achromatise the lenses of a dialyte objective.

When there are three lenses in the construction, whereof the second and third are in contact, the formula is the same as that for the triplet, excepting the variation of the first lens, which is a function of $f/(f-a)^2$.

The value of δ may also be determined in the following manner:—

The dispersion of a lens varies inversely as its focus—that is, the less the focal length, the greater is the dispersion. If δ represents the relative dispersion of a convex lens when compared in contact with a flint, for a focal length of $(f-a)$, it would be $f\delta/(f-a)$.

And, since the lenses achromatise when at the distance a asunder, this proportion must be satisfied—viz:—

$$(f_1-a):f_2::\frac{f_1\delta}{(f_1-a)}:1.$$

from which, as before:—

$$\delta=\frac{(f_1-a)^2}{f_1 f_2}\ \ldots\ldots\ldots\ldots\ldots(\dagger).$$

The preceding rules show what relations must be satisfied in the formation of an achromatic compound; it must now be explained how the numerical values for the dispersive powers are obtained.

There exists in the solar spectrum a number of dark lines crossing it at irregular intervals, but always preserving the same relative distance from each other. The most prominent of these lines were named alphabetically by Fraunhofer, and they still retain this rotation. A well-defined line is generally found in or near each of the coloured spaces; and in achromatising a combination, the union of any selected colours is referred to the lines which characterise them. A standard is thus obtained, by which the optical properties of different substances may be definitely compared. Hence the problem of selecting the best combination rays is resolved into that of finding how two opposing spectra may be arranged, so that the greatest number of spectral lines shall be coincident.

The position of the Fraunhofer lines may be thus indicated. Commencing with the lower, or least refrangible end of the spectrum, we have A, B, and C in the red, D in the yellow, E in the green, F in the blue, G in the indigo, and H in the violet. They do not intersect each coloured space at its point of maximum intensity, but generally lie below it. The most strongly illuminating colours are situated in the middle and lower half of the spectrum, so that the lines D, E, and F have the most effect on the colour of the focal image. They must be, as far as possible, united; and although some diffusion may exist in the extreme colours, it will not be so obtrusive, because it is of much less intensity.

By means of the indices for a pair of glasses, it may be shown what lines will combine with the least dispersion; from which the value of the dispersive ratio may be very nearly ascertained. Fraunhofer tabulated the indices for the lines B to H for seven kinds of glass. Two of these, with the index differences, are:—

Crown:—
B C D E F G H
1·5258–1·5268–1·5296–1·533–1·536–1·5416–1·5465
Difference:—
10 28 34 30 56 49
Flint:—
1·6236–1·6255–1·6306–1·6373–1·6435–1·6554–1·666
Difference:—
19 51 67 62 119 106

Taking the difference between B and H, and dividing it by B, we obtain the dispersive power for each glass, or, crown, ·0393—flint, ·0679, whose ratio is ·578. This is the dispersive ratio for the extreme lines B and H. Secondly, find the difference between C and G, and divide by C, and we have, crown, ·02809—flint, ·0478, whose ratio is ·587. Thirdly, the corresponding numbers for D and F are: crown, ·012—flint, ·0204, ratio ·59. These numbers show, that to combine the different rays requires the crown foci to bear to the flint the following proportions:—

B and H – 578 : 1000.
C and G – 587 : 1000.
D and F – 590 : 1000.

Therefore the crown focus becomes greater as we select rays further from the extremes of the spectrum; that is, the action of the flint lens is increased. It will now be shown which of these proportions gives the best correction.

To compare the action of crown and flint glass, spectra of equal length are required. For the first, taking line B as the starting-point, the positions of the others are according to the differences:—

Crown	0	10	38	72	102	158	207
	B	C	D	E	F	G	H

So that the length of spectrum BH thrown out by this glass is 207. By taking the sum of the flint differences, the length of its spectrum is 424; and by simple proportion the positions the lines would occupy if its length were 207 are:—

	B	C	D	E	F	G	H
Flint	0	9·2	34·1	66·8	97	155	207

Subtracting these from the crown values, we

---

* To find the chromatic variation of $(f-a)$, we proceed thus:—Let the dispersive power be denoted by m (for shortness), then, instead of $1/f$ we must substitute $(1+m)/f$, and we obtain $d\left(\frac{1}{f-a}\right)=(1+m)\left\{\frac{1}{(f-a)\,am}\right\}-\frac{1}{f-a}$. Expanding the second part in a series, we have, excluding powers of m, greater than the second, $d\left(\frac{1}{(f-a)}\right)=\frac{m\cdot f}{(f-a)^2}+\frac{m^2\cdot af}{(f-a)^3}$. The first term only of this result is used in our example, the second, being the square of the dispersive power, must always be a very small one.

† To find a from this equation: By extracting the root we get $(f_1-a)=\pm\sqrt{\delta\cdot f_1 f_2}$, or $a=f_1\mp\sqrt{\delta\cdot f_1 f_2}$, in which the upper sign only is admissible, for the separation cannot be equal to or greater than f_1. Also, it must always be greater than (f_1-f_2), for if not, no real focus can be formed, as the concave would be more powerful and diverge the rays.

When there are three lenses in a combination, the first and third of the same crown-glass, the second flint and the second and third in contact of equal and opposite foci, but separated from the first by a distance a, the formula is (F focus first lens, f that of either of the next lenses):—

$$\delta=\frac{f(F-a)^2}{Ff-(F-a)^2}.$$

Or, if A and a be the acting semi-apertures of the object-glass and correctors, then—

$$F=\frac{A^2}{a^2}\left(\frac{f}{1-a}\right).$$

This is the ordinary formula for a dialyte.

have (disregarding the fractions, the following variations from equality :—

B	C	D	E	F	G	H
0	1	4	5	5	3	0

This result evidently shows that when B and H are combined, the colour is very much *under-corrected*, as the chief differences are among the most illuminating rays.

Performing the same operations when C and G are combined, the numbers are :—

	B	C	D	E	F	G	H
Crown	10	− 0	− 28	− 62	− 92	− 148	− 197
Flint	9·4	− 0	− 25·2	− 58·3	− 88·9	− 148	− 200
Diff.	+ 0·6	− 0	+ 2·8	+ 3·7	+ 3	− 0	− 3

Here it is evident that the inner differences are much reduced, and therefore a better correction is secured than in the former. The outer line H *is overcorrected* by the flint, that is, it is removed beyond the position required by the crown lens.

When B and H are combined, the differences show that the outstanding colour will be yellow or greenish yellow, while in the case of C and G, the interior focal tint will be green, and the exterior pink, resulting from intermixture of the red and violet. These green and pink or "wine-coloured" fringes are considered by Brewster and Herschel to represent the best chromatic correction. Hence the dispersive ratio obtained from C and G cannot be far from accurate. Evidently it gives a slight *under*-correction, as the under-combined rays are in excess. Let us next try the effect of uniting D and F. As before we have :—

	B	C	D	E	F	G	H
Crown ..	38	28	0	− 34	64	120	− 169
Flint	34·7	− 25·3	− 0	− 33·2	− 64	− 123	− 176
Differences	+ 3·3	+ 2·7	− 0	+ 0·8	− 0	− 3	− 7

These numbers show that by uniting D and F, the correction is carried a little too far, for the negative numbers are in excess. The inequalities of the interior lines have been almost all eliminated, but this has introduced an under-correction for the red, and a larger over-correction for the blue or violet end of the spectrum. Hence the outstanding colour will have this predominating tint.

The correction secured by uniting C and G can thus be carried a little further without detriment to the achromatism; but it must not reach that obtained from the union of D and F. The dispersed green may be diminished by throwing a slight over-correction into the blue rays; but as this entails a positive error from the red, it must not be carried too far.

We may conclude, from the preceding results, that a dispersive ratio, equal to the mean of those computed for C G and D F, will give as near an approach to achromatism as can be obtained without experiment.

I am enabled to give an account of some experiments made by Prof. Young on the completeness of the achromatism in two very differently constructed object-glasses. The first is of Clark's manufacture, and does not materially differ from the English form: the maker of the second is not stated; and although it seems a curious combination, the learned professor says: "The telescope is remarkably excellent in every respect." This paper is on *The Colour Correction of Certain Achromatic Object-Glasses*, by Prof. C. A. Young, Princeton, New Jersey.[*]

To be continued.

THE MILLING MACHINE.—II.

A CONVENIENT method of rendering the milling machine self-acting in the longitudinal and vertical cuts is shown in Fig. 2. It will be seen that a small pinion (of gunmetal or malleable iron) is keyed fast to the leading screw of the lower slide, which gears with a toothed wheel on the shaft A, the latter being free to revolve except it be clamped by the hand-wheel B, when it partakes of the revolution of A, when driven by the worm wheel at its other end. The vertical shaft C is suspended to the bracket which carries the slides, whilst its lower end passes through a bevel wheel (not shown in the sketch), being caused to revolve with it by a key sliding freely in the slot shown on the shaft: this admits of its being raised and lowered with the table, without interfering with its freedom to revolve. The bevel wheel referred to above is driven by another keyed to a shaft which runs in bearings on the side of the main casting or standard, the other end of the shaft having a two or three-speed pulley, driven by a similar one on the end of the mandrel of the headstock.

The vertical traverse, although seldom required, is effected by another worm and wheel: the former is keyed upon the shaft A, and the wheel upon the vertical screw D is free to revolve as in the previous instance, save when clamped by the hand wheel E. A larger hand wheel is keyed fast upon this screw, as was shown before in Fig. 1.

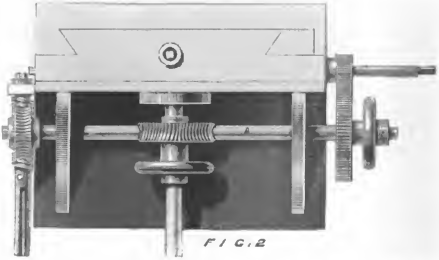


FIG. 2

A self-acting motion of the transverse slide, although it is very rarely necessary, may be managed by keying a bevel wheel on the shaft A, gearing it into another which shall drive a pinion in front of the table-bracket, whilst, to accommodate the gearing to the varying distance of the leading screw of the upper slide from the centre, a swing frame, carrying intermediate wheels, may be affixed to the front of the machine, similar to the familiar arrangement adopted in screw-cutting lathes. The foregoing description will, I hope, be sufficiently clear to enable my readers to understand the methods of making these useful machines automatic. It now only remains to show how work may be fixed to the table, and how to make the cutters. To take the latter question first, I must premise that a forge, a lathe, and if possible, a milling machine, are available. The cutter should be forged of good cast steel, cut off a thick round bar, and formed into a disc by blows delivered endwise of the stuff. The greatest care must be taken not to overheat the metal, or the cutter will be quite useless; no tool requiring to retain its cutting edge longer than do these, owing to the difficulty of sharpening them so as to retain their outline unimpaired. The hole may be punched whilst hot; but it is perhaps preferable to drill the hole in the solid forging. It must now be thoroughly annealed, after which it is ready for the lathe. The hole is to be trued out to the desired size, and the forging placed upon an arbor and turned to the outline and size required. This done, it may be placed between the milling centres and the teeth divided and cut by a cutter with a *rounded* tooth—not one that is straight across the face, because this would leave a sharp internal angle to the tooth which is being formed, and which is especially objectionable, inasmuch as when the cutter is being hardened, it is very liable to crack from these points. The teeth thus roughly formed are finished to a cutting edge by means of a file. If a milling machine is not available for the job, the circumference of the cutter-blank must be divided either in the lathe or with a pair of dividers, and the teeth formed wholly with a file, or if much metal has to be removed, it may be roughly chipped away with a chisel, and then finished up with a file. Take care that the teeth have plenty of clearance, so that they do not rub instead of cut; but at the same time see that the edges are well supported by metal behind, or they will break off when in work. It is not always easy to give clearance to the teeth of a cutter, especially when it has a hollow curved outline: hence the cost of such cutters is very considerable. The cost of cutters is further enhanced by the uncertainty which exists, notwithstanding the greatest care and knowledge of the steel, as to whether they are going to crack in the hardening, or not. It is a good plan to anneal cutters again before hardening them, as this reduces the chances of their cracking. In hardening, heat to the lowest temperature that the steel will fairly harden at (this is a matter of previous experiment with a piece of the rough steel), and quench in chilled water; probably a well-formed cutter is best not tempered at all after being hardened; but if necessary, do it in a Bunsen burner.

W. S. Brown.

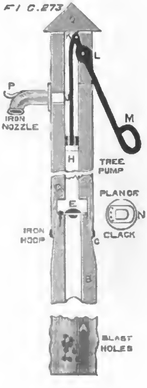
PRACTICAL NOTES ON PLUMBING.—L.[*]

By P. J. Davies, H.M.A.S.P., &c.

(Continued from page 198.)

FOR the fixing of the tree-pump see Fig. 273. A is the bottom-tree which rests upon the bottom of the well; the holes shown at A are the blast-holes leading to the bored part. At C is the cone-joint, made water-tight. Upon the upper end of the tree, as at E, is fixed the clack or lower valve, which in this case is nailed in the top part of the bottom tree. The wood-seating

FIG. 273



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[*] From the *American Journal of Science*, Vol. XIX., June, 1880. I am indebted to the kindness of Mr. J. A. Brashear, of Pittsburg, for this and another communication which will appear in subsequent articles

[*] From the *Building News*. All rights reserved.

or face part of the valve requires to be nicely faced true, so that the leather may shut down fairly upon its seating, in order to prevent the water running back into the bottom. There are many different methods of forming these clacks or valves; but the one here shown is the oldest (known as the bellows-clack; the name clack is taken from the peculiar noise which the bellows-clack makes) and is still in use in many parts of the West of England. The great objection to them is, that whenever the leather is worn out, the top part, or tree, has to be lifted—not at all a pleasant job to do. When this top is off, simply with a cold chisel knock out the clout nails F, and take off the clack; but do not damage the face or seating of the valve. Next, with a suitable-sized piece of good tanned sole-leather, ¼in. or more in thickness, with all the fleshy part ground off, and which is done by rubbing it with water upon a piece of sandstone, or other such like surface, until the fleshy part is all worn off, make the clack as shown at Figs. 274 and 275; but before you can do so, you will require the lead clack, which is made as follows:—

FIG. 274.

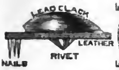
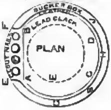


FIG. 275.



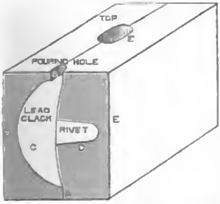
Lead Clacks.

These clacks are cast in a two-sided mould (see Fig. 276). C is the clack; *rivet* is the part which holds the clack upon the leather; also see *rivet*, Fig. 274, which illustrates the rivet turned over the leather. For a plan of this clack see A B, C D, Fig. 275. The method of casting these clacks will be readily seen by reference to Fig. 276. E and E are the two sides of the clack mould placed together, having a clack cast therein.

To cast this clack, make the mould hot, and place the sides as shown. Pour in the lead, and as soon as it is set turn the clack out, and fill up the mould again and again until you have the required quantity. Having shown you the clack mould, I will explain another method of casting the lead clack when you have no mould.

Have a pattern made of wood to the shape and size required, with a piece of wood nailed on to form a rivet. Press the pattern rivet downwards into some sand, and fill it up with lead. Here you get a good clack, with flat top, instead of rounded (as shown at E, Fig. 276). These clacks are the best for drawing the sucker, as will be hereafter explained.

FIG. 276.



Having the clack cast, cut the leather to the size of your clack seating, and rivet the clack on as shown; then, in the case of the tree-pump, Fig. 273, it must be nailed on the seating formed on the top of the bottom tree, great care being taken not to let the rivet be too much spread so as to prevent the leather from shutting down fair over the whole of the seating. Also, see that the leather is not too large to work up against the barrel of the pump. There should be a clear space of ¼in. all round, except where the nails come at *clout, nails*, Fig. 275.

(To be continued.)

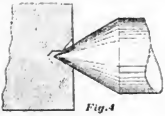


Fig.4

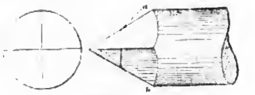


Fig.1

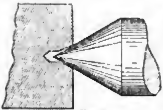


Fig.5

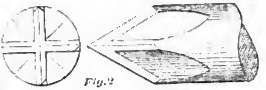


Fig.2

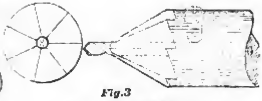
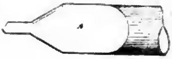


Fig.3



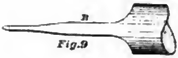


Fig.9

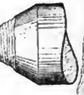


Fig.8

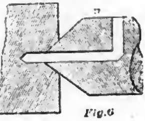


Fig.6

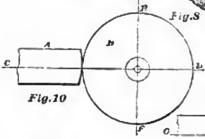


Fig.10

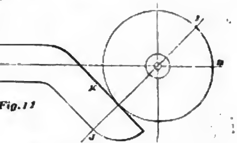


Fig.11

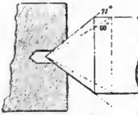


Fig.7

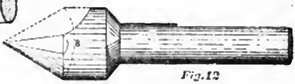


Fig.12

WRINKLES IN LATHE CENTRES AND CENTRE REAMERS.*

After all that has been written upon the subject of centring and turning work in lathes, there is still much to learn. Substantial progress is often hindered, and sometimes prevented, by some peculiar notion that may exist in the fossil-like mind of a proprietor or superintendent.

If there is any one thing used in connection with lathes that remains as a relic of barbarism it is the old-fashioned square centre as shown in Fig. 1 of the accompanying cuts. This cut represents a side and end view of a *thing* erroneously named in the category of tools, which will not cut, but tears its way into the end of a piece of work. Being in most instances made of inferior steel on account of the large quantity of material required to make it, this square centre is easily and quickly dulled.

When first made, this centre is usually filed to a gauge, which corresponds to the other centres of the lathe, so that the hole made with the square centre will fit the other centres. When dulled, the workman takes this square centre to a grindstone and begins to grind it to the same angle as it formerly had. This is when his patience is undisturbed, but after grinding for awhile he gets irritable, and in consequence the tapered end of the square centre begins to rise and the sharp edges to appear. The centre gauge in his pocket is forgotten, and the edges upon the square centre assume the form shown by the dotted lines *a*, *b*, in Fig. 1.

When the work, after being square centred with such a tool, is placed upon the centre of the lathe, the fit is like the example shown in Fig. 4, where it will be seen that the bearing is nearest the point of the centre, which is not as it should be. Some mechanics advocate the opposite extreme, and make the angles of the square centre less acute than the other centres, so that when a piece of work is centred with it and placed upon the centres, the fit will appear like the illustration Fig. 5.

In this instance it will be observed that there is only a narrow bearing upon the centre at the end of the piece of work. Some workmen will lift their voices in high and mighty argument, contending that the plan followed in Fig. 4 is the better, because it will lubricate more speedily, and is less liable to wear out of true upon the centre than that shown in Fig. 5. Others may be found whose opinions upon mechanical matters are equally good, who will use the same arguments in favour of the latter. I must say that my experience has taught me that both are wrong, and as a proof I will call upon the dead centre to testify. It is here shown in Fig. 8. This portrait was taken from life, being a truthful picture of a centre used by a workman who advocated the use of the plan shown in Fig. 5. Much of the work done in his lathe was upon steel, such as taps, reamers, and other tool work, very little care being taken in annealing the steel before centring.

It will be understood without any description how this centre could have been so badly "chawed" as the shopmen say, by the improper bearing of the work upon it. If the principles illustrated in Figs. 4 and 5 were carried out in making pillow blocks, and the various bearings upon steam-engines and other machinery of the present day, we would very soon hear of a variety of accidents and casualties.

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* By Lewis F. Lyne, in the *American Machinist.*

If I were to order a set of hardened steel mandrels to fit the U.S. Standard 60° lathe centre gauge, and they should come to me with centres like either Fig. 4 or 5, I would send them back at once with an inquiry as to why my order was not executed according to directions.

If mandrels are to remain true without damaging the lathe centres, they must fit the centres upon which they are to run, and they must fit with as great accuracy as any other bearing about machinery. Such a fit is shown in Fig. 7.

I have found in practice in railroad and general repair shops that the U.S. Standard centre of 60° is not generally used, being considered too sharp. In turning taper work in lathes not having a special taper attachment, these centres are more quickly destroyed in consequence of their sharpness or the acuteness of their angles. On heavy work the points are more easily bent or broken than if the angles were less acute.

I once tried centres of different angles upon several lathes, to see which would last the longest upon general work, and finally adopted an angle of 77°, as one that did the best work.

Accordingly I had all the lathe-centres in the shop made to one gauge, 77°, and all centre reamers and square centres made to the same gauge, after which I had little trouble with "chawed" centres.

The square centres I used, however, were not like the one shown in Fig. 1, but were cut out upon a milling machine, as shown in Fig. 2.

Some workmen advocate fluting square centres with a round-faced cutter, to reduce the grinding surface. It accomplishes this object, but fluting does not help the cutting qualities of the edges nearest the point. Neither does fluting help the oil to get in, or the chips to get away from the point where they do the most damage. Since the chips cannot get out nor the oil get in, the "chawing" process goes on uninterruptedly. By cutting out a square centre as shown in Fig. 2, it will be seen from the end view that space is allowed for the chips to work out and for oil to be freely applied; but such a tool cannot cut—it can only scrape or tear off the metal. This style of square centre was finally abandoned for the one shown in Fig. 3 without the drill for general work. I wish to say at once that it will not do to make this tool of poor steel. It must be made of the best: otherwise the centre shown in Fig. 2 would better be used.

It will be seen that the tool shown in Fig. 3 has seven cutting edges, which number has been found to work well in practice, as they cut freely, but not too much so. A hole was made through the centre of Fig. 3, to admit a twist-drill of a proper diameter to suit the class of work to be done. The twist drill was held by a small screw, as shown. This tool drills and reams the centre at one operation. To use this tool the work has to be held in a steady rest, or otherwise supported, and it cannot be made to answer the same requirements as this style without the drill, or even that shown in Fig. 2.

A more simple (probably the simplest) form of a tool to accomplish the same purpose, is shown in Fig. 9. It consists simply of a round piece of steel, either milled or filed in the way to make a drill having two diameters, as shown at A, while B shows an edge view of the same tool. This tool is of more value upon brasswork than upon iron or steel, being very useful in centring pieces of brass work held in a chuck. There is difficulty in using this upon wrought iron and steel, for the reason that the small drill is liable to clog up and twist off. Iron and steel are difficult to cut, hence they require a tool to be more frequently ground than brass. To give the chips room to escape requires the small or drill part to be made light at the point of the countersink.

The centre reamer shown in Fig. 12 is an excellent tool, the advantages of which have been stated before. There is one additional point, however, that may be mentioned in favour of this excellent tool. It is this: Cutting off one side less than half the diameter as shown in this illustration, and leaving the cutting edge at an angle and not parallel with the centre line insure a smooth, true centre. For this reason it may be used with safety in centring heavy work; whereas, if precisely half the diameter were cut away, leaving the cutting edge on a line and parallel with the centre, it would be a great deal more liable to chatter upon heavy work.

Such a reamer as the one last mentioned works satisfactorily upon light or special work: the same is true of the standard centre of 60°. The reamer here shown when made of the best steel will last for a long time, and when worn out may be thrown away without sustaining any net loss.

For lubricating the centres of all lathes above 16in. swing, I have found the wrinkle shown in Fig. 6 to work well. In turning off a pair of driving wheels and other heavy work, I have been at times very much annoyed by the centre becoming dry, so that the lathe had to be stopped and the centre slacked off for oiling.

These difficulties may be successfully met by drilling the dead centre, as shown, so as to form an oil-hole reaching to the point of the centre, from which oil may be freely supplied to the bearing surfaces.

In the old and barbarous way of square-centering a shaft in a lathe, the butt end of a tool shown at A, in Fig. 10, was placed in the tool-post and pressed against the shaft B, at the same time the square centre was forced in. The pressure of the tool being on a line with C D, and at right angles to E F, the back of the carriage was lifted slightly, as the rough, uneven surface of the shaft came in contact with the butt of the tool A.

Under such circumstances, the writer has known a workman to waste his time for hours in trying to get a large shaft to run true without success.

To accurately centre a piece of work in a lathe, the rest pressing against the work must be as firm as possible, and the spindle holding the dead centre should project beyond the tail-stock as little as can be allowed, to insure greater stiffness. Another and most essential point to be observed is to apply the pressure to the work at an angle of about 45°, or in direction of the line I J, in Fig. 11, G, H representing the horizontal line from which the angle is to be taken. It will be perceived from the illustration that the revolving shaft cannot by any possible means lift the carriage, but will rather press it firmly upon the shears. In many lathes built at the present time the front of the carriage overhangs to such an extent that, together with overhanging of the weight upon the apron, there is a force sufficient to lift the back part of the carriage from the shears. In almost all lathes a pressure applied, as in Fig. 10, would cause the carriage to be lifted at the back.

In taking a finishing cut with water and a broad nose tool, the writer noticed upon a certain lathe that the tool would cut very nicely for a short distance, then suddenly dig into the shaft that was being turned. An examination revealed the fact that the pressure upon the tool tipped the carriage so that the back part, instead of resting upon the shears, bore hard upon the gib on the under side of the shears. When the tool reached a soft spot in the iron, the back of the carriage would drop and cause the tool to dig in. Upon such a lathe as the one described, the tool should be set so that the cutting edge will not be above the centre.

It may be found necessary to place additional weight upon the back part of the carriage to keep it down firmly in doing certain kinds of work. In well regulated shops all work to be turned is made as straight as possible by the eye of the blacksmith, so that it is entirely safe to drill and ream the centres; then what little straightening may be found necessary should be done before squaring up the ends.

Much stress is put by some workmen upon the impropriety of drilling and reaming the centres in work as it comes from the blacksmith's shop; but I am persuaded that such apprehensions have no special relation to the true cause of the difficulties experienced. The material should be made as straight as possible before it is placed in the lathe; then there will be no trouble; but if material is taken promiscuously from the blacksmith's shop, drilled and centred, I can then readily understand why trouble could occur.

All shops should have a centring machine, which they can either buy or make at a nominal cost, but one should be obtained somehow. Such a machine can be purchased having a centring chuck and a drilling device, which would very soon pay for itself and a profit beside.

Centring rough work in a lathe should never be done when it can possibly be avoided. All material should be annealed and made fit for working; otherwise the cutting tools will be destroyed by the hard scales upon the surface. Unless these scales are removed, standard gauges and tools are of little consequence.

HYDRAULIC MACHINERY.—VII.[*]

By Prof. Perry.

(Continued from page 199.)

IT is usual to assume that the radial velocity of the water through the wheel is one-eighth of that due to the total fall. Dividing this into the number of cubic feet of water flowing, you know the total tangential area of the space between the vanes everywhere in the wheel, assuming that it is the same everywhere, which it usually is. It is usual to take the inner radius of wheel equal to the depth of these passages in the wheel, so that both these dimensions are now fixed. The outer radius is generally twice the inner one, and we have already calculated the tangential velocity of the outside, so the number of revolutions per minute may be calculated. The horse-power given out is usually taken to be less than three-fourths of the true horse-power of the water. Thus, by rules, partly due to practical experience and partly due to imperfect theory, we are able to fix all the dimensions of a turbine of the kind I have been describing.

I think that by entering thus fully into the theory and construction of the turbine, with which I am, myself, practically acquainted, I can dispense with with giving a catalogue of the constructions of turbines generally. This turbine is said to be one of "inward radial flow." You see that, for a given quantity of water flowing, it can be made hydraulically perfect, that is, by proper construction of these guide-blades there is no necessary loss of energy, any more than in the whirlpool-chamber of Thomson's centrifugal pump. Water need not flow from any one place here to any other where there is necessarily, from the shape of the stream lines, a difference in the amount of total energy per pound of water.

You see that in the same manner we could discuss the action of water in the unsteady "outward radial flow turbines," and, again, in the axial-flow turbines of Fourneyron and others. The principle of your stream of acrobats jumping on and off a merry-go-round, will in every case tell you how much energy the water gives to the wheel of a turbine, whatever may be the nature of the flow. In the same way, also, we consider the construction of the floats of undershot water-wheels, and all other wheels on which the water acts impulsively; that is, the water possessing only a portion of its store in the shape of pressure or potential energy; much of its energy being kinetic when it is entering the vanes.

When the available fall is very great, it is not advisable to use a turbine water-wheel. In the turbine, as you saw, there is at least one part of the arrangement in which about half the total store of energy is in the shape of kinetic energy; and when the energy is in the shape of kinetic energy, there is a great waste by friction. The waste is proportional to the kinetic energy—that is, to the total energy, and hence turbines are at least not more economical on high falls than on low ones.

Now, a water pressure engine may be regarded as the inverse of a reciprocating pump. If we neglect the shocks which are always due to imperfect construction, when a water pressure engine works at a certain speed, the loss of energy by friction in the engine is the same on high and low falls, and hence there is a very much greater efficiency on high falls. We employ water pressure engines, therefore, on high falls instead of turbines.

You must remember, however, that in water pressure engines, as in pumps, kinetic energy produced anywhere is almost immediately altogether wasted. Tweddell's punching-machines are almost the only examples in which even a small part of the kinetic energy is converted again into pressure energy.

I showed you in my first lecture, that water-pressure engines, moving slowly, can be made very economical; and I mean presently to show you how easily we can work pressure-engines from a steam-engine at a considerable distance. But there would be great difficulty introduced if, every time I stopped my water-engine, whether it was part of a crane or a capstan, or a riveting-machine, or a punching-machine, or a hoist, my pumps were compelled to stop, and therefore my steam-engine. I want my steam-engine to work continuously, storing energy in the shape of pressure or potential energy in water, so that I may draw on this store intermittently. It is seldom that the energy is stored as the potential energy of water raised to a tank. The usual arrangement for storage is called an accumulator, in which there is a ram carrying a heavy weight; every pound of water taken from this press possesses a store of pressure energy, which you know how to calculate. The pressure here is the total weight of the ram and accumulator, divided by the cross-section of the ram in square inches, and every pound of water leaving the accumulator possesses a store of pressure energy. It may also possess potential energy, due to the accumulator being above the mouth of the discharge-pipe of the water-pressure engine. For the working of cranes, a pressure of 700lb. per square inch is usual. This means that each pound of water has 700 × 2·3, or 1,610, foot-pounds of energy, or as much as if it came from a cistern 1,610ft. high. Instead of coming from such a high cistern, however, it has come from the accumulator, on which the load on the ram is 70,000 lb., the ram having a cross-section of 100 square inches. If this ram can be lifted 20ft. high, before the self-acting mechanism shuts off supply from the steam-engine pumps, it is capable of receiving a total store of 70,000 × 20, or 1,400,000 foot-pounds; the store of one Faure's Electric Accumulator; enough energy to drive a machine requiring one-horse power for 42 minutes.

As an illustration of the small amount of loss of energy in this form of storage, I quote from Mr. Tweddell, when using an ordinary accumulator with a 7in. ram, 12ft. stroke. When being charged, the pressure was 1,250 pounds per square inch, and when being discharged the pressure was 1,225 pounds per square inch. So that, in each case, friction is overcome with a pressure of 12½ pounds per square inch, or one per cent. of the energy is wasted in friction in charging or discharging. In fact 98 per cent. of the energy given to such an accumulator is given out again. I am sorry to state, however, that other experienced men state the loss at 20 to 30 per cent., although I know of no recent figures derived from actual experiment which make the loss so great as this.

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[*] Condensed from a series of Cantor Lectures delivered before the Society of Arts.

If we want our water to have a greater pressure, we can either increase our lifted weight or diminish the section of our ram. There is a limit, however, beyond which it is unadvisable to lessen the size of the ram when a great weight is being carried, and this is specially the case when the accumulator has to be shifted in position.

The common construction of water-pressure engines will be readily understood, if you understand the construction of the steam-engine. Remember, however, that the velocity of water ought never to be great in the engine or pipes. Wire-drawing leads to serious loss by friction in the steam-engine; it is far more serious in water-pressure engines. In these, the valves ought to be quite open, giving a very large passage for water to flow through almost immediately. Remember that all frictional losses are made much greater by quick motion, and by reversals of motion, and hence that it is very important to have a long stroke of piston or plunger. Lastly, remember that, although there ought to be no waste space between steam-piston and cylinder, at the end of the stroke (very little clearance), this is of almost no importance in water-pressure engines, because of the incompressibility of water.

What, now, are the conditions under which transmission of powder by hydraulic action is most suitable?

1st. Intermittent action, because the accumulator is so nearly perfect, giving out energy simply in proportion to the quantity of water used, and yet allowing an engine of small power to be storing continually.

2nd. Action requiring not a very great quantity of power.

3rd. Action of a comparatively slow kind, the water never being allowed to flow so fast, that its store of kinetic energy is great, since the kinetic energy is nearly all wasted. Slow action with considerable force.

4th. Action which is greatly continuous in one direction, not requiring much stoppage or reversal of the water motion.

You will see from this that the conditions required in pressing machinery, cranes, hoists, and lifts are better satisfied by hydraulic transmission of power, than they can be by any other method of power transmission which is known to us. You are aware of the fact that pressing machinery can be made to act in a very efficient manner by the agency of water.

It is unfortunate that, in modern hydraulic cranes, there has not been much attempt at improvement on the original form of Sir. Wm. Armstrong. Whatever defect there is, lies in the use of chains passing over numerous sheaves, giving rise to a great amount of friction. Cranes require so little horse-power to work them, however, that mere economy of coal is barely worth considering, and the risk of accident, which might be done away with very greatly by direct hydraulic action, is not important either.

You all know the conditions required in an ordinary hotel or chambers hoist; these conditions are absolutely the same for warehouse hoists, because a hoist which carries goods occasionally carries men in charge of these goods. Long ago, I had some designing and carrying out of mill hoists, in which the cage was lifted by a rope passing over an elevated pulley, driven from the main shafting of the mill, and stopped at any point of ascent or descent by automatic disengaging apparatus which also braked the pulley. The cage was balanced by counter-weights, as a window is balanced. Our greatest trouble was in the arrangement of safety apparatus, which would stop the cage in falling should the rope break. Now it is well-known that such safety apparatus can never be thoroughly depended upon, however ingenious its design may be, because the ordinary working of the hoist does not keep the safety apparatus in action; immunity from accidents causes it to be neglected, and when an accident does happen, it won't work.

There is nothing so safe as a hoist whose rapid motion is resisted by a considerable amount of friction. But, unfortunately, if the friction is that of solids on one another, there is as much frictional resistance to the ordinary working of the hoist, as there is when an accident occurs, and hence assurance of safety by friction means tremendous loss of power at all times.

Now, you remember that the frictional resistance of water was of quite a different kind. There i almost no resistance to the flow of water, if the flow is slow. There is only a moderate loss of power in the ordinary use of a hydraulic hoist; but the motion cannot become too rapid for safety, for the frictional resistance is exceedingly great at high speeds. A hydraulic hoist, then, can be made perfectly safe without the use of ingenious mechanism.

(*To be continued.*)

THE SENSES OF BEES.

LAST week Sir John Lubbock read to the members of the Linnean Society an account of his further observations on the habits of insects made during the past year. The two queen ants which have lived with him since 1874, and which are now, therefore, no less than eight years old, are still alive and laid eggs last summer as usual. His oldest workers are seven years old. Dr. Muller, in a recent review, had courteously critised his experiments on the colour-sense of bees; but Sir John Lubbock pointed out that he had anticipated the objections suggested by Dr. Müller, and had guarded against the supposed source of error. The difference was, moreover, not one of principle, nor does Dr. Muller question the main conclusions arrived at or doubt the preference of bees for blue, which, indeed, is strongly indicated by his own observations on flowers. Sir John also recorded some further experiments with reference to the power of hearing. Some bees were trained to come to honey which was placed on a musical box on the lawn close to a window. The musical box was kept going for several hours a day for a fortnight. It was then brought into the house and placed out of sight, but at the open window, and only about seven yards from where it had been before. The bees, however, did not find the honey, though when it was once shown them they came to it readily enough. Other experiments with a microphone were without results. Everyone knows that bees when swarming are popularly, and have been ever since the time of Aristotle, supposed to be influenced by clanging kettles, &c. Experienced apiarists are now disposed to doubt whether the noise has really any effect; but Sir John suggests that even if it has, with reference to which he expressed no opinion, it is possible that what the bees hear are not the loud, low sounds, but the higher overtones at the verge of or beyond our range of hearing. As regards the industry of wasps, he timed a bee and a wasp, for each of which he provided a store of honey, and he found that the wasp began earlier in the morning (at four a.m.), and worked on later in the day. He did not, however, quote this as proving greater industry on the part of the wasp, as it might be that they are less sensitive to cold. Moreover, though the bee's proboscis is admirably adapted to extract honey from tubular flowers, when the honey is exposed, as in this case, the wasp appears able to swallow it more rapidly. This particular wasp began work at four in the morning, and went on without any rest or intermission till a quarter to eight in the evening, during which time she paid Sir John 116 visits.

THE STRUCTURE OF BIRDS.

IN opening his winter course of lectures, Professor Ewart last week gave the students of the natural history class an account of the structure of birds. After explaining the main features of difference between the flying and the running birds at present existing, he went on to say that the running birds of the tertiary period had a much wider distribution than the same class had now. Among the flying forms there were a number which could not fly; and the flightlessness was always accompanied with modifications of the limbs and the sternum, and those modifications so mimicked the form of those structures in the running birds that some zoologists believed that all the running birds were only modified flying birds. In the Eocene beds was found the remarkable odontopteryx, which had peculiar bony projections, not true teeth, along both jaws. The chalk beds showed a great abundance of flying reptiles, and while those beds were being deposited there were a large number of aquatic birds, some of which were highly specialised, closely resembling our flying birds, while others more resembled our running birds. The ichthyornis of the chalk period had true teeth, and the vertebræ were like those of fish. The hesperornis, a running bird, had merely rudimentary wings, while the posterior limbs were enormously developed. It had well developed teeth, which, however, instead of growing from sockets, were set in a narrow continuous groove, as in some of the extinct saurians. The brain was like that of a lizard, and the vertebræ like those of ordinary birds. The rocks of the Jurassic period presented enormous flying reptiles, along with remains of birds allied to ostriches, but which had teeth and fish-like vertebræ. The archæopteryx seemed to have had a more or less complete covering of feathers, and it had true teeth and fish-like vertebræ. It was an exceedingly generalised form, closely resembling some of the American jurassic dinosaurs. Apparently some of the smaller dinosaurs were arboreal in habit, and probably differed from archæopteryx in that they had no feathers. It might be inferred that archæopteryx was descended from a still more primitive creature, which, besides being the ancestor of archæopteryx and the birds, was also the ancestor of the dinosaurian reptiles.

SCIENTIFIC NEWS.

THE great comet, which can only be definitely distinguished, for the present at least, as *b*, 1882, continues to create much interest in astronomical circles. Added to the difference in the orbits ascribed to it by rival calculators, we have now some doubt as to who first saw it, though it appears certain that M. Cruls was the first to announce it. Dr. Baring Gould, of Cordoba, says it was discovered there five days previous to the date given by M. Cruls (Sept. 11), and Mr. Ellery, of the Melbourne Observatory, says it was found there on the 7th of September, a day before Mr. Finlay noticed it at the Cape. Dr. Schmidt's observations of a cometary body a short distance from the great comet, suggest a previous connection of the two bodies by the similarity in the arrangement of the elements. Our correspondent "H. O'B." informs us that a letter has been received from a friend at Port Elizabeth, S. Africa, who writes on Oct 6:—"Comet magnificent; head double; may divide." It was Oct. 9, we believe, that Dr. Schmidt discovered the cometary body, which, it has been suggested, formed a portion of the great comet.

We have received several sketches, of which we are unable to make use, mainly because they arrived too late, but also because it is very difficult to impart a correct idea of the appearance of the comet by means of a woodblock printed at a rapid rate. Mr. B. J. Hopkins observed the comet on the 5th inst. at 5 a.m., the tail being then distinctly divided by a dark rift for two-thirds of its length from the nucleus. Later on the same morning, the nucleus was observed in a 5in. refractor to be of yellowish-white colour, oval in shape, with the major axis in the direction of the tail. Mr. Bottone also sends us a sketch, showing the S.E. portion of the sky as it appeared at 4 a.m. on the 6th inst., viewed from Carshalton, the waning moon being about due east, and the comet about 24° above the horizon, with a tail extending to 45°. For some weeks past the comet has been well seen by early-risers on clear mornings, though lately the moonlight has obscured its brilliance. It should be looked for now in the S.S.E., the complete absence of moonlight at the end of the week rendering it a conspicuous object where a clear view of the horizon can be obtained.

The most important astronomical event in 1883 is the total eclipse of the Sun on May 6, which at some points on the central line will last for nearly six minutes. Unfortunately this line runs entirely over the South Pacific, and touches land only in a small coral island in 150° 25′ W. long. 9° 57′ S. lat.

The death is announced of Professor Palmieri, the distinguished physicist and student of seismology, whose observatory on Vesuvius is famous throughout the civilised world.

With reference to Count Du Moncel's opinion as to the invention of the microphone (see p. 133), we have a note from Mr. Berliner in which he points out that the microphone is nothing but a contact transmitter, and one of the worst kind. Mr. Berliner sends us some extracts from articles written in 1880, and an official note from the records of the Patent Office of the United States. From that it appears his caveat was filed April 14th, 1877, and the office has allowed him to insert a clause defining his right as the inventor of the contact telephone, which principle forms the basis of many devices now called microphones. We have not space to publish the extracts sent us by Mr. Berliner; but the date of his caveat apparently gives him the priority, which has been recognised in an official manner by the United States Patent Office.

A pamphlet describing the formation and use of M. de Kabath's electric accumulators has been issued in English, and is supplied by Messrs. Dawson and Sons. We have briefly described the accumulator, which is claimed to offer fifteen times the surface for the same weight as the Planté. That is accomplished by the use of thin plates of corrugated lead.

Lecturing recently at Edinburgh, Professor Fleeming Jenkin said the popular mind supposed that electricity would supersede steam; but what had taken place was that engines were employed to produce electricity, and electricity afforded us the best means yet discovered for distributing power.

The International Electrical Conference has adjourned until the first Monday in October, 1883, without settling anything. Several resolutions were passed, and an endeavour is to be made to procure a larger attendance of representatives next year.

Messrs. Hedley have promised to send the famous locomotive constructed by William Hedley, of the Wylam colliery, to the Edinburgh Museum of Science and Art, where Prof. T. C. Archer will find it a suitable resting-place. This engine is believed to be the first locomotive that worked successfully.

Some valuable experiments have been lately made by MM. Dehérain and Maquenne with a view to elucidating the phenomenon of reduction of nitrates in the soil. In a first series they arrive at these conclusions:—(1) Nitrates, in being reduced in arable soil, liberate, under certain conditions, protoxide of nitrogen. (2) The reduction of nitrates occurs only in arable soils containing large proportions of organic matters. (3) We have not observed this reduction except when the atmosphere of the soil was absolutely free from oxygen. In a further series the authors have proved that a soil loses the property of reducing nitrates when it has been heated; also when it has been submitted to vapours of chloroform; and that soils which have lost the reducing property through heat reduce anew when they have had a little normal earth added to them. (These researches have been described to the Paris Academy.)

Excellent coal has been recently found near Bou Saada, in the province of Algiers. Its luminous power and yield of gas were found, at least, equal, if not superior, to those of the best French and English coals. The yield of coke varied between 62 and 66 per cent. of the coal employed. The coal is found in conjunction with extensive beds of fine white sand, which might be utilised for manufacture of the finest glass. If, as there is reason to hope, the coal should prove to be in such quantity as to be exploited economically, Algeria would be furnished with advantageous means of working her numerous ores, and of manufacture of glass and crystal, &c.

At a recent meeting of the Buda-Pesth Society of Natural Science, Prof. Than (a member of the committee appointed to investigate theatre fires) spoke on the danger of ordinary gas, and the means of reducing it. From experiments, he was of opinion that gas was not dangerous so long as it occupies less than 5 per cent. of a given space; between 5 and 12 per cent. it begins to be ignitable, and at 29 per cent. the danger of explosion is present in high degree. He has improved Anselm's apparatus (which, acting on the principle of diffusion, causes an electric bell to ring as soon as a certain quantity of gas is present), so that even ½ per cent. of escaped gas causes loud ringing. Another ingenious arrangement shows the actual percentage quantity of escaped gas, while a control-manometer, which Prof. Than has used several years in his laboratory, reveals the place of escape of the gas.

Most numerical data regarding the electromotive force of galvanic combinations are referred to the Daniell element as unit. But, on the one hand, different physicists use different liquids with the zinc, and, on the other, sufficient account has not been taken of the variability of electromotive force, through difference in concentration; so that each research may be based on a different Daniell. Herr Kittler, of the Munich Academy, has accordingly defined the following *normal element*: Chemically pure amalgamated zinc in dilute sulphuric acid, of specific gravity 1·075 at 18° C.; chemically pure copper in concentrated cupric sulphate solution of specific gravity 1·190 to 1·200. He observed that the electromotive force of a Daniell element in which the copper is surrounded with concentrated copper sulphate solution increases with the proportion of sulphuric acid hydrate, but only to a certain limit. The maximum value was observed with a concentration of specific gravity 1·187, i.e. (in parts by weight), about 25 per cent. H_2SO_4. Further, with strong acids, the free tension in the Daniell is greater, the more dilute the copper-sulphate solution; whereas, with weaker acids, the electromotive force decreases with increasing dilution. A Daniell element, with earthenware cell, has quite a different electromotive force from the normal element. The constancy of the element was so considerable that in six hours there was no perceptible alteration, and only after 20 hours there appeared a decrease of 0·6 per cent.

At the meeting of the Berlin Electrotechnical Society, on 24th ult., Dr. Stephan gave an address on the progress of electricity, stating, *inter alia*, that in Germany alone, from May to October, 190 patents relating to that branch had been taken out; also that telephone-systems are now at work in 18 German towns, with 3,788 subscribers. Herr von Alteneck reported on illumination of Kochstrasse with incandescent lamps, and of Leipzigerstrasse with arc lamps. The future of illumination (he is of opinion) will consist in a combination of the two systems.

The first volume of a new work on electricity, by Herr G. Wiedemann, has appeared. It is entitled "Die Lehre von der Electricitat."

It must be hard for the people of Newark and Jersey City to take a cheerful view of their water-supply. A few months since, attention was called to the fact that not only was the whole of the sewage of Paterson and several other towns carried down by the river; but that much of the sewage of Newark itself was carried back at each flood tide to the "intake" of the waterworks. Next, a beneficent paper-maker was found somewhere up the stream, who said he discharged into the river so much carbolic acid from the waste of his mill that it neutralised the sewage from the cities above, and made the water "more healthful and pleasant than it would otherwise be." Not long after, this wholesome compound received an additional flavour by breakage of a coal-oil pipe line, causing the river to be covered with oil to a considerable depth; and recently, just after the heavy rains had filled the channel to overflowing, it was discovered that a ton of arsenic had been washed away by the flood in a suburb of Newark, and carried into a tributary of the Passaic. As this last would furnish a fatal dose for six millions of people, it is not surprising that drinkers of Passaic water were alarmed until it was ascertained that the second river into which the poison escaped joined the Passaic a a little below the Newark Waterworks, and the current of the Passaic was so strong, owing to the flood, that there was little danger of its being reversed by the tide.

The project of a coal exhibition in Milan, at which various firing and steam-producing arrangements should be shown, was started soon after the opening of the Saint Gothard Railway. It is being taken up with zeal, and will probably be realised in the autumn of next year. It is anticipated that all the coal products of Europe will be exhibited, and a one-sided character of exhibition will be guarded against.

Wonder is often expressed at the transport of huge stone blocks in ancient times, and it is, perhaps, forgotten that many of the inventions for aiding and increasing human power are very old. In a recent number of *La Nature*, M. de Rochas sets himself to show that in modern times enormous masses have been moved to a distance by means of the simplest machines. He takes as an example the largest mass, probably, that has ever been transported—viz., the rock from which was cut the pedestal of the statue of Peter the Great, in St. Petersburg. It was a block of granite, weighing three million pounds, or about 1,500 tons, and was found isolated on marshy ground about four miles from the Neva. Its shape was that of an irregular prism, about 24ft. high, 47ft. long, and 30ft. broad, in its largest dimensions. An Italian, Count Carburi, a lieutenant-colonel in the Russian service, undertook the operation. His method is fully explained in the interesting article referred to.

An official report recently presented to the American Government treats of tornadoes, of which it is stated that since 1794, about 600 have been observed in the United States. The list of these given is instructive, as indicating the remarkable growth of population, and consequently, of records of those storms. Thus in the first ten years of the period only four tornadoes are recorded; from 1811 to 1821, only 6; whereas in 1880 the number is 111; and in the first three months of 1881, it is 60.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE SUPPOSED IDENTITY OF CERTAIN COMETS.

[20702.]—I SUBJOIN a table for purposes of comparison, of three elements of the comets of 1683, 1843, 1880, and 1882 respectively, which approach the sun very nearly.

The perihelion distance differs considerably in all four, although always small. From the nature of the case considered, that element is probably difficult of accurate determination, and the period would be still more so,

	1683	1843		1880	1882
	°	°		°	°
∠	83	36		46	37
ϖ	85	279		256	58
☊	173	1	15	333	347

I have written the nearest degree.

We may probably read for the comet of 1683, 353° as the longitude of ascending node. It does not appear possible, or, at all events probable, that any two of these four comets are absolutely identical. It would appear, perhaps, more likely that they are each distinct concentrated portions of one common meteor stream, which have had their elements differently disturbed by passage through the solar surroundings. If the sun were encompassed by anything like a regular medium, no change of the plane of orbit or perihelion longitude could take place. But if this medium be irregular in its character, the disturbance before and after perihelion passage might be unsymmetrical, which might be further increased by changes in the shape of the body (which must almost certainly take place), then the perihelion longitude would change. The medium might even be so irregular in connection with the shape of nucleus, that an impulse might be given out of the plane of the orbit.

In any case, as we suppose the period to be much diminished during the passage through perihelion, this circumstance, combined with a possible symmetry of changes before and after perihelion, would really give rise to different orbits, and if in determining the orbit, observations were combined taken before and after perihelion, a true orbit could not be expected. It is the orbit after perihelion of comet of 1880 which would have to be compared with the orbit of the 1882 comet, as it was before perihelion, or, indeed, any close approach to the denser portions of the solar atmosphere.

So that discrepancies must be expected in the case of comet orbits which approach the sun so nearly. I should not be surprised if many comets' orbits were found to have more than one meteor aggregation, whose number might not be the same at different times. If all had gone well with Biela we should have had at least three aggregations moving in that orbit—namely, the two portions into which the largest aggregation divided, and the portion seen by Mr. Pogson at the time of the earth's passage through Biela's node.

With regard to the comet of the present year, I am afraid we must give up all hopes of that comet having the honour to be the humble means of destroying our tight little world at least this year, and if not this year, never; because I believe, according to the Great Pyramid, after the present year there will be an end of everything.

W. C. E.

SATURN'S SATELLITES.

[20703.]—WITH reference to "W. L.'s" letter (20662, p. 182), I would remark that Mr. Marth published his ephemerides of Saturn's satellites up to November 30th in the June number of the *Monthly Notices* of the R.A.S.; the continuation will be published in the Supplementary Number, which is now just ready. In the *American Ephemeris and Nautical Almanac* for 1882 and 1883 will be found ephemerides of the satellites of Mars, Jupiter, Saturn, Uranus, and Neptune.

H. Sadler.

THE DIURNAL INEQUALITY OF THE TIDES.

[20704.]—The alternate advance and retreat of the sea as it washes our shores or fills our harbours presents a phenomenon which never fails to excite admiration, and almost forces into exercise a certain amount of scientific curiosity. Few, however, care to give to the subject the attention it deserves. The general explanation which ascribes these changes of sea-level to the combined action of the moon and sun is sufficient to satisfy the cursory observer. An exaggerated idea prevails of the difficulty of calculation involved in the problem, and so a closer examination is put aside as out of ordinary people's reach. Like a huge pendulum, the waters flow and ebb; and the latent power of the main-spring is not more clearly seen in the motion of the seconds-hand of a watch, than is the mighty force of gravitation in the vibratory upheaval of the tides. In their rise and fall we have gravitation made visible. The attractive influence by which the great globe is retained in its course round the sun, and by which, in fact, all matter is kept in a state of cohesion, cannot be seen by the eye; yet here we have a palpable demonstration that it is continually working.

The matters of commonest observation with regard to the tides are principally three—viz., (1) that they approach and withdraw twice a day; (2) that they have extremes of spring and neap tides twice a month; and (3) that they rise to unwonted heights, and recede with a more than ordinary ebb, twice a year. Storms and tempests may excite the splashing billows into fierce activity, and the general sea-level may be raised or depressed accordingly; but above and beyond the action of these, more powerful agencies still demand obedience, and their behest is, "Thus far shalt thou go, but no farther, and here shall thy proud waves be stayed."

There are, however, certain minute irregularities in the flux and reflux of the ocean, which escape casual notice, but which soon begin to be discerned by any one who makes himself familiar with what nature exhibits in this special sphere of her operations. The rambler by the shore traces the limits of the last tide by the line of sea-weed and debris left high and dry; and he finds that when the tides are springing, as it is called, it is not that each succeeds the other with a uniform increase of height, but that, on the contrary, the steps by which they surpass each other successively are most unequal. For example, at certain times a tide of 20ft. elevation above the standard level, may be followed by another 2ft. higher; and then a third may succeed a foot *lower* instead of being *higher*, and so on for several days. After that, the order may be varied, and the steps by which they follow each other, increasing or decreasing, may be almost uniform in magnitude. It is needless to say that illiterate observers were much puzzled by this curious anomaly; and finding no explanation of it, supposed it to coincide in periodicity with that of "the dews," though nothing could possibly be more foolish than such a notion.

What, then, is the explanation of this remarkable peculiarity and this "diurnal inequality of the tides"? To make it intelligible may be a task of some difficulty, but we are encouraged to make the attempt. Let us suppose the globe of the earth to be covered with an envelope of water to a uniform depth. The attraction which the moon exerts upon the shell of water which is immediately under it is greater than that which it exercises upon the solid mass of the earth, and greater still than that which it exerts on the waters on the obverse side of the earth. The waters, then, being free to obey these excesses of attraction, will necessarily be heaped up in two convex protuberances, or tide-waves, on opposite sides ot the globe, and these two will circulate round it in consequence of the earth's rotation, bringing high water twice a day.

But these effects of rotation require to be more closely examined. If the moon and sun were always in the plane of the earth's equator, and always at the same distance, these two tides would be of invariable magnitude. Now this is not the case. The moon, for instance, sometimes is seen high in the sky, and at others has a very limited arc above the horizon. So with the Sun in summer and winter. The effect of this, if the earth were uniformly covered with water, would be that one of these tidal-waves—viz., that which is under the moon's eye, where she soars the highest, would bring more water than that tidal-wave whose summit is at the other end of the line joining the moon and the earth, because its crest is far down in the south. This then constitutes the "diurnal inequality," and explains what would happen, as far as the moon is concerned, if the sphere were uniformly covered with fluid. But this is not the actual fact; and, more than that, there are vast portions of the surface without any water at all. Continents and islands are situated most irregularly, and what is the consequence? The result is that the configuration of land and water in the two hemispheres is so diverse as to cause the tide whose crest is (or rather perhaps I should say ought to be) in the northern hemisphere to become invariably of lower magnitude than that whose crest is in the southern hemisphere, and this, for the simple reason that neither moon nor sun can possibly generate a tide in regions where little or no water exists for the purpose. Besides this, the direction of the Moon's motion makes a very great difference in the magnitude of the tide-wave which reaches our shores. For when the moon advances from the southern to the northern hemisphere, crossing the Equator as she sometimes does at an angle of 18deg., and sometimes at 28deg., it is seen that her line of motion approximately coincides with the general trend of the Atlantic Ocean at the time the earth's rotation brings that part of the globe directly beneath her, and this causes a further development of the tide-wave in the direction of Europe and North America, whereas when the moon declines from north to south her course is diagonal to the former one, crossing the Atlantic, roughly speaking, in the direction of its breadth, whilst in the other case she crossed in the direction of its length. And in point of fact, this configuration of land and water produces peculiarities in the circumstances of each part, which cannot be ignored when its special tide-tables have to be calculated.

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GRINDING AND POLISHING GLASS SPECULA.

[20705.]—It will be observed in the machine, so far as I have described it in my two last letters, that it is the simplest way I could devise to produce four motions—viz., the straight stroke, the side motion, the revolution of the speculum, and the revolution of the tool—the machine being so made as to allow any variation or adjustment or combination of these. In making the machine, I bore constantly in mind that I should have to describe it to amateurs, who, perhaps, were not so expert as I was in the use of so many tools, and I hope no amateur will think it too difficult to make; but now we are coming to a part of the machine and subject that requires thought and care: I refer to the management and control, and the understanding of the laws that govern the tool. I think for the sake of those amateurs that have got as far as being able to grind and polish, but who are not masters of the figuring. I had better take up that subject at once; it is not exactly in the order of the working—the grinding and polishing ought to come next, but these things will take some time, and those who have actually mastered the preliminary steps are entitled to a help at once. The amateur of the future, who in reading these letters, feels he would like to commence, must wait in deference to those who certainly have a prior claim, as already having begun, perhaps even before these letters appeared.

Now, in treating of figuring, I want to make my letters and those of others who can contribute at this stage, to contain all the information possible to be got on the subject; and what is more than all, I do hope to be able to show the laws that govern the whole process, both ancient and modern. This will make the subject interesting and doubly instructive; but I must ask all to help me who can. I may be a kind of leader or general, but I must have soldiers who will work heartily with me, and who may feel that the pleasure and honour is equally theirs if they contribute ever so little to the general victory and success, if only it can be said of them, as it was said of the woman of old who only gave two mites to the treasury, "she hath done what she could." We have seen in the doubted subject of the parabolic zonal aberration at the centre of curvature, that by our united aid we have settled a subject that was in doubt even among the learned before; all honour to all—even those who have contributed only a mite; and then the good temper that was displayed I admired much. Let us all remember that "to err is human," and let us forbear with one another and not take too hardly any "rubs" that in our jostling together to help to attain the common end we may unintentionally give to one another. Well, with these as the general orders, we will advance to the attack, and I fancy I hear a whole host of amateurs each saying, "What can I help in? I am ready and willing." Well, I shall have occasion to call on all, upon several connected subjects, as we proceed; but my first call is to all who have it in their power to tell us how the old masters figured. They have a great reputation (another call will be to see if this reputation can be established—but that subject not just yet; one thing at a time.) Now there are those of our readers who have access to old books or old friends who knew others who bordered on the time of these old masters, who, by tradition, may know bits of information of great importance and interest. What I want is to collect in our columns all the reliable information on this subject of figuring, and to bring my investigations into the laws to bear on the explanation of all known processes, and then, when we have mastered all this, we shall be able to decide, in a scientific way, which is the best mode of figuring, or the best combination of modes. All other ways of deciding are only guess or rule of thumb. To begin, then, we want to know how the Rev. Edwards, of the last century, and Short and Mudge and Tully and Herschel and Lassell and Rosse produced the parabola, or rather, as near an approach to it as they could; I am inclined to think they did not get so good figures as we are apt to imagine. I am afraid it is distance that lends enchantment to the view we take of their figuring—at least, so I am led to think from one of Tully's I have tested. I have "Herschel on the Telescope," which I shall refer to and draw from; but there is an account, I believe, in the *Philosophical Transactions* of the last century, of, I believe, the way the Rev. Edwards figured, and another account of figuring in *Nautical Almanac* of about the same period; now, perhaps, some F.R.A.S. has these in his library, or has access to them in the library of the society, who would copy or describe for us, so as to make the process intelligible. We will then study these old processes and find out the laws that govern them. I will now commence to describe what I know about the old processes, and in doing so I shall have to begin at the beginning and take it up in a very elementary way. Let not those who are beyond this be impatient, but remember that we are writing for those that will have to begin in the future, with, perhaps, what they only can get from our columns. I therefore want to make our investigations as complete as possible from the beginning.

The old masters almost universally figured with the speculum on the polisher. The modern almost as universally figure the opposite way—at least amateurs; the trade way I would here leave out, as they think it consistent with their own interest to keep to themselves their own individual modes; but I believed they are more afraid of one another than of amateurs; but we have one noble exception in "Prismatique." I hope the trade will not think I am against them, but rather feel for them, for the world is very selfish I know; but I think we may ask for all the information possible of the late Rev. Cooper Key's mode of figuring, which perhaps is known by some; and there is Mr. With's process, who I believe improved on Mr. Key's, and who has produced some specula of note, who is not now in the trade. Would he tell us how he figured? He cannot now be the loser: he has cast off figuring, like old clothes, for something better; but it is a sin to throw away even old clothes, when there are poor at our doors who would be glad to receive them. I wish to gather up the fragments, that nothing be lost. Perhaps, therefore, Mr. With will not object to tell us a little of the principles, at least, of his process. As figuring with the speculum on the polisher was the first mode used, we will study its mode of action first. In Fig. 1 we have this old mode of working represented, with the speculum at the extreme of its stroke. Now it will be easily perceived that from the moment the speculum leaves the centre of the tool to the extreme of its stroke, it must be pressing more and more on the edge of the pitch polisher, because of the weight of the overhanging part A being added to the weight of that part that remains on the edge of the polisher. We may even conceive of the middle of the polisher P being relieved of part of the weight of the speculum over it, by the balancing effect of the overhanging part A, causing the speculum to rock on a point midway between P and A. All this is of course also true of the action of the speculum at the other extreme of its stroke to the left, and as the operator walked round the post on which the polisher was fixed, the whole of the edge of the polisher would be pressed below the general curve of the speculum; thus the speculum would rock or tilt on the elevated centre of the polisher. Now it is further evident that the longer the stroke and the smaller the polisher, the greater the tendency to lower the edge, and leave the middle of the polisher elevated. To the same effect would be more side-stroke, i.e. straight strokes not crossing the centre at each stroke, and the more circular strokes, which of course keep on the edge of the polisher during their whole length, the more the edge would be depressed much more than by straight strokes; thus the centre of the polisher is left elevated, and the effect would be to polish away the centre of the speculum at a greater rate than the outside, and so deepen the centre faster than the outside, and thus making it more concave in proportion to the outside, would shorten its focus, and so make the curve of the speculum a parabola. This, then, is the old mode of figuring. Now it will be observed that (1) the distance the stroke carries the polisher from the centre, and (2) the time the speculum is kept pressing thus on the edge more than the centre, and (3) the yieldingness of the pitch, are the three main influencing conditions. The process to adjust all these by hand, so as to

FIG. 1.

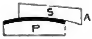
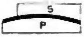


FIG. 2.



just produce the parabola, must, of necessity, be a very difficult one, and this explains what, I believe, is found in the directions for this old process of figuring—viz., the number of strokes, even to the counting of them, and their length and direction (so many straight strokes so many circular) are all given. I hope we shall have all this fully transcribed or described in our columns (for further study) by some who desire to help. It will be easily understood how difficult a matter it was to hit upon the right combinations and conditions, for the hardness of the pitch added to the difficulty in so complicated a process—hence, its almost infinite difficulty; and those who, with almost superhuman labour, learned to do it with any degree of certainty, felt they were justified in trying to turn the art into money's worth as a kind of compensation for all their trouble, and so they tried to keep it to themselves, like those in the trade now. How strange that no one had attempted to study the process, to reduce it to its laws, and then make it all known for the good of future workers and science generally. How much labour might have been saved, and the process put on a scientific basis, and not remain as it has until now a close art. I hope to do my part to do away with the present disgraceful state of things. This letter will not contain one-tenth of the laws and conditions I shall have to explain. Another most treacherous condition is the heat of the back of the speculum being more than the face, which is kept cool through being wet. I have proved that if the back of a glass speculum during figuring be only a few degrees warmer than the face—only the difference, in fact, between the wetted face and the dry back, without any warming of the hand, that when the heat is equally distributed, which will take some hours, the alteration of the figure is to the effect of losing more than half of the correction given, and what was a parabolic surface when fresh from figuring, became an ellipse approaching the sphere more than the parabola after some hours; but this more fully when I come to the actual working and the necessity of having the back of the speculum wet to counteract the contracting influence of the wet face. I merely refer to this here to show the uncertainty of the old mode. Happily for the amateur, I have almost absolute certainty to assure him of, if he will only master the laws of all the conditions, which laws I hope to explain and settle once for all. There is yet another influencing condition to be studied in the old mode of figuring: it is the size of the polisher. Hitherto I have supposed the polisher to be the same size as the speculum; but, of course, it may be made any size. Let us study this condition. In Fig. 2 it will be seen that the polisher P is larger than the speculum S, and if we suppose the speculum to only be brought to the edge of the polisher at the extreme of each stroke, whether straight or circular, it is evident that the outside of the polisher will be only pressed down very little, and then not by any pressure produced by an overhanging of the speculum; and so the centre of the polisher will be depressed more in proportion than the outside, and so the curve of the face of the polisher will not be so convex as the speculum is concave; and thus the outside of the speculum will be polished away too much and too suddenly, and an irregular curve will be the result of this attempt to figure by lengthening the outside focus at a greater rate than its centre. This way of figuring is just the reverse of the former. Now, we can lessen the size of the polisher till we get such a balancing between the extra wear of the outside, on account of the size of the polisher not allowing the outside to be pressed down to the general level of the curve of the speculum, and the wear on the centre that we can bring the outside focus to coincide with the centre focus for parallel rays; this would be figuring by lengthening the outside. Now, the focus in this way would, as a whole, lengthen, the outside focus at the centre of curvature keeping ahead of the centre; in the former mode, where the elevated centre of the polisher did the figuring, the focus as a whole would be shortening, the centre focus keeping ahead of the outside, at the centre of curvature. Now of these two modes it is found that the centre shortening figuring (if I may so call it), gives the nearer approach to the regular parabola, for this reason—if we keep the polisher concave as compared with the speculum, i.e., not touching the centre of the speculum when the speculum is over its centre, only in fact touching its edge, then the edge of the speculum will come in for wear that cannot be extended far inwards, only in fact when the speculum is off the centre of the polisher; whereas if the polisher is kept just convex as compared with the speculum, it will in its rocking or tilting extend its influence to deepen the centre, from the edge to the centre of the speculum. Now it is found by actual experiment that if we make the straight stroke about $\frac{1}{4}$th the diameter of the speculum and combine a certain number of circular strokes with the straight strokes and have the polisher about $\frac{1}{20}$th larger than the speculum, then the pressing down of the edge of the polisher, as compared with the centre, will just keep the whole so convex as compared with the speculum, that a parabola is produced by the centre of the speculum being worn away a little faster than the outside. If we have the polisher a little larger than this, and all the other conditions the same as above, then the outside will be only pressed down as much as the centre, because of the extra support of the extra outside of the polisher, and a spherical surface will be produced. If we have the polisher still larger, the other conditions remaining the same, then the edge of the polisher will not be pressed down so much as the centre, and the edge of the speculum will be rounded off—for that is the best way to describe it—so as to make the focus of the outside just as much longer than the focus of the centre as is necessary to make them meet for parallel rays; but the intermediate zone will partake of the nature of a sphere with the centre. Now, before the Foucault test was known, the performance on a star or other object was all the old workers could test by, so any minor irregularities in the surface could not be detected: they had to judge of the surface as a whole. I must leave these minor irregularities for future consideration. I would add that I have it among my notes, that the late Andrew Ross says a speculum is best worked with the polisher $\frac{1}{20}$th larger than the speculum; Herschel (p. 143) says about $\frac{1}{10}$th larger, the difference being easily accounted for by a little shorter stroke in the Ross proportion—in fact much larger that $\frac{1}{10}$th may be used, if a longer stroke be given, or more circular strokes. What the old workers had to do was to balance these opposing elements and find out the best size to give as regular a parabola as their testings would allow them to judge of, when the proper amount of stroke was used, with whatever sized polisher they thought best to bring the outside rays to the same focus as the centre for parallel rays. Now between $\frac{1}{20}$th and $\frac{1}{10}$th seems to be the best proportion to make the polisher larger than the speculum, when the speculum is worked on the polisher.

It may be interesting to many readers to know Mudge's process—it is described by Sir John Herschel (p. 140). I therefore give it, with a few remarks of my own to elucidate it, and these, with the previous explanations, will make it easily understood. It runs as follows: "In the beginning of the operation, when fresh from the emery-grinding, the metal is worked round and round upon the polisher, carrying the edge but little over that of the latter, and now and then interrupting the circular movement with a cross-stroke. The effect of this is to drive the pitch inwards, and force it to accumulate towards the centre of the polisher, and, in consequence, he found that in this way of working, the polish invariably commenced in the centre, and extended itself gradually to the circumference of the metal." I would here remark that this is a mistaken explanation, the true one being, the circular stroke keeping the speculum always over the edge of the polisher, would be constantly pressing its edge down, and thus leaving the centre of the polisher more elevated than the general curve of the speculum, and so polish the centre first as described. I have proved that the pitch is all the while sinking from centre to edge, only the outside sinks faster with the circular strokes than with the straight strokes, for reasons I have before explained; and with the size of polisher Mudge used, it was only by such a combination of strokes that the polisher was kept right in shape; and, further, a combination of the circular with the straight strokes was necessary to obliterate the tendency to form rings, which either stroke had alone. Sir John proceeds:—"The form being originally perfectly spherical, it is evident that the figure thus communicated must deviate from that form by a continued and regular increase of curvature towards the centre; or, in other words, in the direction of that of the paraboloid. This process, then, was continued until the polish nearly reached the edge, when the circular motion was exchanged for short, straight strokes carried across the centre, the operator meanwhile walking round the table on which the polisher is firmly bedded." I would here remark that it was necessary to revert to the straight strokes now, for with the size of polisher used, and the extent or width of the circular stroke used by Mudge, the parabola would have been passed, and the hyperbola reached. What he wanted was to keep the figure under the parabola till the polish was completed, when the circular strokes were reverted to, to lower the edge of the polisher and thus leave the centre higher, so as just at last to sink the centre of the speculum enough to convert it into the parabola, as to its general surface, for I believe few true parabolas were produced by the old workers. Sir John proceeds, "The polish thus is extended equally over the whole surface, the figure meanwhile reverting to the sphere. Finally, the polish, being perfected, which is known by the perfect smoothness of the working, recourse is again had to the circular motion to restore the parabolic figure, which is accomplished in a few minutes; but if overpassed, can only be brought back by going again over the whole process of working out a spherical figure by cross strokes, and finishing by circular ones as before. It does not appear how Short worked his admirable specula; but Mudge, with whom he was contemporary and in habits of communication, considers himself as having strong reasons for believing their processes identical."

Another influencing condition to be considered is the weight of the speculum. This will be easily understood by reference to Fig. 1, where it is evident that the greater the weight of the speculum S, the greater the downward pressure of the overhanging part A, and so the less the stroke must be to press the outside into shape, with the centre. Now the old workers used speculum metal, which is several times heavier than glass, and I do not remember having read that they had to cut away the outside facets to make the pitch more yielding on the outside. Do any of our readers remember any reference to cutting away the facets on the outside in any of the old masters' mode of working to produce the parabola? I think they found the weight of the metal speculum sufficient. Could any of our readers tell us where the idea of cutting away the facets is first mentioned or used? If we try to figure a glass speculum with the same size polisher as before mentioned for metal specula, and under the same conditions, we find we must either reduce the size of the polisher, or lengthen the strokes, or cut away the facets towards the edge, to allow the lighter glass to press the polisher into the shape of being a little more convex than the speculum is concave; convex, as compared with it, in fact; but this we can partly do by many more circular strokes, if we work by hand; and I have thus more fully explained these laws, so as to help those who are trying to parabolise by hand; but, after all, it is nothing near so certain as by machine. I hope our readers will let us know all they can get as to the old workers, now we are on the subject. It will be noticed that from the varying thickness of the specula, according to diameter, the weight must considerably vary, and, therefore, each had to be treated differently. Thus, with all these varying and influencing conditions, the process may well be confined to the few who had indomitable patience and perseverance.

I must leave for my next letter the explanations of my form of balancing the polisher, in which all these conditions are under control, so that the conditions we work under for one size speculum, can be produced in any other size in the same proportion, so that, once get the right conditions, and these can be reproduced for any other specula. This reduces the process to absolute certainty, and this is by having traced out and mastered the laws under which we are working.

All the above laws are confirmed in the working of flats, as given by Dr. Hastings and Mr. Brashear, where it will be observed (Vol. XXIV. p. 593, col. 1), that in Dr. Hastings' method, where the polisher is top, the polisher has to be "from $\frac{1}{3}$ to $\frac{1}{6}$ less in diameter than the glass." If it were the same size it would be pressed concave, and work the glass convex. In Mr. Brashear's process (Vol. XXVI., p. 139, col. 1, line 2), the glass being top, he says, "If the disc is working concave, the strokes are shortened so that they go only to the edge of the polisher, and usually diametrical." Evidently his polisher is larger than the glass, as it ought to be, according to what I have explained before. Mr. Brashear has forgotten to give this important piece of information—viz., the proportionate enlargement of the polisher over the glass. I hope he will add this, and the average length of stroke.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

MEDICAL REPLIES.

[20706.]—DREAMING AND UNSOUND SLEEP (48264).—The condition from which "Didaskalos" suffers is known well as a mental disease of much importance, and is technically termed "insomnia." No life can be healthy and no mind be stable unless calm and regular periods of sleep are obtained. "Didaskalos" incidentally says, at the end of his long question, "I am 38, *my nervous system has, in the past, been largely taxed*, &c." Now, in this incidental remark is the key to his condition, and in this, as in gout, one may premise by saying that the sufferer has either inherited an unsound brain, or has manufactured one. We cannot put a new set of brains into "Didaskalos": he must treat himself upon the same general principles as those which underlie the remarks upon gout at page 209 (No. 919)—i.e., avoid continuing to overtax his brain, get into model shape and best physical health, relieve urgent symptoms as they arise. To apply this personally needs the skilled inspection of a physician, and I can only advise "Didaskalos" to get some experienced physician to take stock of him and talk the matter over. I may, however, suggest that his supper would be better of beef-tea and toast than milk; that his diet should not include tea or coffee; that he should avoid drugs, and especially narcotics; that, instead of reading medical treatises on the subject, he should burn any that he may already have purchased; that upon the general discipline of mind and body which he can carry out will depend the result. The quality of sleep is often improved by rather diminishing the length of time in bed, and by breaking up the working day by a half hour's sleep after a midday dinner, so as to rest the brain. A hot shower-bath at bedtime cleanses the skin, and often predisposes to sleep. Sometimes, in bad cases, I have got sleep by the "hot water turban"—i.e., a large calico swathe wrung out of hot water, wrapped round the head, and covered over with a waterproof nightcap. In some cases holding the head under a small stream of cold water, and allowing the water to make its way between the roots of the hair, until the heat and overaction of the brain is checked, induces sleep. Then there are various devices for fixing the mind and wearying it out by some monotonous exercise until sleep is induced, as by counting the ticks of a clock, or listening carefully to a somniferous sermon. One well-known gentleman, who suffered much from this disease, is said never to have obtained relief till he took to attending the afternoon lectures at the Royal Institution; and so grateful was he for the comfortable sleeps which he there obtained, that in his will he left money to found an additional professorship at the Royal Institution, in order that these benefits might always be available for other sufferers who might live in its neighbourhood. Having myself often attended these afternoon lectures, I can vouch for the fact that there are several persons who appear to obtain regular sleep there, and were "Didaskalos" to make acquaintance with these persons, he might find that when not able to attend the lectures there, they had some other resources that he might find useful. Possibly they know a series of somniferous preachers of written sermons, who can be sat under at times when lectures are not going on at the Royal Institution. If casual afternoon sleeps do not rest his brain sufficient to enable him to sleep at night, there may be errors in the quantity or character of the work which he does. Sometimes there is want of balance between the amount of muscular and mental work. In this case, the use of the tricycle, so as to work off unused muscular energy, and take him out into the open air under conditions which fully occupy the attention, will often restore the balance. For myself, I often find vast refreshment in going into my lathe-room in some soft permeable woollen clothes, and doing a few hours' mechanical work. In London, this is more often available than outdoor work, and, though not in the open air, still combines amusement, mental occupation, and muscular effort, in excellent proportion for those whose muscular system is on the wane, and who have a comfortable, well lighted, well-ventilated lathe-room. Then music is of great value to some such sufferers, and of all music, learning the violin, if there be the necessary ear and the necessary fingers. The point is to get some period of the day so appropriated that "mooning" can be stopped when away from business. Some people acquire a morbid habit of introspection, others devote themselves to debating what might, could, would, or should have been; and what might, could, would or should have happened, if they had left undone something which they had done, or had done something which they had left undone. Possibly "Didaskalos" devotes his leisure to considering where he would have been if his grandmother had married somebody else; or to the maturing of some plan which will make the world go round more accurately. Now if such be the way in which his leisure be employed, he had better at once bespeak quarters in some well-managed lunatic asylum, unless he can stop so wasteful and useless an expenditure of nervous energy. Then, just as a gouty man should take the measure of his working power, and keep carefully within that, so Insomnis must take the measure of his brain power, and must keep carefully within that measure, both as to the tension and the quantity of the brain-work which he does. If a pony be made to draw a brewer's dray, the pony will soon break down. If a man of feeble muscular system be set to work as a blacksmith or excavator, he will soon be ruined in health. If a broken-winded horse be galloped, he will drop down dead. It is mere matter of every-day experience that there is a measure, both as to quantity and as to intensity, in the work which can be got out of any particular machine, or any particular animal. If this measure be overpassed, the machine will be broken, or the animal will be killed. If the full measure be continuously exacted, the integrity of the machine is always at the mercy of a slight accident, while the wear and tear are vastly increased by each of the last increments of duty which are exacted. But with men this is not always realised. One man has a brain large as to size, and fine as to structure. Such a man can take a grip of affairs, and can hold together a complicated business, or handle a great debate in Parliament without apparent effort, and with no injurious strain. Take that wonderful Midlothian set of speeches during our last election. Take a business man like the late A. T. Stewart, of New York, of whom I may say that I never saw anything so remarkable as the perfect and wonderful detail which he kindly showed me in his business, when I was in New York, with a personal introduction to him as one of the remarkable men whom I wished to see. Take Napoleon—the biggest thief and murderer of modern history. These men are not the creations of mere circumstance; they are all men of gigantic capacity. They have large, highly-organised brains, *plus* those organs of animal life which are required to generate the energy which such brains can transmute into intellectual force. Other men there are, doubtless, even greater, but of whom we know nothing, because circumstances have never developed them. But this we may say, that, just as a common horse could not run beside a great racer like Eclipse, common men cannot do the same work that great men achieve. Now men too often fail to gauge their own mental powers accurately, and sometimes they "overtax" their power in point of quantity of work, sometimes in point of intensity. Men who have once strained their minds until they break down are never again quite the same men, just as a sprained joint is never again quite as strong as before. Some men are "worriers"—i.e., they are always "worrying" about things which one must judge of, and decide upon, and have done with, and take the consequences, whatever they may be. Here an unduly prolonged deliberation only tires out and confuses the mind—as Shakespeare so beautifully says:

> "The native hue of resolution
> Is sicklied o'er with the pale cast of thought."

Such a habit unhinges the mind, is a fertile cause of *insomnia*, and does not conduce to the wisest decisions. Then there are greedy men—men who think to get rich by gambling. Such men call themselves "speculators," and when they have gambled away their creditors' money, they say they have had "reverses." Now "speculation" is as legitimate and useful a business as any other, and partakes of none of the attributes of gambling. A true speculator hedges so far that he can afford to lose some things, and counts to get a profit only on his general result. He hedges more or less according to the doubtful character of his speculations; he never risks what he cannot afford to lose, and he makes it his business to know all that is knowable about the matters in which he speculates. Such a man may sleep as well as a country rector for all that his business need trouble him, and if he have the instinct for sound speculation he will assuredly get rich as easily as in any other business for which he is fitted. But the gambler is a man who risks money that he cannot afford to lose, who adventures in matters of which he does not know all that is knowable. He goes to bed every night with his mind worried and burdened with the vague fear of ruin on the one hand and greed for unearned wealth on the other. Such men get *insomnia* or become drunkards. Other men, from mere over-conscientiousness and over-anxiety, take too much upon themselves. They try, out of a struggling business, or professional position, to keep a large domestic establishment going, or they spend too much money upon the education of their children—money which, if well spent upon earnest, sensible young people, is more fruitful, both in happiness and in wealth, than any other outlay; but if it merely goes to make conceited or snobbish young men, or useless fine-lady daughters, is a source of untold sorrow and mental suffering to the father. Such a man struggles manfully on, in hopes that the young people will do better, and ultimately finds that he is in the position of either breaking his heart with further efforts, or of shutting his doors upon his children. Here the man will get insomnia, as the first symptoms of mental breakdown. Such a man will generally have a giddy or a weak wife—a wife who gives him no support in the conflicts that grow up between him and his children—a woman who cannot see the principle which underlies the paltry conflict of the moment, and who thinks the father "very hard." Instead of promptly compelling the children to give way, and afterwards advising carefully with the father, in order to second his efforts, the wife criticises him before his children, and, perhaps, parades his own shortcomings. The trouble between him and his children extends into a row all round, and then follows a general break-up of the family discipline. The father, who, of course, may not be perfect, and who may have worries and outside troubles that are very imperfectly appreciated at home, loses his temper and becomes disgusted because he sees himself paralysed in working for the good of the family. Meanwhile he has committed himself to plans, which have to be completed or to be abandoned as an entire loss. What is he to do? Here the remedy is to live well within the average income of the business, and to squeeze no capital out of the business for higher educational purposes, or for useless loafing of daughters at home, unless each instalment of such expenditure produce adequate results, and be made good use of by the young people. A father has no right to ruin his business, or worry himself out of health, in order to keep young men and women in idleness. It is better for both father and children that they go out at once to earn their bread, and get that training which the world never spares to those who will not take it from a father. Other cases which I have in my mind would only more amply illustrate the principle on which *insomnia* is to be prevented and to be cured. It all comes to taking the measure of the mind's capacity, and keeping fairly within that limit both in quantity and in intensity of the work that is done. All attempts to blunt or stave off these warnings, by the use of drugs such as opium or alcohol, merely hasten and aggravate the results. The remedy is to remove the cause. Act firmly and act promptly in changing the conditions out of which the insomnia is growing. Sometimes change of scene and climate and work does wonders if the cause lie outside the man, but not so if the cause lie in the man himself.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

BOOT AND SHOEMAKING.—V.

[20707.]—In proceeding to last your shoe or boot, place your last upon its sole, place the back seam central, and the crease down the vamp straight down the front, and with thumb and forefinger of both hands strain over the toe and turn over and handle as shown in Fig. 8. Take your lasting pincers and seize the toe of upper, letting the bole of the pincers rest upon the last. Give a prise from that as a fulcrum, and snatch forward to you, and put a tack in at A; turn end for end, and tap the last in its place at the heel, and in position, as shown in Fig. 13, A, in my second letter, and place another tack on one side of the seam at the heel, about 3in. from the bottom of the last; then take the same implements and pull in in the same manner at D first, as this is the outside of sketch, and again at C, and serve the upper at E and F the same, and the thing, if done properly, will represent the right-hand figure shown in Fig. 19. Now, when you last in at the toe at both sides A A, you will form two flutes, as shown at B B, which it is impossible to work over or make a job of; so last back to I J, and at E F. Break up the flute, then take a small sewing-awl and a wax-end and proceed to bridle it. Make a knot at end of wax-end, and put your awl in at C, and out again, as shown. Pass through your upper on a level with your inner sole, just behind tack at D. Then take split hold of your shallow flutes, J, E, and F, I, and pull well up, damp your upper with a wet sponge, and pane in just on a level of your inner sole with the pane of your hammer, but not too hard, and be sure that your hammer pane is nice and round and smooth, or you will cut it through. After you have well pulled it up and paned it, pass through the upper at G just behind the tack, but not so close that the tack-hole and awl-hole will break into one, but so as to make a good stitch from the tack-hole, and using it as one, pick up the inner sole, and pass the end through, and do the same again, which will make a stitch, and make it fast. Use the face of hammer and lightly tap everything in its place upon the last. Note, your shoe always lasts better for being well damped two or three times half an hour before lasting. Having proceeded so far, you may commence sewing, the heel or seat first, taking split hold of the inner sole middling deep, and through the upper, handling the awl as shown 1, at Fig. 20, commencing where the awl is shown inserted, with the heel towards your right-hand, Fig. 19. Sew towards you, first make a hole for the insertion of thread, and join both ends of thread to equalise it for both hands; then insert it again, and this seat must be sewn lockstitch, or, as it is termed by the craft, overcast. To do this refer to 2, Fig. 20, for the heel; E represents the leather. Pass the right hand hair B next to you, and the left hand on the inside of that; then pick up loose thread A, and pass over bristle B; pull the right hand that was with the left hand hard down, and snap the left-hand thread down upon it sharp, and the stitches will lay as shown at A, Fig. 21, the style for a fancy balmoral without seam up the front or across the toes. The dark part from B, junction of heel to toe C, is the welt, though many, when making this class of work (channelled soles), do not work welts farther than the joint of tread both sides, and some work a seat from there, while others last over the waist, and tack or peg down and stitch from the inside; so you can please yourselves. When sewing the welt, commence with a firm stitch off the seat at junction M, and pull in the awl hand well and not overcast on the outside there; but referring to Fig. 20 again, you will find the order reversed. E is supposed to be the inner sole, and curved, as it is more especially meant to represent the toe, in which every stitch should be locked or overcast upon the inner sole; for this lock-stitch at the commencement of sewing welt in, it is necessary to keep it from drawing and leaving a hard lump that you cannot get rid of unless you pare it off, to the great detriment of your work; so at this junction, and when finishing off the sewing of the welt, be very particular to overcast on the inside or inner sole. Pass the right-hand hair, D, on the other side, and the left, C, near you; let the slack thread at D lie under, and the slack C left over; pull in the awl hand very tight, and snap the other down upon it while you hold it with the other hand, and you will make a sound job. While you are sewing the welt it is necessary to pull your welt tight, and at every stitch tap the welt down and the upper in its place before the welt. For this purpose the pincers are used, or a light hammer laid alongside. After sewing is finished, tap with the hammer in its place, and pare the top of seam close, not into the stitch, but within a full 16th; then hammer down lightly on the flat top of seam, not hard, or you will break the work. Now, for fillings-up, I generally select the inner soles of my old shoes for the purpose, being well seasoned, and pared up, they will make a complete fitting, shank-piece and all, and the waist-piece of outer soles generally serve me for other shank-pieces for stiffening the waist, which is very requisite, as the life of the boot or shoe depends a great deal on this packing or filling-up. If the shank-piece is good, you may fill the fore parts up with some stiff paste and any cuttings; but when I have the outer sole-shank I make out with old uppers. Wet them well and tap them out upon the flat-iron. You cannot have anything better, as they are so well seasoned, and will not absorb so much water as new leather. The waist should be thrown up nice and round, or bold, and the fore part very nearly level, or as near the shape of the last as you can get it. Now we shall shortly be ready for the sole. All fittings-up should be put in with some good stiff flour paste, well boiled; but proper paste can generally be bought at the grindery stores.

FIG. 18.

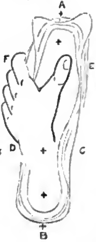
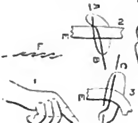


FIG. 20.



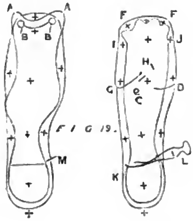


FIG. 19.

In answer to "F.R.C.S." on the question of boots and shoes and price. In my experience I have found that, in some instances, I could make warrantable articles at a comparatively low figure and fair profit; while in other instances it would not pay to make them at any price; and hence, as most tradesmen are supposed to know their own business best, we cannot say anything about the high prices or the cause of such. But if, on the other hand, such prices are paid, there is no reason why the article should not be of good serviceable quality. But there is a great quantity of leather damaged in its transit from abroad, in the shape of green hides, in the packing and storing of which due care is not taken; and in many instances the grain of the leather, which is the mainstay, or, I might say, the future life of the hide, is destroyed.

I was looking over a sample of kips the other day, for which a good price was asked—no credit to buyer or seller—and I would not give housing to a ton of such, let alone pay a price for it. In the whole lot you could not find a patch of unbroken grain so large as the ball of your thumb; and, in consequence, little better than brown paper. I suspect it was owing to this class of leather or split hide that was used in your boots for lining that they gave out at that point. Some hides imported are partially destroyed through sweating, some perished with salt, and perhaps, in some instances, nitrate of soda may be used with the salt; and in the tanning, to remedy these evils, over-limed, and acid that is used render the material anything but what it should be. Leather, to be good, choose grain side, a good warm snuff brown, not brown rappee, and should be as soft as silk, and when cut with a knife should not show hard black grains in it. This is speaking of upper leathers; the flesh side should be free from veins, and when pinched up should not break up scaly or mealy. See that the grain is clean and unbroken. There are quantities of hides split to supply the wants of the upper class with the best material for fashionable boots and shoes, and the working class have to put up with an article that is neither wind-tight nor water-tight; and there is no method of rendering the material so, and if the working man is no judge he is likely to be sold. He may be called upon on Saturday night to pay 11 or 14 shillings for the like which he might light upon in another locality for 5 shillings; in fact, I have seen them marked 3s. 9d., and in another locality 10s. 6d.; but you will understand the former article if, as it should be, the average life is 12 months, and the latter about 6 weeks or 2 months. Sole-leather to be good English tannage; colour, warm brown, and flexible; foreign hides dark dirty, approaching to lead and purple, very horny. Red Australian, almost ochre-red, not good for wet weather, as it takes the water very readily; the foreign stand wet best. A boot or shoe that is made for gentry's town wear will not do for rusticating, gipsy parties, or sea-beach; and what will do for the latter will not do for the ball-room. If they are for sloppy weather, good grain or Cordovan for ladies' wear, and light kip or calf if for seaside; for gents', dress with good clean lard melted down with one ounce of beeswax before starting. If ladies must have light bazel boots, and gents unblacked calf to correspond, scrape some curd soap into some milk, and dress; you can perfume it with ratifia, bergamot, or lavender, cloves, nutmeg, or anything else; nothing so destructive to shoes as salt-water.

In selecting boots or shoes, pass your hand inside, seize the sole with left hand, and with your hand turned fingers uppermost, press up and draw your hand out; if the upper wrinkles up like an aged person's face with a loose skin, it is inferior—no matter what the leather; then press the upper along the side of soles, to see whether it has been bled, and if the work grins at you, the stitches showing up like a lot of teeth; next take the shoe or boot by the back of the heel by the right hand and placing the forefinger and second finger of left hand upon the upper at the toe, with the sole of shoe uppermost, and the ball of the thumb in centre of tread of sole, bend, and if stiff in the waist and sole and do not wrinkle up in the waist, it will pass; but if sundry wrinkles show in the waist, it is inferior. Many boots and shoes are to be found in different localities of good quality and reasonable prices, as well as good shape, made by the tradesman whose trade and good name are of some value, and who has no gratuities to pay and no credit, all done over the counter for the ready—and the articles must display some taste to cause a quick and ready sale, and he depends upon reasonable profits and quick returns. Lastly, for gents' boots and shoes, see that the inside is good in the grain, clean and bright and soft as kid, unless as many fishing, shooting, and water boots are made of grain or memel—i.e., dressed with grain outside, where it can be readily inspected, the other tests of course standing good. I have suspected some leather for the last few years being cured with bichromate, instead of bark; it will not take the dressing, and, in consequence, is anything but serviceable, as it must naturally destroy the nature of the hide, and the leather is little better than brown paper.

Jack of All Trades.

THE DYNAMO—THE EARTH.

[20708.]—I HAVE worked out a problem leading to so great economy in the motive power required, that it must settle the question of comparative economy with gas; but, notwithstanding, I do not think the gas companies will suffer loss.

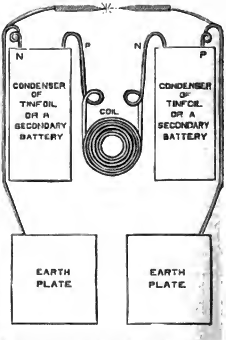
The improvement to be effected in the dynamo consists in taking the earth into partnership. How this may be done, and the advantages thereby accruing, I shall presently describe. But, first, I will speak of that which enabled me to perceive the possibility of improvement and economy. Consider, then, the working of the old frictional machine: in one case the rubber insulated; in the other connected with the earth. Now, in the last case, the electricity is furnished abundantly, and has been said to be pumped up; but with insulation, very little is obtained. How is this? If an apparatus is furnishing (as it does) a continuous supply, it is evident it must come from somewhere, for any insulated body contains only a *limited* quantity. And that somewhere is that vast store of electricity—the earth; and let it be understood that the earth receives and parts with any amount of electricity, with which mankind can deal with the same ease that we can appropriate for use, or throw away, any amount of the atmosphere surrounding us; for to say (as some do) that the fluid travels back to the place from whence it started is a great mistake.

But to return to the cases of insulation and non-insulation of rubber: in one case, good supply is obtained through a good metallic conductor to the earth; in the other case, the supply is very limited, seeing the bad conducting power of the air, which is the medium to earth; and hence the diminished supply for the same amount of work.

Having premised so much as to the frictional machine, it is now time to point out that the dynamo, as now constructed and used, partakes of the same kind of disadvantages as we have seen attached to the use of the insulated rubber; for is it not evident that the *limited* coil supplying the current must obtain its continuous supply through the bad conducting air or its insulating material, and that hence occurs a sort of wire-drawing, which leads to a considerably augmented use of motor power in order to obtain the current?

Now, the method I put forward avoids this waste of power; for the current in the coil is not used in this case to produce light or do any work, and, therefore, remains intact, and not rarefied by being used up for work. The way in which I make use of it is, by its presence, to induce a current from the earth; the *inexhaustible* and *facile* supply, as before referred to, being used to supply the light or do other work.

In the drawing herewith, I have shown only so much of the apparatus as is required to explain the invention and avoid complication. The drawing almost explains itself; and it may be as well to observe that the coil is put as the representative of a dynamo such as it may be, and not needing any alteration or reconstruction; but that the condenser and earth-plates are in addition to the usual machines, for the purpose of effecting the improvement herein described, and that the electricity shunted off for work comes from the earth-plates.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P
N
P
CONDENSER OF TINFOIL OR A SECONDARY BATTERY
COIL
CONDENSER OF TINFOIL OR A SECONDARY BATTERY
EARTH PLATE
EARTH PLATE

I may now point out that by adopting this principle, two secondary batteries may be charged, with less expenditure of power than one can at present.

The same principle may be applied in taking off the current for work in ordinary galvanic batteries.

J. H. Huxley.

Barry-road, S.E., Oct. 21.

NOTES ON DYNAMO MACHINES.—BRUSH MACHINE.

[20709.]—I PERFECTLY agree with Mr. Evershed in his statement that the retardation of the magnetism of the iron core in the armature of the dynamo does not completely explain the fact that lead requires to be given to the brushes; but "Ll.B.A." is guilty of an inaccuracy when he says "that it has nothing to do with the delay in magnetising the iron ring, or to the self-induction of the coils." The fact is it has to do with both these things, although, as explained by Mr. Evershed and "Ll.B.A.," the greatest effect is produced by the disturbance of the magnetic field due to the magnetisation of the iron core.

Some time ago I arranged an experiment for the purpose of ascertaining the amount of this disturbance, and although I was unable to finish it, it may be of some use if the method by which I intended to carry it out were briefly described. There are two ways of taking the observations for the purpose of mapping out characteristic curves. The first, employed by Deprez, is to send known currents round the magnets and to measure the E.M.F. at the brushes, with no current flowing in the armature. Manifestly, a characteristic drawn in this way will not show any fall due to the disturbance of the field by the iron in the core. The second and more general way is to couple up the machine as usual, letting the current flow through armature and field magnets, and observing simultaneously the E.M.F. at terminals and current flowing. Having measured the resistance of the machine, the total E.M.F. can be calculated, and the curve drawn accordingly. What I intended doing was to obtain two characteristics by these different methods, and by drawing both on the same paper, the difference between them would show at once the weakening of the field due to magnetisation of the iron core. I had nearly completed the characteristic obtained with the current flowing through the arm. and F. magnets in the ordinary way, and was getting an arrangement constructed to enable me to put the brushes in different positions, when I was compelled to abandon the project. Fig. 1 is the characteristic so obtained up to 35 ampères, carefully drawn to scale. Speed, 850 revolutions per minute. Total resistance of machine = 1·2 ohm = tan. DBC. Resistance of field magnets = ·75 ohm = tan. EBC.

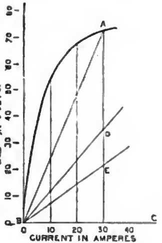


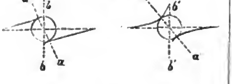
FIG. 1.

"Ll.B.A." says when a large current is employed more lead must be given to the brushes, otherwise there will be a loss of E.M.F. I have reason to believe that with the brushes in their very best position there is a loss of E.M.F., due to the weakening of the field with large currents flowing through the armature, and it was with the object of testing this that I started the experiment detailed above. I should very much like to know the results of the experiments "Ll.B.A." has carried out in connection with this matter.

In answer to a correspondent who some time ago asked for information concerning the Brush machine, I can only say that I have never had any trouble with my sixteen-lighter. We give the commutator a dab with a leather pad moistened with oil occasionally during the run, and have no difficulty. I can easily imagine a four hours' run wearing away the commutator if it had not been oiled at intervals.

Fig. 2 will explain the probable effect of bending the brushes; virtually they were brought back by bending through a considerable angle $= a^1 b^1 - a b$; hence the lead, although pretty nearly right for 100 revolutions, may have been quite wrong for 900 revolutions per minute.

FIG. 2.

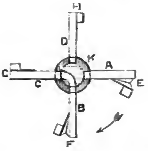


E.

P.S.—"Ll.B.A." will find the phenomenon to which he refers mentioned in Note 45.

"A. S. L.'S" HYDRO-DYNAMIC PARADOX.

[20710.]—I AM sorry to see that no one has yet really pointed out the fallacy of this apparatus of "A. S. L.'s," and hope some reader learned in mechanics will enlighten us. I copy "A. S. L.'s" figure, as it is some time since it appeared.



"A. S. L.," in his letter 20593, says that the weight at E could not at the same time raise water from the bellows F, and act as a counterpoise to the weight at G. "M.I.C.E.," however, points out (letter 20631) that a self-acting arrangement could be made to stop the whole apparatus till E was full. The catch could then be released by the lower board of the bellows E as it opened. "G. B. T." (letter 20659) condemns the device on the ground that the water would not rise into E, in consequence of the pipes containing air. But evidently it would be perfectly possible to completely fill the apparatus with water to start with, and if properly made it would allow none to enter.

Until some one can point out where the fallacy really lies, we may be content to believe in perpetual motion, resulting from the action of gravity. I may point out that the weight on F will assist the weight on E in forcing the water from F to E. In the figure E and F are both partly open: E is filling.

Porcupine.

LATHE-PLANERS.

[20711.]—I SEND a sketch of a very simple planing-table and vice, combined, for use on the lathe in connection with a planer head such as Northcott's, "F. W. G.'s," and "J. L.'s" in last week's "E. M." The slide-rest being parted at the quadrant and the upper part of it fixed on the planer head, the table, Fig. 1, is fixed in its place.

FIG. 1.

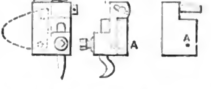


FIG. 2

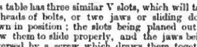


FIG. 3

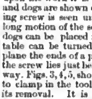


FIG. 4

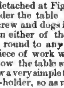
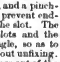


FIG. 5



This table has three similar V slots, which will take the heads of bolts, or two jaws or sliding dogs, shown in position; the slots being planed out to allow them to slide properly, and the jaws being traversed by a screw which draws them together upon the work it is desired to hold. The screw and dogs are shown detached at Fig. 2, and a pinching screw is seen under the table to prevent endlong motion of the screw and dogs in the slot. The dogs can be placed in either of the slots and the table can be turned round to any angle, so as to plane the ends of a piece of work without unfixing. the screw lies just below the table surface out of the way. Figs. 3, 4, 5, show a very simple tool-box adapted to clamp in the tool-holder, so as not to necessitate its removal. It is composed of two pieces, the foundation plate, Fig. V, with a strong pin to act as a hinge; and a steadying pin A, to prevent the shake which would otherwise occur with so narrow a hinge: the second part swings on this pin; it is bored with a hole to receive the steady-pin and a small spring is added, if necessary, on the top to keep it down.

I ought perhaps to say that this plan is still untried; but Mr Hines, who is making it for me approved it highly, and asked me to allow him to make others like it.

The manifest objection to all these plans of utilising the lathe-bed is of course, that the bed might be worn unequally: but, where the head can be fixed at any part of the bed, this objection does not hold good, as the wear can be distributed, and, by doing the planing upon the unused parts of the bed it might even prove advantageous and help to keep it straight and true.

Another advantage of this arrangement is, that by clamping the drilling spindle in the slide-rest tool-holder, when the latter is fixed on the planer-head, you have at once a capital vertical drilling machine, the work being placed on the planing-table or on the lathe-bed. The arrangement would of course come in for slot-drilling when the work is fixed on the table.

There is an admirable description of a hand planing machine in Vol. X., page 100, in a letter by "J. K. P." **F. A. M.**

[20712.]—IT is not a little amusing to find "J. L." writing *an article* under this heading, after his letters on the same subject, which appeared in Nos. 879 to 882. Both "apathy" and objections seem to have disappeared in the mean time, and we find him coming forward now to build up what he then used all his power to pull down. As he seems to have come round to my views, and to acknowledge that there is a place for combination on an amateur's lathe, he will permit me to make one or two remarks on his article. I may state, in the outset, that he is wrong in describing either Lee's or Booth's attachments as planers—they are *both shapers*, and only Booth's is driven by a pin from the face-plate. Munro's is a planer proper, costing, I have no doubt, quite as much as a separate machine, so that, placed where it is, it is quite out of place.

Let us look, now, at what "J. L." recommends and illustrates for the unfortunate amateur with a short purse. It is, in fact, "E. P.'s" proposal, as given by him in No. 880, letter 19688, as far as the lathe-bed rack and pinion is concerned, and to which my objections are stated in No. 882, letter 19716.

If this L form of arm is the one to be chosen, then by all means let "F. W. G.'s" pattern, given in No. 883, letter 19736, be taken, and not "J. L.'s," and let it be bolted on the right-hand of lathe-bed, and not as shown in "J. L.'s" illustration, where it will not only be awkward, but awkward to work, for to do so you will require to stand at *right-hand end* of bed, which will be found to be inconvenient.

How will "J. L." attach the cross-head, Fig. 2? It is represented as a single casting. If this be so, the sides of bed where it is bolted on will require to be planed, and the cross-head *well* fitted to them, so that when bolted in there may be no twisting caused, and that top piece be parallel with top of bed.

If slide-rest is to be fitted into the four bolt-holes so as to be of any use, it will be more than any amateur who would put up for five minutes with such a botched contrivance would be able to accomplish. Then it is understood that this is intended to be applied to one of those small cheap bench lathe-beds, which, as they can be got elsewhere, there was no occasion for privately advertising any particular firm. These beds are usually 2½in. or 3in. wide on top, so that supposing the drawing to be anyway near to scale, there would only be about 4in. or 5in. between the sides, and this would greatly reduce the value of the addition,—small enough, in all conscience, as it would be.

It may truly be said this falls under the head of *inferior expedients;* but that it cannot be avoided, even in the poorest amateur's workshop, I deny. But if it is to be only such as this, then I must turn round to "J. L.'s" opinion of a little while ago, and declare all such combinations only a delusion and a snare. But why did not he refer those who want to fix a small planer to their lathe to the very much better plan and *illustration* of "F. W. G." above referred to? It would have been kinder, as well as something else, to have done so, for I think we have seldom had anything cruder or more misleading appearing in the way of *an article*, and not often as a letter, even from the most ignorant tyro. Coming from one who writes *ex-cathedrâ*, it must be the more misleading.

Frederick Carre.

SPHERICAL SLIDE-REST.

[20713.]—IN answer to "F. A. M.," I beg to say that, though I have not myself made a spherical rest, I have studied the mechanism of it, and would most certainly not advise "F. A. M." to attempt fitting the upper slides of one on the saddle of a slide-lathe which is used for metal-turning, as it would only end in disappointment. Any slide-rest that is used for metal-turning will, sooner or later, develop an amount of backlash, which, though not of the slightest consequence in metal-turning, would be fatal to the use of it for ornamental work, for which latter a spherical rest is entirely used. If "F. A. M." can procure the first numbers of a paper which came out a few years ago, which was first called the *Turner's Manual*, and afterwards the *Forge and Lathe*, but which is now defunct, he will find a series of articles by Mr. Evans on the spherical rest, illustrated with full-sized working drawings. It is a great pity the *Forge and Lathe* was given up. I have bad all the numbers that were published bound, and it forms one of the best books of reference for amateur mechanics I have ever seen. **F. W. G.**

"IMPROVED BICYCLE-HEAD."

[20714.]—We beg to inform Messrs. E. Martin and C. F. Archer that the idea illustrated in letter 20617 would be an infringement of our Patent Self-Steering Head. **W. Gorse and Son.**

Icknield-square, Birmingham.

[20715.]—I have much pleasure in replying to criticisms upon my design, let. 20570 of Sep. 29th.

Referring to the sketch of Mr. Archer, let. 20617, I may say that it is almost a *facsimile* of my original design; but that upon account of the difficulty of keeping the head free from shake radially for any length of time, I reverted to the double slides and open-head, as a considerable amount of wear must then take place before any looseness can be felt. I have no doubt placing the centres behind head may be an advantage in keeping machine true when running; but I have not been able yet to see one so made in use. Possibly the upper portion of forks, ⅜in., does appear small, but it must be considered that all pressure put upon steering-bar will be transmitted by the head, which is braced down front, to the lower portion of forks, where the diameter would be 1in. Of course the size can be increased to ½in., increasing other parts proportionately. "A Bicycle Rider" suggests that the jumping of the hind wheel may cause the loose head and, consequently, backbone, which it carries, to shut down upon tire; bad he examined the designs more closely, he would have found that there is in both a limit of 1in. space between backbone and tire, beyond which the head cannot fall. I should like also to remark, that the jumping of the hind-wheel would give a horizontal, and not a vertical motion to the head, in consequence of the lower end of forks pivoting upon spindle of front-wheel, acting in the manner of a bell-crank, and converting the vertical motion at lower end of backbone into a horizontal one at point of head. This will be seen more plainly if "A Bicycle Rider" will get someone to raise and lower his back-wheel, he watching the effect upon the head. It thus becomes apparent that the rider is submitted to two motions—the vertical, caused by the large wheel; and the horizontal, transmitted from the small one, which, coming so quickly one after the other, partake of the nature of a vibration, and the smaller the wheel the stronger and more frequently they occur. For this reason, I would not do away with spring under saddle, but should prefer one after the style of the indiarubber suspension, made by the Coventry Machinists, but which will admit of a horizontal motion, in a line with backbone, without any side-shake. Until such a spring is designed, we shall not have reached that perfect ease in riding which we have a right to expect.

A gentleman complains that having a spring in head will necessitate a man riding a machine 1in. smaller than he otherwise would do. I certainly think this no detriment; as, for road-work, a machine should always be one size under the rider's capacity; my experience teaches me that one can get more work out of such a machine, with good hill-climbing power, than when riding a machine which thoroughly extends him. **E. M.**

A REQUEST.

[20716.]—Somebone has suggested that a series of articles on Fitting would be valuable. I sincerely hope this suggestion will be complied with. We have practical articles on Lathes and Machines, the Organ, Object Glasses, Carriage-making, Watchmaking, &c. Can no one be found to carry on the series so ably begun by the late Mr. F. Hoffman, and give plain practical details of shop-work in the construction of Locomotives and other Engines? Cannot some one of those gentlemen, who so kindly reply to the irrepressible and comparatively useless queries about the numbers and dates of engines, give a little help in these matters? **Nero.**

GRINDING-CHISELS AND PLANE-IRONS.

[20717.]—There is a little instrument of American invention, sold at most tool-shops, for holding chisels, &c., whilst being ground. It is simply a small iron frame, through which the chisel blade is passed and allowed to project more or less according to the angle required to be ground—a thumbscrew holding it fast. A small wheel on the underside of the frame travels against the face of the stone, and enables the workman to keep the iron to be ground steadily fixed in one position.

Will "Calculus" (letter 20689) kindly say how he finds the small grindstone he uses answer for large chisels and plane-irons, and what the size of it is? I have hitherto depended upon the nearest carpenter or builder for getting my tools ground; but as this plan has many drawbacks, and involves a loss of time, I have resolved to buy a grindstone, and shall be very grateful to "Calculus," or any of our readers, for a little advice as to the most suitable grinding apparatus for an

Amateur Carpenter.

JERKS IN RAILWAY TRAINS.

[20718.]—May I be allowed to differ from C. E. Stretton (letter 20677) as to the cause of the back jerk referred to by "S. J." (letter 20646)? I need not here point out where I think his explanation is wrong; but will only remark that if his theory be correct two opposite effects should be felt in the same carriage, depending whether you may happen to be in the fore or after part. The explanation, I take it, is simply this: When the brake is put on the train is retarded. If a person *stands* in the carriage (in which position the effects are most observable) he will feel, on the application of the brake, a tendency to move on at the original rate (from inertia) that is faster than the train is now moving. To prevent this he lies away from the direction of motion, and on mechanical principles which I need not here enter into *continues to lie* in this position, which is not upright so long as the train is suffering retardation. He is, however, being now in equilibrium, unconscious of his having assumed this position. When now the train stops, not being vertical, his tendency to fall is evident. If the brake force was not a uniformly retarding one, but a uniformly *decreasing* retarding one, this effect would not be felt, but the necessities of the cases in which brake-power is used prevents the employment of such. The way to prevent the effect is *not to rise from your seat* till the train *has stopped*, because in the sitting position (especially with your back against the rail), the body more readily accepts the varying movements of the carriage. Many interesting illustrations of these effects might be given. Suppose a friend to give you a gentle push from behind, the first effect on you will be a tendency to fall forward, but if the push be continued, you will assume a position (lean backwards) to resist this push. If, now, your friend suddenly remove the pressure, you find a tendency to fall backwards. Again, you would find if a person in a train stood on a spring or hung from a spring, the spring would register a greater force during the time the brake was on, because the force registered would be the resultant of two forces at right angles to each other, the weight of the body and its extra pressure forward. Indeed, all the qualities of the brake might be distinguished in this way without looking out of the carriage.

Swansea. **A. R. Molison**, Science Teacher.

RECENT RAILWAY ACCIDENTS AND CONTINUOUS BRAKES.

[20719.]—The accidents which have occurred within the past few weeks again furnish most conclusive proof in favour of efficient automatic brakes.

On the 25th October a Great Eastern Company's express train left the rails when running between Helpringham and Sleaford. The evidence as to the *cause* is very conflicting. Two Great Northern engineers state that the rails were out of place to the extent of nearly 2in., but, on the other hand, the Great Eastern Company maintain that the line was in perfect order.

The comparatively slight injury to passengers and rolling stock which followed is entirely due to the fact that the train was fitted with the Westinghouse automatic brake, which stopped it without any "telescoping."

I have received the details of an accident which took place in Holland on the 2nd November (of which a short account was first published in the *Nieuwe Rotterdamsche Courant*). An express train No. 14 from Arnhem on the Rhenish Railway was running at a high speed between Veenendaal and Ede, when the driving-axle broke, causing the engine to instantly run off the rails, dragging after it the tender and front vehicles. In this case also the train had the Westinghouse brake, and was safely stopped by it; no telescoping took place, and the details conclude with the remark, "No person was hurt nor any damage done to the carriages"; this happy result is due to the efficient action of the brake.

The recent accident at Liverpool Central Station continues to receive considerable attention. No official report has yet been published; but the details given by passengers in the train furnish convincing proof as to the *cause*. The train was fitted with the *two minute* modification of the Sanders-Bolitho vacuum-brake, as used by the Midland Company.

One of the passengers, writing to the *Engineer*, states that he left London by the 10.5 a.m. train, and when "going into the station at Liverpool he felt the brake put on in the usual way, and it was grinding on the wheels of his carriage until about *forty yards* off the end of the line at Liverpool, when to his surprise the grinding ceased, and the train seemed to jump forward, as if all the brakes had suddenly gone off." It will be clearly seen from this statement that the brake leaked-off (as it is constructed to do), just at the very moment when it was required to stop the train.

The danger of such a brake is well known, and was pointed out by Col. Rich, in his report upon the Portskewet Pier Accident. It is much to be regretted that an important company like the Midland should continue to use a brake which is dangerous in construction, frequently fails to stop the trains at platforms and signals, and often causes draw-bars and couplings to be broken when it is used.

A large number of letters have been addressed to me upon the subject of the Pullman Car disaster at Leeds; pending the verdict of the jury I shall not, of course, express any opinion upon the *cause* of the fire; but I can point out that if the conductors on the cars had either pulled apart or uncoupled the Westinghouse automatic-brake hose-pipes between the two cars, the train would have been stopped without any delay in pulling the communication-cord, and the life of the unfortunate passenger might have been saved.

Clement E. Stretton.

Brighton, Nov. 4th.

DIE-CUTTING.

[20720.]—Die-cutting, or engraving, or sinking, is very like ordinary engraving, only more difficult, as the material, soft steel, is very hard, and the form of the incisions has to be considered, and not only their depth and contour. The dies for letter-paper stamps, if contined to lettering, are not usually engraved, but the letters are produced by pressing or hammering steel punches, each with a letter engraved upon them. This is not very easy, and the work has to be touched up with a graver, and the surface of the die, which becomes raised around each punched letter, restored.

For monograms, the die which is awkwardly shaped for holding is cemented into a block of wood that can be grasped in the hand, and rested upon the ordinary leather sand cushion. Lightly trace with ink or pencil on the die. The first process is to cut the outline with an ordinary graver, but whereas the engraver works with only one form of graver, which cuts a furrow, the die sinker uses a multitude of tools, gravers of every form of section, as well as minute chisels and punches struck with small flat-faced hammer. Proofs of the work are taken repeatedly by means of wax softened in the hand and made opaque with red ochre, or bread kneaded in the hand and coloured with vermilion.

Large medals are now generally modelled in wax, twice or more as large as the intended medal, and in relief. The die is then cut by a machine which works from a revised cast of the model, and reduces the design to the proper size, and cuts the steel die by one operation. The die-sinker has then only to finish the surface on which the machine leaves slight traces of the path of the cutting-tool.

Dies for coinage are produced in large numbers by punches, upon which the subject is in relief, and these punches themselves are made from dies which are themselves produced from a punch, the original work of the engraver to the mint. The softening, hardening, and tempering of the punches and dies are still rather haphazard processes, so that a die will sometimes be destroyed before it has struck a single coin, or split in pieces on the first occasion of its use. **Robinsoe Crusoe.**

THE WIMSHURST INDUCTION ELECTRIC MACHINE.

[20721.]—As I have seen this machine at work, perhaps you will permit me to say a few words in reply to the criticisms of Mr. Molison in your last.

Mr. Molison disputes both the originality and the merits of Mr. Wimshurst's invention by what appears to me (to take a charitable view) a total ignorance of the facts.

In the first place he assumes that the publication of the description of the machine in your excellent paper was the date of the construction of the machine. The machine was seen in operation more than two years ago by myself, and also by some of the leading makers of such machines; by several members of the Physical Society; and others. These have invariably expressed admiration of the power and volume of the sparks produced. This, I think, puts Mr. Molison's exhibition in June last, at the Physical laboratory, out of the question. Again, speaking of the merits of the machine, Mr. Molison, it seems to me, reads a short outline article, and then jumps to an adverse conclusion, without taking the slightest trouble to ascertain the facts. *He* says that "for 32in. plates, 7in. sparks are short"; but he does not care to inquire for the reason for their limit—viz., the short distances for insulation between the case and the machine, which are necessarily limited in order to make so large a machine portable. Nor does he inquire the size of the Leyden jars or condensers attached to the machine, nor the multiplying power of the gear. He says that four or five sparks, &c., are poor. The Leyden jars in use were 1ft. high by 6in. in diameter; the revolutions of the glass discs are two to one of the driving-wheel, and for the purpose of counting, the handle was turning about 30 revolutions only per minute. With small condensers in use, the number of 3in. sparks appear to be continuous, and several passing side by side.

The substitution of rectangular slips, which are inexpensive and easily removable, does not detract in any way from the efficiency of the machine; but, on the contrary, they rather add to the efficiency of the machine; and it seems to me they are a considerable step in advance of the costly and dangerously frail perforated discs used in the Holtz. Mr. Wimshurst deserves, I think, great credit for introducing this design to the makers, thus making it possible for anyone to obtain a powerful and convenient source of electricity at a low price.

M.Ph.S.

THE LINK-MOTION.

[20722.]—The figures drawn by "Milverton" (letter 20688) are those upon which Watt's parallel motion is founded. Fig. 4 gives us a practical application of the principle; it is, in fact, the same as that applied to the beam engine, where the point E represents the top of the air-pump rod, the top of the rod of the piston of the steam cylinder being worked by a parallelogram of bars, so that the top of the piston rod works parallel to that of the air-pump rod; that is to say, in a straight line (approximately). The lengths of the various links, &c., which produce the most effective working, have been given in various works, such as Rankine's "Applied Mechanics," and there is little more to be said on the subject; but an interesting subject of inquiry would be to ascertain how much the approximately straight line deviates from a mathematically straight line, and this, I think, was the question which was asked in the correspondence on this subject.

M.I.C.E.

LEGAL REPLIES.

[20723.] — Street Nuisance, Playground (48450).—Boys have no right to make a playground of the street to the annoyance of passengers and of the inhabitants; and they could be summoned by the police. But I do not see any other way of proceeding; for certainly the schoolmaster can hardly be held responsible for the conduct of his boys after school hours, and there is no way of getting at the parents. This is one of the many annoyances of life for which the law provides no adequate remedy; though on the side of the boys it might be argued that they must play somewhere, and as no playground seems attainable, they make the best of the street.

Landlord and Tenant—Notice to Quit (48456).—As so often happens, this answer mainly depends upon a fact which is not stated. Did the tenant pay the first half-quarter's rent and then pay at the usual quarter-days, or has he paid every three months from the half-quarter? If the former, which is the most probable, then, although the inference of law is that a tenancy began upon the entry, it will be held that the half-quarter was as it were a separate thing, and the holding commenced at the quarter-day following; so that in this event six months' notice must be given to expire at Midsummer. If the latter supposition be correct, then the notice must expire at the half-quarter.

Apprentices' Hours—Factory and Workshops Act (48459).—The querist does not give his age, though this is the most important point, and that upon which the answer must turn. I think the case comes within the Factory and Workshop Act if the apprentices are under eighteen years of age, but not otherwise. Under the Act, young persons below this age, whether apprentices or not, and whatever may appear in their indentures, are only to work twelve hours a day, with intervals for meals and rest, and between 5 a.m. and 9 p.m., and not at all on Sunday, nor after 2 on Saturday afternoon.

Real Estate—Void Devise (48468).—It would be more satisfactory to know generally the contents of this will, and whether it was proved, and what happened. But taking the question as it stands, it is clear that the devise to B. and C. was void, as they were witnesses to the will. They have now held possession for over 20 years, and thus they have a good title by occupancy which no one can dispute because of the Statute of Limitation, unless the rightful heir was an infant. But as they did not take under the will, the conditions of the will as to the descent of the property can have no effect. In short, B. and C. hold the land in fee simple, and they can devise it as they like, or it will descend to their heirs-at-law in the usual course. If, when the testator died his heir was an infant, he would have six years after his majority in which to claim. The querist had better send me fuller particulars.

Partnership—Limited Liability (48471).—Partners are undoubtedly both jointly and severally liable to their creditors, whatever they may arrange between themselves. Nor can this liability be limited to the amount of the capital brought by each into the firm. If A. and B. trade and lose, their private property will assuredly become liable to pay the debts of the firm, and there is no way of preventing such a result. The principle upon which the law as to limited companies proceeds is that the creditors know the capital to which they trust. But this could not be applied to private partnerships; and even if a firm were to announce their capital they could not bring themselves within the Companies' Acts, by means of a deed or in any other way that I can imagine.

Will—Duress (48473).—I hardly know how to advise in a case of this kind, for the law does not provide for a woman of 32 being controlled without force. Surely the woman can leave her brother's house if she chooses to exert herself, and insist upon living where she likes, and managing her own property. She has only to make a later will to revoke the one which I presume is held by the brother, and which if made under duress of compulsion would itself be wholly void. But this is a case for the interposition of a solicitor, and one upon which it is impossible to give brief advice: though if the woman should be wrongfully put away in an asylum her relations can appeal to the Lunacy Commissioners, or proceed by way of writ of *Habeas Corpus*.

County Court—Particulars (48475).—You cannot charge for making out the necessary particulars to annex to a county-court summons; but it is not essential that every item in a long account should be carried out fully. If you want help in this matter you might read my shilling book, "Hints upon County-court Practice."

Rating—Appeal (48482).—I do not quite see the point of this question. Appeals are heard before the Assessment Committee upon stated days, and it may have been disposed of without the querist's knowledge or attendance. He had better inquire of the collector, and find out what has happened.

Income-tax—Equitable Mortgage (48499).—This is an equitable mortgage, and it stands in the same position upon this point as a legal mortgage, and so being an interest in land, the querist is bound in law to allow income-tax upon the interest payable. This is the usual practice in all mortgages relating to land.

Fred. Wetherfield, Solicitor.
2, Gresham Buildings, Guildhall, E.C.

DOMESTIC RECIPES.

Vegetable Butter.—Mr. N. Jepson, an English vegetarian, not wishing to use poor and adulterated animal fats, has sought a substitute, and found it in a composition for which the following is the formula: Take four ounces of the finest Brazilian nuts, pounded very fine in a mortar; four ounces pure olive oil; rub them into a smooth jelly; add eight ounces of fine wheat flour and a quarter of an ounce of salt. Rub the whole into a smooth paste, and use as butter. This would certainly be preferable to much that goes by the name of butter.

Pressed Beef.—Buy three or four pounds of beef from the neck; boil or steam until the bones will fall out, using but little water; salt and pepper it just before taking up; pick out the bones and pack the meat in a dish in which you can press it nicely; leave a little of the liquor in the meat and apply a heavy weight for several hours. This is a savory and economical dish.

Grape Leaves for Pickles.—A writer in the *Country Gentleman* recommends the use of fresh green grape-leaves to place on top of pickles in jars in place of flannel or other cloth usually employed. He claims the leaves will preserve the vinegar sharp and clear and impart a nice flavour. The leaves should be rinsed in pure water and left to drain before use, and occasionally changed. They exclude the air, and besides imparting a delightful flavour to the pickle cause less trouble to the housewife.

Blowing out a Candle.—There are two ways, the right and the wrong, of performing this seemingly simple operation. If the candle is held on a level with the blower's mouth, or blown down upon, as usual, as it stands on a shelf or table, the wick will smoulder and smoke till the room is filled with its disagreeable smell, and the wick burned away so that it cannot be lit next time but with difficulty. If the candlestick is held well above the blower's head, and the flame blown out from below, the ignited wick will almost immediately be extinguished, and no trouble will be found in relighting the candle.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[44505.] — **South Eastern Engines.** — To "Clyde." The 7ft. express engines stand on a wheel-base 17ft. 3in.; leading and driving centres 8ft. 6in.; driving and trailing centres 8ft. 9in. apart. Weight in working order:—On leading-wheels 10tons 6cwt.; on driving-wheels 12tons 9cwt.; on trailing-wheels 9tons; total, 31tons 15cwt.—Carstairs.

[47885.]—**Turbine Pit.**—In the first place, any pump will empty your pit so long as it can pump more water than leaks into pit through dam. Secondly, the time taken depends on diameter of pump and speed at which it is driven. Thirdly, the strokes per minute depend on length of stroke of pump as well as on the above data. I will assume that your 8in. pump is worked by a crank, which is capable of being driven by a pulley, and that its stroke is 12in., suction-pipe 4in. diameter, and pump single-acting. Allowing a loss of about one-fifth, it would require 6,400 strokes to empty pit. Multiplying gear for reciprocating pumps is objectionable, but we will allow of the use of pulleys in the ratio of two to 1 in this case. That is, if pulley on crank-shaft of pump is 1ft. diameter, that on driving-shaft will be 2ft.; the pump will then make 40 revolutions, or 20 effective strokes, per minute, and will take $6400 / 20 \times 60 =$ a little over 5½ hours. I have been obliged to assume dimensions, as you have not given those I asked for.—Glatton.

[48036.]—**Shells.**—An eminent conchologist in the South of Ireland, well-known to collectors fifty years ago, told me that he cleansed his shells with dilute muriatic acid, the strength being regulated according to the work; and that if in finishing, the acid solution is as hot as can be used, it leaves a polished surface on the shell; if used cold, the surface would be dull. I have since often verified this.—R. J. Lecky.

[48043.]—**Dead or Chemical Black on Steel.**—It was a very small job that I experimented on, and I found that about a wineglassful of turpentine and a teaspoonful of sulphur had the desired effect. You will require to be very careful, and go over the work without leaving any grains on the metal, as it leaves it all spotted when heated. A trial or two will soon enable you to judge the proper quantity. I tried it on the propeller-shaft of a model steamer, and it protects it perfectly.—Auld Reekie.

[48043.]—**Dead or Chemical Black on Steel.**—Perhaps the following may be of use to "Bicycle Rider":—Add to oil of turpentine strong sulphuric acid drop by drop, stirring it until a syrupy precipitate is formed. The liquid must be repeatedly washed with water until the water exhibits no more acid reaction. The precipitate is next brought upon a cloth filter, and after all the water has run off, the syrupy mass is fit for use. This is painted over the iron with a brush, being previously diluted with oil of turpentine, in case it does not flow well. Immediately afterwards the paint is burnt in by a gentle heat, and, after cooling, the black surface is rubbed with a piece of woollen stuff dipped in linseed-oil.—E. O. B.

[48073.]—**Water Engine.**—You can make your water-engine exactly like a steam-engine if you like; but I should prefer one like the Backus water-motor, illustrated in No. 692, or a turbine.—Essar.

[48078.]—**Muntz Metal Tubes.**—I do not know at what temperature your Muntz metal melts, but the spelter should run at a few degrees (say ten) less. Borax is the flux. Try with the ordinary spelter of the shops, and if that will not work ask for some softer stuff.—Essar.

[48083.]—**Keeping Launch Funnel White.**—There is nothing but whitewash; but you might try the effect of putting a little bichromate of potash into the size or glue, using an extra quantity of black or blue to correct the yellow tinge.—T. P.

[48086.]—**Red Ink.**—You mean Brazil-wood—not logwood, as you will only get a purplish ink from that. Take 4oz. of ground Brazil-wood, 1¼ pint of hot white wine vinegar, and digest, preferably in a glass vessel, for a day; then simmer for half an hour, and add towards the end of the time half an ounce each of gum-arabic and alum. You can vary these proportions; possibly improve upon them.—E. F. C.

[48087.]—**Dynamo Machine.**—The quantity of wire required is a matter for calculation. You will find much assistance in the tables published in Mr. Sprague's book, but it is rather a troublesome calculation, and unless someone has a similar machine which is successful, it is scarcely to be expected that anyone will make the calculations for you.—E. G. M.

[48103.]—**Straightening Wire.**—You can do nothing better than draw it between the rows of zigzag pins. See No. 850 for a capital description. —Essar.

[48122.]—**Drying Room.**—Pass a hot solution of lime through them; or if they have a deposit of naphthaline use petroleum or paraffin oil.—T. P.

[48135.]—**To Mr. Lancaster.**—I am extremely obliged to you for your valuable hints as to laying insulated wires all over the house. But I am saved a great deal of trouble through being able to bring my wires out of the rooms on to the landings, and then direct to basement. I think my only trouble is in the constructing of the indicators, which I am very anxious to do myself, and shall be grateful to you for drawings and instructions.—Onward.

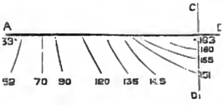
[48141.]—**Case-hardening.**—You do not say how you case-harden. If the ordinary way with leather cuttings, charcoal, &c., you could try letting them cool gradually; but the proper way is to turn them into water or oil whilst still red.—Essar.

[48142.]—**Liquid Gold.**—You must have used one of the so-called gold paints. Procure some real gold powder, and mix it with any suitable vehicle,—*e.g.*, gold size, pale copal thinned with turps; or mix with weak gum-water, and varnish after work is finished.—H. D. W.

[48286.]—**Electric Engine.**—The magnet may be magnetised by placing a piece of soft iron upon its poles, and beginning at the bend; pass a powerful bar-magnet down one limb, across the armature, and up the other, always using the same pole of the magnetising-magnet, and leaving off at the same place as the process commenced; or a few turns of insulated wire, loose, the ends connected to a couple of Bunsen or bichromate cells, passed round and round the forging, always in one direction. The armature is grooved lengthwise; its cross-section representing ⌶ thus, may be made of a piece of soft iron, turned, then the groove filed or shaped out, round the ends also, leaving the groove about ⅜in. deep all round, which, you will see, is easy to wind; and ought to be wound before the brass ends are finally attached. These, which are merely to mount the armature upon its shaft, should previously have been fitted, and armature and shaft trued in the lathe, then taken apart and wound. The groove should be tightly wound and filled with the wire. The sheet-copper brushes should rest on the commutators, and do not require turning.—Fred. Walker.

[48333.]—**Induction Coil.**—To "Ohm."—Want of time prevents my replying to "Ernest"; but Mr. J. Brown, Belfast, who worked with me at the induction experiment, has kindly consented to give the information asked for. I therefore leave it in good hands. I hope shortly to again resume the experiments and complete the coil, which I trust may be as great a success as the Belfast-coil. Meanwhile, I should be glad to have any hints on the above subject, or any friendly criticism of the experiments.—Ohm.

[48333.]—**Induction Coil.**—To "Ohm."—I have obtained the permission of "Ohm" (Mr. McWhirter, of Barrow) to give "Ernest" the benefit of his experiments in electro-magnetic induction. They were undertaken in order to discover the proper form for the secondary of a coil having a core 24in. by 1⅝in., and primary of three layers. The winding of these is peculiar, all three being started at one end of the core, and their ends aftewards connected by wires under the base. Mr. McWhirter believes, from some experiments previously made, that this plan gives greater magnetic power. It certainly allows a closer packing of the wire. Over the primary is the vulcanite tube, about 3in. outer diameter. The magneto-inductive action in the space round the core was tested as follows: A disc of wood had a 3in. hole cut in its centre, so as to slide along the tube; on its face were fastened 10 rings, or separate single coils of copper wire, ·036in. diameter, and rising by half-inches from the diameter of the tube to 8in.—the size of the outer one. Each of these could be connected to a reflector-galvanometer of about 1,000 ohms resistance. The swing of the galvanometer on breaking-circuit was taken to represent the electromotive force acting on the ring to which it was connected. After noting the result for each each separate ring, say, at the middle of the core, the disc was shifted ½in. along the tube, and readings again taken, and all plotted out on a diagram, giving a section of the core and its field. The resulting picture is very interesting. The lines of equal electromotive force are, as might have been expected, similar to the magnetic curves; but the difference between the E.M.F. at the middle of the core and at the end was, to me, very surprising—viz., 163 against 39. The accompanying cut gives some of the curves corresponding to the electromotive forces as marked, and gives a rough idea of the state of the field surrounding the core-tube, of which *ab* is one side, *cd* being the middle of the core. It is possible the higher readings are a little exaggerated, as the reflector had a straight scale, so that the reading is really the tangent of twice the angle of deflection. The advantage of placing the secondary near the middle is, however, sufficiently apparent. A learned friend of mine contends that the mutual induction of the turns of the secondary on one another would tend to diminish this advantage, by making it necessary to spread them as far apart as possible. It would be easy to throw some light on this part of the subject by trying what proportion the sum of the readings given by any two or more coils bears to their reading when joined in series. I think this should be done before deciding on the form to be given to the secondary.—J. Brown, Belfast.



[48346.]—**Great North of Scotland Engines.**—As nothing has been said in reply to this query, about the above engines, I append a few lines thereon. The oldest class of engines on this line had 5ft. 6in. wheels (4 coupled) and cylinders 15in. by 20in. There were also two locos., built by Beyer, Peacock, and Co., to work the Kittybrewster Incline; these ran on 4 wheels 4ft. 6in. diameter, and had cylinders 15in. by 24in.; weight, 25 tons. These two classes were Mr. Clark's design. Subsequently, the predominant design developed into an outside-cylinder engine, with a leading bogie, and which is now the standard pattern of engine. For goods traffic, Mr. Cowan (the present loco. superintendent) designed a class with 5ft. 6in. coupled wheels, and cylinders 16in. by 24in., and weighing 35tons 9cwt. Another class had 5ft. wheels, and cylinders 16in. by 22in. The latest class of engine was turned out by Neilson and Co. They have 5ft. 6in. 4 coupled wheels, and cylinders 18in. by 24in. "Alaric" will find some further information in Vol. XXVIII., p. 79.—Carstairs.

[48349.]—**Gasholder.**—(1) When the gasholder is (so-called) "empty," it is really full of air, which has an appreciable weight. If, now, it is filled with gas (coal-gas is, I suppose, what is meant), as the gas is only about ⅜ the weight of the air before contained in the gasholder, the weight of the whole concern with its contained gas will, of course, be reduced. (2) If now the pressure is doubled, the volume will be halved, and it will be necessary to use two vols. to fill the gasholder under the increased pressure, and the weight will be increased by the weight of the extra vol. of gas introduced. You say, "Will the weight be the same"; to what weight does "the same" refer? If to the 9½lb. manifestly not, for this is the weight of the gasholder with its first vol. of gas only. If "the same" refers to the weight when filled with air—viz., 10lb., it is possible for it to weigh as much; but, of course, it depends on what the weight of the gas is relative to air. Taking coal-gas (as above), to weigh ⅜ of what an equal vol. of air does, then the gasholder can be found, by elementary algebra, to weigh 9⅕lb., and the air ⅘lb.; therefore, weight of equal vol. of gas = ⅘ × ⅜ = 3/10lb., and, therefore, weight of the two compressed vols. = ⅗lb.; therefore, the gasholder will weigh 9⅘lb.—B. B.

[48360.]—**Knee-Joints.**—There is a work published by Messrs. Churchill, London, entitled "Injuries and Diseases of the Knee-joint," by W. P. Swain, F.R.C.S., which might be of use to you.—W. Henley Richmond.

[48361.]—**Plating.**—For the process of plating in gold and silver, Smee's battery is the one most extensively used. It consists of a platinised silver plate, and a plate of amalgamated zinc. The elements are placed in leaden vessels lined with asphalte. First of all, clean the pieces thoroughly in a solution of caustic soda. Then they are suspended in the solution of gold or silver, by a wire connected with the negative pole of the battery. To another wire connected with the positive pole of the battery is fastened a piece of platinum, which is also immersed in the fluid. To obtain a uniform deposit move the cathode backwards and forwards. The whole process is a decidely quick one.—W. Henley Richmond.

[48372.]—**Staining Elm.**—In reply to "Jack of All Trades," I wish to stain my vehicle a straw colour, so that the grain of the wood will be brought out. It is a stain that is commonly used in vehicles. —Spex.

[48378.]—**The Voice.**—I fancy if "Chorister" were to inquire of some respectable bookseller for treatises on the cultivation of the voice by G. Nava, in Italian, but translated now by C. Santley, one of his pupils; one by Lablache, one by Crivellis (I believe this is 21s. in price); also Jno. Hullah's 1845 to 1852, J. H. Parker and Son, of West Strand, publishers—that he would find ample information on the subject he inquires about.—Birkbeck.

[48378.]—**The Voice.**—In August I replied to a query on the subject of voice culture, and gave a slight outline of the conditions of good singing. The best books relative to voice-training that I have met, are those published by Curwen and Sons, Tonic Sol-fa Agency, No. 8, Warwick-lane, London. The most useful are, "The New Standard Course," price 3s. 6d.; "Teacher's Manual," 5s., and "Ellis's Pronunciation for Singers," 4s. 6d. But, after all, a few lessons from a thorough master are better than any quantity of books. The querist asks also for advice and hints, and I am, therefore, justified in enlarging a little on the subject. Let me advise any singer to cultivate all parts of the compass equally. The head voice, falsetto, or upper thin register is often sadly neglected. The register a little below, called the "upper thick," is frequently totally wanting, which is about the state of affairs with "Chorister." And the deepest tones of the voice are usually forced by untrained singers. All of these faults could be pointed out by a teacher in a few minutes.—J. Wallis.

[48378.]—**The Voice.**—A good treatise for the bass voice is Lablache's "Complete Method of Singing" (Chappell, price 21s.); but Mr. Reeves, of Fleet-street, London, in his musical catalogue, has a copy, 102 pages, for 4s. 6d. I cannot state whether it is for soprano or bass. There is Randegger's "Singing" (published by Novello and Co., price 4s., or in boards, 5s.), and get Emil Behnke's "Mechanism of the Voice" (3s.) and Ellis's "Pronunciation for Singers" (both published by Curwen and Sons, 8, Warwick-lane, London, who will forward a catalogue on application). I recommend these works because I know their contents. Now, as to practice, it is rather difficult to advise, not knowing what time is at "Chorister's" disposal; but I give (not being a professional man) my own experience of over 30 years as chorus and solo singer. When I began I took to the violin to help the voice, and as a basso profundo only reached middle C; now I can sing the Benedictus of Mozart's 12th Mass in its integrity. This is the method I should advise: Practise the scale in the key of F or G as convenient up to C for one hour every day, divided into 15 minutes each practice; sing every note full and sustained, and take good breath before every note, begin soft and in tune, bring it out full in the middle, and finish off soft; mind and keep to the note, and sing every note in time, either as one bar of 4 beats or two bars of 8 beats, allowing one beat for breath; follow this up for one month daily, then another month up to D, and so on. This is what I call laying the foundation of a voice for good singing. Dr. Kitchener used to say of Henry Phillips that "he made his voice by constant practice." There are two first-class exercises for bass in Handel's choruses, "We never will bow down" ("Judas") and "Wretched Lovers" ("Acis"), published by Novello, small edition for 3d.—Country Joiner.

[48379.]—**Gower-Bell Telephone.**—Shouting through the instrument will not improve it, but will, on the contrary, damage it to no small extent. Your natural voice should always be used, but speak clearly and incisively. The position of the reels should be quite at the end of the magnet, which in its turn should be placed very close to the diaphragm; but this latter position can be best determined by trial. Good results are sometimes obtained by polishing the inside of the case as well as out. It may happen that the instrument is suffering from the inductive effect of neighbouring wires, which should be immediately remedied.—John Bull.

[48379.]—**Gower-Bell Telephone.**—Faults appertaining to transmitter:—1. Arm, L.H. side (facing instrument), making indifferent contact. 2. Straps leading up to transmitter, do., do. 3. One or more carbon rollers binding between outer block and centre one. This is most important, as one of the rollers binding has been known to completely short-circuit the instrument. The hole in the outer carbon block should be brought to bear (as near as possible) diametrically in a line with hole in centre carbon block; they should have a little end-play. The top edge of wood diaphragm should be free to vibrate. The copper straps on which the outer carbons rest may have their points turned up free of the wood diaphragm, so as not to jar. The receiver:—1. Coils on magnets loose and falling down on metal diaphragm, causing indifferent articulation. 2. Defective magnetism in magnet—this may be tested by applying an armature; it should have a good pull. 3. Adjustment of magnet—this is to be as close to the diaphragm as possible without touching; this may be accomplished by getting the magnet near the diaphragm and applying a 1-cell battery to the receiver binding-screws. If the poles are too close you will get no noise in the tubes on listening. Adjust to about 1/16in., and work up gradually closer, using the battery as you proceed. 4. Iron-filings sticking to pole pieces causing a scratchy noise in transmission—remove these if any. 5. The wires from receiver binding-screws to bobbins to be clear of magnet, or the receiver may be short-circuited by the wires resting on magnets. 6. The forked tube in which the indiarubber tubes are fitted protrudes too far through diaphragm frame, preventing the diaphragm from vibrating—This must be unscrewed and the end filed off. Resistance test.—Transmitter, 8w.; induction coil, primary wire, 1w.; secondary wire, 200w.; bell coils, 100w.; receiver-coils, 200w. If you obtain anything glaringly below these figures, that part is partially short-circuited. 7. Arm R.H. side making indifferent contact. See that the slots on both sides of the instrument are cut well up, so as to allow the arms to make good back contact.—Vincent.

[48387.]—**Soap-Making.**—I am glad "Dandie Dinmont" has asked this question because I had some thoughts of communicating my experience of a process recommended about a year ago in the English Mechanic. In consequence of what was said, I tried it, and with every reason to be satisfied. I allude to soap-making by the cold process, and should advise "D. D." to send for their pamphlet upon the subject to the Greenbank Alkali Company, St. Helen's, Lancashire. The process involves very little trouble, and the result is absolute purity. The querist speaks of soft-soap. Probably he does not use the expression in its technical sense. I have not tried that; but, as for the scouring, and the toilet soaps made in this way, I can speak very highly. We use none other, and the quality is better than can be procured.—Devonshire Squire.

[48389.]—**Semi-Incandescent Lamp.**—Use same battery of low internal resistance. The battery described by Urquhart in his "Electric Lights" is eminently suited for the purpose. If it is not necessary to have a fixed spot for the light, I prefer the lower electrode to be of carbon. If made of platinum, it should be ⅛in. or $\frac{1}{16}$in. platinum wire, with the top on which carbon rests filed flat.—H. T. Barnet.

[48390.]—**Fossils.**—Various sorts occur in flints—echinodermata, shells, and sponges. Choanites are found about here in small numbers, some turned into chalcedony, others entirely made of flint. Cut, and polished, they sell for a good sum—that is to say, fine specimens well coloured. I have a small one, also a pecten turned into flint; it is black, inserted into a yellow matrix. Stones do not grow, they are generally deposited by water. For the rest of your query, you ought to consult some text-book of geology.—C. J. R., Ventnor.

[48390.]—**Fossils.**—No. 1. Yes, fossils are sometimes found in flint—viz., choanites (a species of spongiform zoophite), also diatoms and foraminifera, the minute structure of which is beautifully shown by the microscope. They have a commercial value, fine specimens realising as much as 20s. No. 2. All rounded stones found in loose soil bear unmistakable evidence of water-action, and are probably the remains of beaches, which have been scattered and distributed over our island during the glacial drift period, while England was below the sea-level. They do not grow, their tendency is rather to diminish in size by crumbling away.—Hopkin Thomas.

[48393.]—**Scraping Cast Iron.**—The scratching you allude to probably proceeds from your way of holding your scraper, which should not cut, but sharply rub, as it were, powder from the high places left from filing. I usually take a worn saw-file and grind the cuts out upon its three faces, oilstone it to an edge, and hold it by the handle in the right hand, while I give it a radial motion from the right wrist, with the left hand upon the scraper. Should I have to scrape the same place twice, I move the scraper at right angles to the former movement, giving a more finished appearance to the work. If, as I presume, you have a large surface to get up, I should recommend a round file, say ⅜in., cut in the centre, and the end flattened to about ⅛in. thick, squared off, ground and oilstoned. This is more suitable for a large job; but on cast iron it must be frequently sharpened, or in endeavouring to make it cut, after the edge is gone, the corners will scratch the work.—Fred. Walker.

[48398.]—**Regulating Clock.**—If you wish to make a clock or watch go slower, you must lengthen the pendulum; if faster, shorten it. The pendulum of a watch is generally called a hairspring. You had better get the "E.M." for the last six months—it will teach you more than a book, as books are generally written for improvers and such as have an insight to the trade. Watch-wheels are first stamped out, then threaded on a piece of wire screwed tight together by means of a nut at the end; they are then placed under a cutting-tool in a lathe, which cuts grooves from one end of the wire to the other. The grooves are regulated by means of a large dotted steel plate, which revolves with the wire; the cutting-tool is so made that it rounds off the ends of teeth, and polishes at same time.—A Fellow Workman.

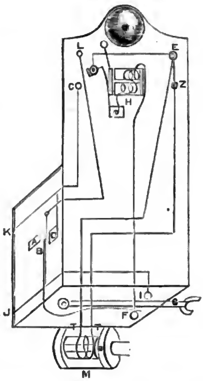
[48405.]—**Interference of Light.**—I have not given much attention to the subject, and must, therefore, refer "Ll. B. A." to the "others," to whom, with myself, he directs his inquiry.—O. V.

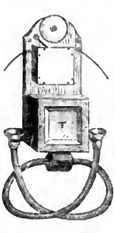
[48406.]—**Reed Organ.**—If "E. J. L." has gone so far without seeing where he was going, he has only himself to blame, though it is not unlikely that he may have been misled. His bellows-action now takes him up to 30in.—why, I cannot imagine; but surely it can be reduced, for he can get a harmonium pan, or an American organ action, underneath the keys, and then have the manual only 31 or 32in. at the outside. The former figure is about the usual, and without particulars as to the bellows constructed, it is only advising in the dark. Even those who know "all about it" always make a rough sketch and measure up, to see how things will come; but your correspondent seems to have gone on the happy-go-lucky system, and has got into a fog, as might be expected. As he has balance keys, if he can alter his valves, he might put in a harmonium pan, and use pressure bellows, the front part of the keys depressing levers acting on two rows, and the end of the keys lifting levers acting on two and a half rows. But bellows occupying 30in. in height are a caution, and, without knowing whether they can be reduced, I scarcely know what to say. Leaving them with the suction action, he might put an American board under the keys, and one above (by cutting it down), but then his keys are most likely C scale, whereas American organ boards are usually F scale. I cannot conceive what sort of an instrument he has been endeavouring to make, and for all he says, it might be better to follow out the original instructions; but I do not think the instrument will be worth house-room when finished. Has your correspondent access to back volumes? Because, if so, he might find in them just the information he wants. At present he seems to have bought a "white elephant"; but, if possible, I will help him to build a suitable stable.—Organon.

[48407.]—**Creation of Power.**—When a magnet is used to magnetise a steel bar it loses none of its own power. I suppose Mr. Harcourt imagines that it imparts some of its attractive force to the bar, but it does not. The theory is that every piece of iron or steel contains the magnetism in a latent state, that the latter consists of what we are bound, for want of a better term, to call two fluids, the north and south magnetism, which, like positive and negative electricity, exert a repellent force upon themselves and an attractive one upon each other. When the pole of the magnet is drawn along the steel bar it separates the combined fluids in that body, attracting one and repelling the other, and these being prevented from recombining by the coercive force of the steel, the latter becomes itself a magnet with its two poles complete.—Conrad.

[48410.]—**Marina Glue.**—Marine glue can be made in the following manner: Dissolve by heat and agitation in cold naphtha, small pieces of caoutchouc. Then add to the solution powdered shellac. Heat the whole, with constant stirring, until combination takes place. Then while it is hot, pour it on metal plates, in order to form sheets. To make it fit for use, it should be heated to 240° Fahr.—W. Henley Richmond.

[48417.]—**Simplex Telephone.**—As requested by "Cantab.," I send sketch of switching for the Simplex telephone, the front top and one side removed to show the connections. It is manipulated as follows:—To call the distant station press the button A, which breaks contact at B and puts the line, L, and carbon of battery, C, in contact at D. The circuit is completed by putting the zinc of battery to Z, whence the current passes through the receiver M, and out at E—either to earth or return wire. By this arrangement the ringing at the distant station is repeated or made known at the sending station. The contacts at B are made with two strips of hard rolled metal, and continued under the lever G, which must be kept down on F while signalling with the bells, but be in contact with I when speaking. This is done by hanging the ear-tube on the lever hook, or the Bell receiver, should that be used instead of the electro-magnetic one. In coupling the instrument, the L of one is connected with the E of the other. The transmitter T swings on two small brackets inside the front, and contact is made at J and K when the front is closed. The carbon-cups are made out of ¼in. carbon, and is best done with a rose countersink, large enough to take half the ball without touching the head of the screw which secures the cup in its place, or the cup may be glued in its place, contact being made by twisting a wire round the outside; the discs are made with slices of carbon-pencil with a groove round them to have wire twisted, and when the balls are screwed up in the case they should be quite free to rattle. The cups should be arranged 1in. apart. An old saw and a file will do all the cutting and shaping, and if you have no lathe, a brace will answer the purpose. In the receiver, a bundle of iron wires takes the place of the permanent magnet, which was devised to meet the case of "Bell's" disclaimer, in which he disclaims a magnet excited by a battery in the line circuit. The adjustment of the diaphragm has to be made before finally screwing up, and will give no trouble if you observe to file the faces of the body of receiver and the core a dead level. Then cut a ring of stout writing-paper, with the hole about 2in.; glue one on each side, and when the ferrotype-plates are laid on, they will be the right distance from magnet, and may be screwed up. In conclusion, I would observe that the instruments switched in this manner are as loud as any made; but they can only be used in pairs, unless a separate switch is used with each instrument to reverse the poles of the battery. But in order to remove that obstacle, I have discovered that if the receiver is formed of a small induction-coil instead of the simple one, then an alternating induced current is produced, without using an induction-coil in the instrument. The result of this discovery will be that any resistance in long lines may be overcome by simply increasing the battery-power to increase the power of the magnet; the induced current being proportionately strengthened.—W. H.





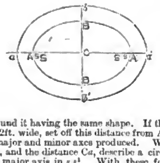
[48421.]—**Battery for Bell.**—I am much obliged for last week's answers; but do not think my battery is of the bichromate type, for if it was, the solution would be of a red colour, but as it is, it is as clear as water; but there is acid in it, for I have tasted it. I thought it was a solution of sal-ammoniac. What is the best solution I can use in my battery, as described on page 194, Oct. 27th?—A. Dabbler.

[48421.]—**Battery for Bell.**—Your battery is of the Leclanché type: a zinc-carbon element. The zinc is plunged in a solution of ordinary commercial sal-ammoniac, and the carbon firmly fixed in a porous pot, with a mixture of peroxide of manganese and carbon, in the form of a coarse powder. In order to recharge your cells, all you will have to do will be to add fresh commercial sal-ammoniac.—John Bull.

[48422.] — **Carbon Binding Screws.**—"A. Dabbler" is much obliged for answers to the above query. I have many back numbers of the "E. M.," but cannot find the exact answer I want—namely, how to re-solder brass binding-screws on to carbons. Full instructions how to go about it will greatly oblige.—A. Dabbler.

[48422.]—**Carbon Binding Screws.**—To re-copper (or electrotype) your carbons, proceed as follows:—Make up a couple of Daniell cells, and obtain an ordinary marmalade jar, and into this place the end of the carbon you wish to be coppered; attach a wire to the top of the carbon by either twisting it round firmly so as to insure perfect contact; or get a small nut and bolt, previously twisting the end of the wire round the head of the bolt, and place this across the top of the carbon—the bolt-head and wire on one side, and the nut on the other. The nut can be screwed up tight, which keeps the wire in contact with the carbon quite securely. The other end of the wire you must connect to the *zinc* of the Daniell battery. Now obtain a plate of sheet copper, and place this also into the marmalade jar with the carbon, but at the opposite side of the jar. Care must be taken that the copper and carbon plates are exactly opposite each other, and that they are not in contact. A wire must be connected to the copper plate, and also to the *copper* of the Daniell battery. After charging the Daniell cells, also place about 3oz. of crystals of copper sulphate in the jar with the copper and carbon plates. Now pour in some water, which should be on a level with the height you wish to copper the carbon. You will find that the side of the carbon next the copper plate will be coppered first, and when the coating is thick enough turn the carbon round, and when it is sufficiently coated on both sides (which will take several hours to accomplish) the carbon can be taken out of the bath, and all the solution of copper sulphate washed off the coppered portion; and when this is quite dry, paint it over with spirits of salts, and place a piece of fine solder on the surface, and with a soldering-bit proceed to carefully float the solder over the sides, edges, and top of the coppered part. Great care must be taken to see that the soldering-bit is not too hot, or it will cause the thin coat of copper to blister and peal off the plate, thus rendering the whole process useless. Now a lead cap can be easily cast to the top of the plate, a terminal being held in contact with the plate while the lead is being poured into the mould. When the lead is cool, the terminal will be firmly and permanently connected to the carbon. The lower part of the terminal may be previously tinned, which insures perfect contact throughout. As the moulding process would take up considerable space were I to describe it fully to you, I cannot occupy more of your space this time; but should you require this subject more fully explained, and if our Editor will allow me, I will send instructions as to the way in which I prepare my carbons and cast on lead caps; and as I have never had a faulty plate since adopting my present method, it may be of some slight service. To prevent the salts creeping and attacking the lead, I coat the lead cap, and 1in. below it, with a mixture of rosin and pitch, which, when well floated over the work with a warm iron, makes really a first-class job of the plate, and effectually prevents the salts creeping up.—Sergeant Arthur Sharpe.

[48429.]—**Garden Bed.**—If $A\ B\ A^1\ B^1$ is the elliptical bed, whose foci are $S\ S^1$, a walk can be made round it having the same shape. If the walk is to be 2ft. wide, set off this distance from A and B on the major and minor axes produced. With the centre *b*, and the distance C*a*, describe a circle cutting the major axis in $s\ s^1$. With these foci, and $a\ a^1\ b\ b^1$ for axes, the required ellipse can be described parallel to the bed.—F. O'D. Hoare.



[48431.]—**L. and S.W.R.**—318 cylinders 17 by 24, 5ft. 8in.; "Castor" cylinders 17 by 22, 7ft. The cylinders of "Castor" were originally 17in. diameter; they may now be 18, but as to this I am not certain. I believe the "Castor" class run the expresses on account of their having 6in. more on the driving wheels, the bogie engines having 6ft. 6in. drivers.—Clyde.

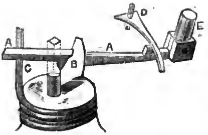
[48431.]—**L. and S. W. Engines.**—The cylinders of bogie tank No. 318 are 17 by 24, coupled wheels 5ft. 6in., cylinders of No. 96 "Castor" 17 by 22, coupled wheels 7ft. The express trains are taken quite as much by the new bogie engines as by the "Castor," &c., class; but the latter being more numerous it may appear that they run them more. The latter are greatly inferior in power to the bogie engines.—W. B. P.

[48433.]—**Cleaning Clocks.**—Why do you use cutting stuff for cleaning clocks? You had better wash the clock in hot soap and water, and then proceed as follows: Rub some salad oil, or common oil, over the parts of the clock, then place them near a fire until they get hot, then, while you hold them in a piece of rag, brush them with a brush, which has been previously dipped in paraffin, or benzoline oil. This will remove everything excepting the polish, then, with a dry brush and some soft chalk, make your clock look like new; the holes are cleaned with strips of good print, drawn to and fro in the holes, and then finish with pegwood.—A Fellow-Workman.

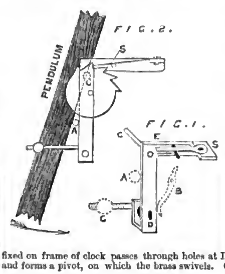
[48434.]—**Single-Needle Telegraphs.** — The bottom of your needle is not heavy enough, and the pegs are too wide apart, perhaps.—H. Stooke.

[48434.]—**Telegraph.**—The difficulty you mention does not arise, it seems to me, from the lightness, or otherwise, of the needle. What you call the pointer is the "needle"; the magnet is between the coils on centre of spindle. The fault is in the commutator, since it stands to reason that as long as the electro-magnet (the coils) is excited with the current there can be no vibration of the magnet. Take a common permanent magnet, and lay it on a table or hold it in your hand, swing the armature (or holder) by a piece of thread, and let fall against poles; it will not rebound, but adheres at once. So should the magnet lie over against banking-pin as long as a current circulates in coil. Examine roller in commutator; see that contact-pins above and below (that is, earth and line) just make contact and a circuit, and no more; the springs to line and earth, making a complete circuit, should be strong enough always to press against roller when handle is moved. The rebounding of your needle is caused by *two* impulses,—that is to say, the contact is not perfect, but is broken and then renewed. Of course, the needle ought to be the lightest possible, for I have seen a needle which was weighted so as to overpower the current in the coils.—Scotus.

[48436.]—**Clock-Cleaning.** — A is stopwork: B is the blade on fusee; C is the line which raises stop A; D is a spring which is screwed to front plate, which keeps stop away from blade B, when the clock is not wound up; E is the stud in which the stop works, and is riveted in the plate; you will, therefore, observe that as the line travels (from the barrel) up the fusee, it raises the stop until the blade B enters the notch, as shown in drawing.—A Fellow-Workman.



[48437.]—**Electric Clock.**—A piece of sheet-brass is cut and bent, as per Fig. 1, E. A pin fixed on frame of clock passes through holes at D, and forms a pivot, on which the brass swivels. G is a pin fixed on E, which is struck by pendulum as it swings, and thus causes E to rock on D. A is a stop fixed to clock-frame. E is held up to A, either by a spring B, or by a balance-weight C, preferably the latter. S is a spring which serves as a ratchet to move 'scape-wheel, as shown in Fig. 2. Stop A must be fixed so that one tooth only of 'scape wheel is moved, no matter what swing of E may amount to. 'Scape-wheel may drive the other wheels, either continuously, as in an ordinary clock, or by once in every revolution, as in a gas-meter dial. A click is attached to clock-frame, and clicks on teeth of 'scape-wheel to prevent the latter turning wrong way. This click is omitted in sketch.—Glatton.



[48441.]—**Case Clocks.**—The faults you complain of in the old-fashioned clocks can with certainty be located in the escapement, and it is there you must look for the failing. When the pallet holes wear large the pivots are, by the action of the escape-wheel, thrown upwards at one beat and sideways for the other, and so on in repeated order. This occasionally permits a sort of tripping upon the teeth of the escape-wheel, and so produces an irregular and jerky beat; or, as you say, makes a few jumpy beats and then stops altogether. Remedy—Close up the holes, or put bushings in. Again, the escape-wheel may not be true in the round, or, a tooth or two may be bent slightly forward or back from pitch line, and so causes an uneven drop. Remedy—True up the wheel as required, and correct the drops. Also, the pallets may be found loose upon the staff (as I will call it) if they are fixed to the collet with a screw, as many are. This error, in conjunction with an uneven drop or untrue wheel, would cause the beat to be at one moment right and at another wrong. Remedy—make the pallets and incorrect parts perfect and secure. Now, there is another fault, and one, too, often ignored by other than amateurs and apprentices; and I make particular mention of it because from neglect to correct it, much trouble emanates. The part I allude to is the "leader" and "crutch," the "crutch" being the forked arrangement which moves the pendulum to and fro. It is a very common fault to find a large amount of play between the pendulum bar and the sides or chaps of the crutch, and is especially noticeable when the clock has been running for a long period of time. In looking at the action of a clock possessing this fault, it will be seen that the crutch gives a jerk at each beat, and produces a sound audible to the ear. It is just the same where the pendulum bar has a slot in it, and a pin is attached to the "leader." In the common Yankee and German clocks, even when new, this fault is by no means of rare occurrence. Its effect is to prevent a sufficient vibration of the pendulum, after each impulse from the escape-wheel, and I have frequently found clocks that would not go start off and do good work when this seemingly trite error had been corrected. There should be only just enough freedom to prevent any touching on one side of the pin or crutch when there is contact on the other. That sufficient importance is not attached to this I well know, and so little does the action of the escapement seem to be known to outsiders, as I have observed from some of my customers' remarks—that I veritably believe some people think the pendulum makes the clock go, instead of its being the other way about. I must not go into the subject any further just now. If I can find a convenient opportunity in the time to come, I will do what I can to comply with the desire of "Blue Gown" in writing a few short papers upon the work of cleaning and repairing clocks. This is a conditional promise only.—Alfojoe.

[48454.]—**Railroads**—"Glasgowegian" will find a short account of the Oroya railway in "South America," by Gallenga, published by Chapman and Hall. The height given by him is 15,000 to 16,000ft. above sea-level; the gradients are "3 to 4 per cent." Page 113.—D. H. W.

[48455.]—**Bath Boiler.**—"Glaswegian" had better make a small cross-tube vertical boiler, 9in. by 4in., with about eighteen ½in. tubes. Set up on the flow and return principle, as near to bath as possible.—A. Hughes.

[48455.]—**Bath Boiler.** I would advise "Glaswegian" to get one of "Fletcher's Patent Radial Bath Heaters," heated by gas. It makes no smell or steam in the room; it also helps to keep the room warm, dry towels, &c. It can be kept ready for immediate use, and costs less than a penny for twelve hours.—Nomen.

[48455.]—**Bath Boiler.**—If the lower or main bath is an iron one, with pump or other means of raising the water to the shower cistern above, the best and cheapest means of heating will be to get one of Fletcher's solid flame burners, and a flexible tube; place the burner under the bath, light it, and the bath will be ready for use in about 30 minutes when nearly half-full of water. Of course, the more water required or the hotter the water, the longer time required to prepare it.—Boswell.

[48458.]—**Finishing Wrought Iron.**—To my fancy there can be no better finish to wrought-iron work than the clean finish that a spring tool and soap-and-water makes. The graver, if sharp, and held flat against the work, in hand-turning, makes a splendid finish, if moistened with the mixture. But in slide-rest and saddle work, a properly-adjusted spring tool, whose cutting edge is level and parallel to the centre-line of the lathe, and has a piece of thick indiarubber in the bow, a slow speed and thick soap-and-water produces a polish that no emery nor lapping can do. But in work that can only be done in the vice, finish with a small dead-smooth file, moistened with oil. Take out every ridge, however small, for polishing only magnifies defects in workmanship. Then polish with No. 2 emery-cloth and oil, wrapped round the file; finish with flour emery. Burnished articles are got up, after polishing or scraping, by means of a burnisher, which I usually make by selecting an old file, of whatever shape may suit my purpose, grinding all marks from its face, then well polishing. This, borne hard upon the work, and used as a draw-file, will burnish to your heart's content.—Fred. Walker.

[48463].—**Measurement of a Degree on the Earth's Surface.**—"M. I. C. E." has forgotten that, in the matter of the length of a degree of a meridian on the earth's surface, the degree is the angle between the horizons or the plumb lines at the two stations, and not between the radii drawn from the centre of the earth to the two stations. Since the earth gets flatter, or its curvature is diminishing, as you proceed northward, it is necessary to advance a greater and greater distance in order to make the plane of your horizon change by one degree. It might be said that a "degree of a meridian" naturally refers to the angle between the lines drawn from the centre of the earth to the two stations; but this angle cannot be directly ascertained by observation.—Dubliniensis.

[48465.]—**Gas-Tar.**—I was troubled in the same way, but got out of the difficulty, by immediately after tarring, riddling over the surface a mixture of fine ashes and sand. As to this tar for tarpaulin, my brother (who is in the trade) says it does not do at all; the chemicals in the tar appear to burn or destroy the fibre of the canvas. Stockholm tar, boiled and mixed with whale oil, applied evenly with a brush, is the correct thing to use.—A Member of the Society of Engineers.

[48474.]—**Model Cutter Yacht.**—The frames may be fastened to the keel by slender wood screws, passing from above downwards through the floors, as the bottom timbers are called. If the model is to be left bright, English oak will be best for the outside planking, pitch-pine for the deck, masts, and spars (if any), and teak for the rail, bitts and coamings of hatchways. Oak can be bought in London, sawn, from ¼in. thickness and upwards, from the hard-wood merchants. There are four papers on model yacht-building in the fourth volume of "Cassell's Household Guide," which "G. F. L." would do well to refer to. These papers are fully illustrated, and comprise the sheer, draught, half-breadth, and body-plans of a fast-sailing cutter yacht to scale, from which "G. F. L." could easily get out his working drawings.—Robinson Crusoe.

[48480.]—**Calculating Weight of Copper Leads.**—I have not a rule for this that I can give at present. I have been considering the subject latterly, and may give some information thereon some of these days. It is not a matter for cut-and-dry directions.—Sigma.

[48481.]—**Rigging Boat Yawl.**—"S. S." must give the nautical readers of the "E. M." more particulars of his boat before they can advise him on the style of fitting her out. The word "yawl" signifies the rig, and not the build of a boat, and a boat 25ft. long, may be a light open gig of 4ft. beam and 2ft. depth, a sea-going lugger, or a 4 or 5 ton half-decked cutter. If "S. S." will give the dimensions, and further particulars of his boat, and state whether she is for use on a tidal river, obstructed with bridges—a lake, or the open sea, no doubt he will get some excellent counsel as to her rig and fittings. Water ballast is seldom used except in large sea-going steamers to replace the weight of coal consumed. It is too bulky and cumbersome for a small boat. Iron in the shape of old furnace bars or pigs, or clean shingle in canvas bags of about 56lb weight are commonly used. A steering wheel in a small boat would be very unadvisable, as the helm has often to be put hard up or hard down in a hurry. With a tiller this is done in half a second, with a wheel it takes about half a minute.—Robinson Crusoe.

[48493.]—**Gas Stoves.**—I have tried the stoves mentioned by your correspondent, "Hayling Island," both in my workshop and library, and I find them most useful and economical. The one I use in my workshop gives both light and heat, that in my library heat only. They each consume about 6ft. of gas per hour, certainly not more, at a cost to me of little over one farthing. Like "Hayling Island," I also used unprotected gas-lights to work with at night, and was much troubled with condensation on my lathe and tools in consequence.

Now, however, I obtain equally good illumination with a Ritchie's "Lux Calor," to which I have adapted two reflectors which throw the light on any spot desired, and all my trouble from condensation has vanished, and my lathe and tools are kept in capital order. The system of this stove, which absolutely requires no flue, is ingenious and effectual, and appears to eliminate all the noxious results of gas combustion, except perhaps a trace of carbonic acid, which must be so small as to be imperceptible in any room with a door and window. It is probably this defect, as it may be called, that recommends the stove for use in greenhouses and conservatories; but on this point I have no experience. All I can say is that I have had the two, as described above, in constant use for over two years, and find them admirably suited for the purposes required, and quite free from all the objections and annoyances invariably caused by the use of gas.—Amateur.

[48495.] —**Sharpening Steel Points.**—They are generally used wet with water.—Nomen.

[48497.]—**Plating Brass.**—"T. F. C." can easily tin his brasswork by dipping in soldering fluid, then into melted tin. If that will not suit him, and he chooses to advertise his address, I will tell him how I silver-plate things without either a battery or heat.—A. Hughes.

[48498.]—**Hardening Brass.**—"T. F. C." cannot harden brass except by hammering or pressure; he should buy his wire a few sizes too large, then rig up a draw-bench, and draw to the required size; he will then get it as straight and hard as he chooses.—A. Hughes.

[48498.] — **Hardening Brass.** — Can't you straighten them by drawing through a hole in a steel plate, and so harden at same time? At any rate, that is how to harden those you have softened. Must they be made separately, instead of being cut off from long lengths.—T. M. P.

[48501.]—**Scale in Boiler.**—The advantage gained by removing the scale is so great, and the cost of a few gallons of petroleum is so little, that "J. O. E." could not do better than try a few tubes (say 3 or 4) and report the result to this paper, for the benefit of all. As I am daily engaged among boilers, I would be glad of any new "wrinkle" which may be found, particularly with petroleum or other oils, as I never found anything good in their use. I should also be glad to know the object sought by following instructions given by "Jack of all Trades," in answer to 48380, as it cannot possibly prevent formation of deposit, but it would tend to make it stick to boiler and cause overheating; and I am sure it could not prevent corrosion. Of course, I am only speaking as far as my experience leads me, being that of a practical boilermaker with nearly 10 years' experience as inspector.—Boswell.

[48504.]—**Roman Candle Stars.**—You cannot make stars out of your composition. Camphor is no use, and may be the ruin of some colours. The means of mixing them vary with the nature of the compositions. Shellac in spirits of wine, starch, gum-arabic are all used. You cannot do better than get "'Practicus' on Pyrotechny," which was advertised in this magazine, and will tell you all about it.—J. F. E.

[48507.]—**Sky-Rockets.** — Your composition seems altogether too strong, but you do not mention the diameter of your rockets. All rockets require a cavity in the charge, which is the size of the orifice at the mouth, and half that size at the other end. I suspect this is what you call a choke, but choking proper is now very frequently abandoned, and clay-stopped mouths used instead. See answer to No. 48504.—J. F. E.

[48507.]—**Sky-Rockets.**—In answer to "Glen's" query as to sky-rockets and coloured stars (48504), I inclose the following extracts from Spon's "Workshop Recipes," slightly abbreviated: "The sizes of rockets are indicated by weight—i.e., ounces and pounds. Thus we say an eight-ounce rocket, a pound rocket, &c. By this expression it is not meant that the rocket itself weighs this amount, but that the bore or cavity will just admit a leaden bullet of that weight to pass down them." Rocket cases are made of stout brown paper, as I dare say you know. All rockets must have a choke, which is made as follows: "To choke the case, draw the former partly out, until you can see about 1in. of the inner cavity of the case, then put on the second joint (the wire of which fits into the hole in the former) and push it in until its end is about ½in. within the case, leaving a space of about ¼in. between the two joints occupied by the wire alone" (Fig. 1). Then turn a strong cord once round the case where the cavity is and pull it tight. When sufficiently compressed tie it with strong twine. You ask about an inner empty case in the rocket—there is not exactly a case, but a cavity (the size of the hole at the choke), running about ⅔ the length up the case. This is formed as follows: "The rocket mould is represented at Fig. 2. It consists of a solid foot of wood; upon the centre of this stands a short cylinder about ¾in. high and exactly the size of the mould to be placed over it, as afterwards described; this short cylinder has a shoulder above and terminates in a round top. Out of the middle of the top is a tapering thick brass wire projecting some inches upwards (about ⅔ the whole length of the case as before stated). The whole is so arranged that when one of the new cases is put upon the wire and forced down, the wire fills up the choke-hole, the round top fits into the small part of the case below the choke, the shoulder of the cylinder bears the extreme end of the case, and the short cylinder agrees in size with the outside of the case. There fits over this (case and all) a strong wooden or metal tube, so that there is no cavity but the inside of the rocket-case, and inside this the wire projecting upwards. The composition is rammed in with rammers, made of hard wood (Fig. 3) with a cavity to admit the piercer." The rocket-case is put over the piercer, and the tube is put over all, so that however hard the compo is rammed in there is no fear of bursting the case. *Rocket Composition*—Saltpetre, 12oz.; charcoal, 6oz.; sulphur, 4oz.; meal powder, 1oz. Smaller quantities in like proportion. After the rocket-case is filled the cavity left by the piercer is filled up with meal-powder, made into a stiff paste with spirits of wine. *Compo for Rocket Stars: Red Stars*—Chlorate of potash, 24 parts; nitrate of strontia, 32; calomel, 12; sulphur, 6; shellac in powder, 6; sulphide of copper, 2; charcoal, 2. This is a formula given in Spon's, but I have found that ordinary coloured fires will do as well. They should be slightly moistened with spirits of wine, and rolled into balls about the size of peas. Roman-candle stars can be made in the same manner, but should be cylindrical instead of round, and fit the case they are intended for. They may be about the length of their own diameter. Reference to sketch:—A, brass tube; B, case; C, piercer.—Grapho.

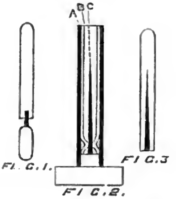


FIG. 1. FIG. 2. FIG. 3

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47818. Horizontal Windmill, p. 604.
47825. Dandelion Beer, 604.
47832. Nickel Analysis, 604.
47836. Pott's Patent Irons, 604
47841. Sifting Machines, 604.
47845. Canaries, 604.
47851. Photography, 605.
47858. Deep Sea Cables, 605.
47873. Revolving Shutters, 605.
47874. Plastering Rooms, 605.
47876. Irish J. P.'s, 605.

48082. Simple Eccentric Link Motion, p. 98.
48097. Egyptian Railways, 98.
48102. Dynamo, 98.
48107. Tin and Zinc Work, 98.
48116. Cigarette Making, 98.
48117. Electro-Plating Solution, 98.
48136. Eczema, 98.

To produce "crackle" surface glass, a French inventor, M. Bay, covers the surface of a sheet of glass with a paste made of some coarse-grained flux, or easily fused glass, and placed on a table in a muffle, and subjected to a high temperature. When the coating is fused the sheet is withdrawn and rapidly cooled, and the superficial coating separates itself and leaves the irregular surface. By protecting some parts of the glass from contact with the flux, designs and lettering may be left in smooth glass.

QUERIES.

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[48508.]—**Stains in Sulphur Bleaching.**—For some months past in bleaching woollen or cotton goods by stoving with burning sulphur, a large number of pieces have come out of the stoves bearing light yellow stains. These stains on drying destroy the fibre and render the fabric rotten. All possible means have been tried to detect and remove the cause, but without success. As I believe this is a complaint not confined to us, perhaps, some correspondent of "ours" may have heard of a remedy. The pieces before stoving are milled with fuller's earth and afterwards scoured.—Bramelia.

[48509.]—**Varnish or Polish.**—Is there any proof against the heat of a teapot or jug filled with hot tea or hot water? I have an oak tea-tray polished or varnished. Standing a teapot full of hot tea, and a jug full of hot water on it has marked it and, so far, spoilt its appearance. I should be glad to know if there is any varnish or polish with which the tray may be varnished or polished, and which will be proof against marks occasioned under the above circumstances. I should prefer not to alter the colour of the oak or hide the grain of the wood. I have noticed that lacquered tea-trays are not affected by vessels filled with hot water being stood on them. I do not know it lacquering can be effected on oak, or what effect it would have on the colour or grain of the wood. Any information on the subject of this query will be thankfully received.—O. L.

[48510.]—**Electro-Motor.**—To Mr. Lancaster or One of "Ours."—I want to make an electro-motor to drive a small blowing-fan. Would you kindly give a little instruction how to proceed, the best style of motor for the purpose, size of magnets, quantity and size of wire, silk or cotton covered should it be, if insulated and what with, the quantity and size of Bunsen batteries required to drive it, or if there is any other battery more suitable? I have got a quantity of Bunsens by me, half-gallons. Please state about the cost of battery power per week (say 10 hours per day). The size of the revolving fan is 10in. dia.; number of revs., 4,000 to 4,500 per min.; dia. of discharge, 5in.; dia. of pulley, 2in.; breadth of strap, 1½in. A small sketch would make it more clear, if not giving too much trouble. I would have used a small steam or gas-engine, but am not allowed, the premises not being my own.—J. A. W.

[48511.]—**To Mr. Wetherfield.**—I find in the "E.M." of Oct. 20th, reply 48284, you only partly answer my question. If the road is to be 30 or 40ft. wide, as the case may be, can I build my fence 15 or 20ft. from the crown, or am I to measure 30 or 40ft. from the fence at the other side as a line to build my fence? I see, by an extract for the better management of highways in England, 29th July, 1864-51, no road to be less than 30ft. wide, and no fence to be built less than 15ft. from centre of road. Is there any other Act since then touching upon that point or any power given to the local authorities (i.e., board) to make any alterations in the roads what width they think proper?—J. Ryall.

[58512.]—**Steam Fishing Vessels.**—This is a type of vessel which has not yet come into use to the extent which, taking the enormous traffic carried on by the ordinary fishing vessel, it should occupy; and as this is a subject which will, no doubt, interest a considerable number of readers, I will feel obliged by any correspondent giving full details as to the size of vessel, engines, &c., stating the horse-power required, and coal which an ordinary size vessel would need; also stating what men would be dispensed with by the using of steam instead of the present slow-going method of fishing. Would it not be a safer vessel for the fishermen, as they could run into port, instead of being caught continually in storms, thereby causing great destruction of life and property; and it should be more economical and ultimately lead to an increased trade in fish, and fish would be brought to port in better condition.—Saltwater.

[48513.]—**Geometrical.**—Given an infinite plane revolving on an axis perpendicular to the axis of an infinite cylinder. What will be the equation of the curve traced by the foci of the varying ellipse formed by the intersection of the plane and cylinder when the former is made to revolve? The axis of cylinder and the perpendicular thereto in the plane cut by the major axis of the ellipse being referred to as axes of co-ordinates. Also, what will be the equation of the curve under similar conditions when a cone is substituted for a cylinder?—W. A. H.

[48514.]—**Bichromate Potash.**—I should feel obliged to any of your correspondents who would give me an outline of the manner in which bichromate of potash is manufactured: not a method which has been exploded for fifty years, yet still is quoted in books, but the *bonâ fide* process, by means of which the thousands of tons sold in this country is made. The method pursued some twenty years ago was to roast in a proper reverberatory furnace the requisite proportions of chrome ore, carbonate potash, and for the purpose of keeping it open and porous, slaked lime. This mixture, after sufficient furnacing, was exhausted by means of water, furnishing a solution of neutral chromate potash. One-half the potash contained in this was taken up by means of sulphuric acid, forming sulphate potash, which fell out from its comparative insolubility, leaving bichromate in solution to be evaporated and crystallised. The sulphate potash was then worked up into carbonate for another operation by the ordinary Leblanc process. There have been many patents for improved methods, some of which carried failure on their face; but have any improvements of real practical value been made? Should my inquiry lead to a reply from one who practically understands this manufacture, it might lead to more queries, for which a reasonable fee would be paid.—A. B.

[48515.]—**Resistance of Wire.**—Will someone be good enough to state the respective resistances—in ohms or otherwise—of 1 pound of cotton-covered wire, Nos. 12, 14, 16, and 20?—C. P. M.

[48516.]—**Dividing Circles.**—Having to divide my indicator dials, which are circular, into unequal divisions, and then divide these divisions into tenths, I find great difficulty in doing so quick. As a rule it takes me about 30 minutes for each, and having sometimes 40 or 50 to do, it becomes very tedious. Could some of our mathematical friends inform me of an easier plan, or of some instrument I could fix over the divisions and divide them at once?—M. F. I.

[48517.]—**White Metal.**—Will some practical reader kindly give me a recipe for a white metal that will turn well in the lathe and not clog as is usual with soft metals—it is essential that it be hard and tough?—T. F. C.

[48518.]—**Painting on Enamel.**—Having to paint lines and figures on enamel without any experience, I shall feel obliged if some of your readers will kindly give me instructions how to proceed.—M. F. I.

[48519.]—**Gearing.**—Would some correspondent kindly give me a description of Hedge's belt frictional gear with strap-tightening apparatus, with figure if possible, or any other strap-tightening apparatus they may know of?—P. H. N.

[48520.]—**To Mr. F. Wetherfield.**—Could you kindly inform me when the Agricultural Holdings Act came into operation? And if a farm lease granted prior to such Act would be prejudiced thereby?—Farm.

[48521.]—**Harmonograph.**—Will any of our contributors give me a rough sketch which would enable me to make one of the above? I do not want to go in for an elaborate affair, but merely a simple piece of apparatus which would cost a few shillings to put together.—Civil Engineer.

[48522.]—**Polishing White Wood Plates and Boxes.**—I should be glad to know the best way to polish the above after I have painted in water-colours thereon. I know how to varnish, but prefer the polish. What polish is required, and how is it applied?—B. T. B.

[48523.]—**Instantaneous Shutter.**—To Mr. Lancaster.—Would you be so kind as to try and help me about following?—I have just purchased a rather expensive instantaneous shutter; it is made of two thin plates of metal, the hole opening and shutting in the centre of lens, actuated by a rubber band. When I take a photo, it always comes out on development double, and rather thin. The stand I use is a light ash folding portable tripod. The lens a Ross 5 × 4 rapid symmetrical; plates, Wratten's "London"; instantaneous shutter by Browning.—J. H.

[48524.]—**Photographic.**—I have a considerable quantity of a mixture containing old used developing solutions, gelatine negative fixing baths, and silver print fixing solutions; in the whole lot a quantity of silver worth saving exists in some form or other. Will any of "ours" kindly give me full instructions how to reduce and separate the silver from the solution? I prefer to obtain it in the metallic form, and wish for a process as simple as possible. Also, how can I best obtain gold in a metallic form from old toning baths?—F. Yelwoc.

[48525.]—**Faraday's Law of Electro-Magnetic Induction**—Is thus stated: "If a wire be moved in the neighbourhood of a magnet in any direction, except along a line of force, a difference of potential will be produced at the ends, which, if the ends be connected by a wire not acted on by the inducing magnet, will cause a current." In this rule nothing is said about variation of magnetic field being necessary. Being rather confused by these conflicting statements of skilled electricians like "E." and "Humble Bee," I should be much obliged if someone would tell me which is right and to what extent?—Perplexed.

[48526.]—**Cyclops Fans for Organ Blowing.**—Will Mr. John Watson Warman, or some other professional gentleman, advise me as to whether Cyclops pressure fans will answer for supplying wind to an organ bellows in place of the ordinary feeders? I have a gas-engine with which I intend to blow my organ. Shall I work the feeders in the usual way or put in a fan? I am inclined to think that a fan would give a steadier supply of wind, but should like advice before proceeding further.—C. B.

[48527.]—**Electric Clock.**—To "Glatton."—From "I. J. C."—I thank you for your reply to query (47910). I have succeeded in getting my clock to work and to keep passable time. I have reduced and altered the piece of metal on pendulum-rod until I have the surface ⅜in. wide, when I get the best results. Your hint to have the pendant on one side of the vertical of pendulum-rod, I think has helped me much. I have it now to make contact in about every five oscillations. I should like to make more oscillations (say, ten), and as I am about to take it to pieces to have brasswork cleaned, I shall have the face enamelled. It has been silvered, but I prefer it being enamelled. Can you tell me where I can have it enamelled? Also, how to regulate the number of oscillations between each contact-making? At present the armature is ¼in. from electro-magnet; but I mean to put it as close as possible, when I again put it together.—I. J. C.

[48528.]—**Bee Skeps.**—In the spring of last year I bought some elm-boards for Bee Skeps, of an undertaker, and after screwing some legs to them, put them into use, but they warped so, that I was obliged to disuse one at once, and another, as soon as possible; bulging up in the middle. The boards are round, with a projecting piece, for the bees to alight on, and being for large skeps they measure 20in. across, and are made of 1in stuff. Since they have been in use I have screwed two strips on the bottom of each, and have tried weighting them, but without avail, and as they cost 1s. 6d. each, I wished to cure them, if possible.—Amateur Mechanic.

[48529.]—**Vacuum Lamp.**—Writer wishes to make a Ruhmkorff's induced current v. lamp, and will be glad of answers to following: 1. Size of tube required for light of 2½ to 5 candle power. 2. Name and quantity of gas. 3. Size of coil required. 4. Number of small (2½in. long) coils required instead of large one. 5. If condensers required, how made? 6. Diagram to show connections of small coils. The battery would be a half-pint one filled with granulated zinc and carbon in respective pots. Acids as per Grove's couple. The form required for the lamp is a tube of, say, 1in. diameter, 2in. length, or proportional size. Which would be better, the small coils or one large one? The latter would be better adapted for regulating the power, and (?) more portable.—Thor o' the Hammer.

[48530.]—**To Dr. Edmunds.**—A woman aged 73 has a swelling in her left arm, extending from the shoulder to the fingers. It has been coming on for the last two years. There is no pain or annoyance, only the inconvenience of the arm being half as large again as the other. She has good health, walks well, eats well, abstemious in her diet, drinks a glass of cider at dinner and one at supper, rather subject to diarrhœa, never alludes to the swelling, and will not see a doctor. I asked one to look at it and give me a private opinion. He says it is a venous affection, not dropsical. I shall feel much obliged if Dr. Edmunds will say what he thinks of it; whether it is likely to disperse, or what it will end in?—Angelus.

[48531.]—**To Engineers.**—Would any of your readers suggest to me a movement by which I can propel a travelling plate? It is required to progress step by step—i.e., with a momentary rest, say, every 2in.—Rydal Mount.

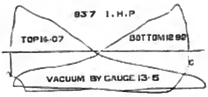
[48532.]—**Nitrate of Lead.**—How can I make nitrate of lead on as small a scale as will pay commercially?—Chas.

[48533.]—**Angles of Pyramid.**—I should be obliged if any of your readers could give a formula for finding the angle in a regular four-sided pyramid made by the sides with each other.—One Puzzled.

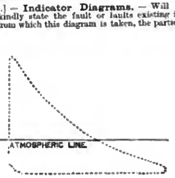
[48534.]—**Copper Boiler.**—Will any practical reader answer the following questions? viz:—Thickness of copper best suited for boiler 24 × 18, proper number of tubes, and best means of fastening same in. Suggestions will be thankfully received by—Amateur.

[48535.]—**Varnish.**—Would "R. J." (see reply 48369) say how he makes his varnish, and the quantities and cost of material?—Delta.

[48536.]—**Indicator Diagrams.**—Would any of our engineering readers tell me the cause of the loop in the diagrams? And, how to remedy them?—Fixer.



[48537.]—**Indicator Diagrams.**—Will some reader kindly state the fault or faults existing in the engine from which this diagram is taken, the particulars of engine being—length of stroke, 2ft. 9in.; revolutions, 80 per minute; cut-off at ½ stroke. Engine horizontal and condensing?—F. C. D.



[48538.]—**Plumbing.**—Will any of your readers tell me how to make a plumber's (or egg) joint? And, also, how to put on a brass tap properly? I can manage everything that can be done with the copper bit. I shall also want to know what solder or metal to use.—A. A.

[48539.]—**Electric Indicator for Tank.**—Could any reader tell me how to make an electric indicator for telling when a tank is full? I can make the indicator show how many inches there are in the tank when pumping; but I don't know how to make the pointer return when water is drawn.—R. H. Roe.

[48540.]—**Coil for Transmitter.**—Can anyone tell me how to make a coil for a transmitter with size and amount of wire?—R. H. Roe.

[48541.]—**Measurement of the Height of Waves.**—I shall be obliged if any of your readers can give me information on the most practical and accurate manner of measuring the height of waves? Information is also requested as to whether there exists any self-registering instrument for measuring the heights where the waves break on sea-wall in harbours.—Inquirer.

[48542.]—**L. and N.W.R. Locos.**—Will "Prometheus" kindly oblige with further particulars? Distribution of weight, Constance, 817; and Nos. 1121 and 2230 classes. I always was under the impression that Puck 819 had cylinders 16in. × 22in. Also, can "Prometheus" or anyone else give particulars of No. 1820?—Carstairs.

[48543.]—**Gresham's Automatic Vacuum Brake.**—Will Mr. Stretton, or any other authority on continuous brakes, oblige with description of driver's brake valve and ejector of the above brake, as lately fitted on the L. and S.W.R.?—Clyde.

[48544.]—**Drilling-Engine.**—I have a drilling-engine with self-acting feed. The drill obtains its feed by means of a long screw which is in the inside of a brass barrel, so that when the barrel makes one revolution the screw does also; and the nut that regulates the feed is going round the same way and same time as the screw. The barrel and the nut are worked by spur-wheels connected immediately to crankshaft of the engine. The numbers of teeth in the wheels are:—The one on the crankshaft that drives the nut 17, and the one on the nut 42; and the one on the crankshaft that drives the barrel 12, and the one on the barrel 21; the pitch of the screw is 4 threads to the inch. Will any reader give me a rule for finding out how many revolutions of the engine to a foot in length of screw? And, as I do not understand algebra, please work it in a form that I can understand.—J. T. B.

[48545.]—**Discharge from the Ears.**—To Dr. Edmunds.—My little son, age 7½, has suffered for some years from the above, and also from severe headaches, arising, I suppose, from the same cause. He has just been through attacks of chicken-pox and whooping-cough at the same time. He is now at a village in Ireland without medical advice. As I am in England I am anxious about him, and should be very grateful for any hints for the treatment of his case. He has taken cod liver-oil at various times, and has now plenty of milk and eggs. I fear the disease is spreading internally. What domestic treatment will ward this off? Is there any hope of his out-growing it? He is slow, but intelligent.—T. Cox.

[48546.]—**Induction Coil.**—I have constructed an induction coil as described by J. Sutcliffe in the English Mechanic for Nov. 25, 1881, substituting, however, cotton-covered wire for the silk-covered. Each layer is separated by a sheet of paraffined paper, and the whole thoroughly soaked in melted paraffin. At first it gave a spark about ¼in. long, but since then it has failed to give any spark. I have reason to believe that the insulation is not perfect. Is there any way of making it more perfectly insulated? Or, will it be necessary to unwind it? Would it be more likely to be successful if wound in sections?—No Name.

[48547.]—**Cording Machine.**—Could any reader of your paper give me some idea how to construct a machine for the purpose of putting cord on to an article, which, in its newly-made state, is about 16in. long and 3in. in diameter? It is compressed by the cording to 1¼in. diameter, with a stretch of an extra couple of inches in length. The article is pliable and easily bent. In the meantime it is done by hand, and is rather tedious work.—Inquirer.

[48548.]—**Steam-Engine.**—I am about buying a steam-engine for the purpose of driving a circular saw. I shall want to cut up to 9in. stuff, and should like to cut 11in. planks. Will someone kindly tell me what is the smallest horse-power I can manage with to do the work well? Are vertical or horizontal engines best, room not being limited? Is a horizontal cylinder more likely to wear sooner than a vertical one? Is a riveted or welded boiler considered the safest? And, what construction as to tubes, &c., is the best? What pressure should the boiler be tested to? Whatever horse-power required, please state size of boiler required, and probable working pressure. Any other particulars would oblige—Steam Engine.

[48549.]—**Steam Boiler.**—I have a small steam boiler new 6ft. × 18in., manhole 9in. × 6in., with ring round, ¼ iron plate, riveted seams. What is the bursting pressure? I have been told I can safely work it at 100lb. to the inch. Which would be the best water to feed it with—rain or clear brook water (no limestone about here)? How often would it want cleaning out, using it 24 hours per week?—W. W. W.

[48550.]—**Bricks, Tiles, and Kilns.**—Will some of your readers kindly inform me whether there is any good treatise on making bricks, tiles, and common earthenware, and on the erection of dome-topped kilns?—H. G. B.

[48551.]—**To "A. S. L."**—Please send description of equatorial stand mentioned in letter 20609, as I have just finished a 3in. telescope?—C. J. E.

[48552.]—**Electric Bells.**—How can I make single-stroke and continuous-action bells? I can make the ordinary kind. Also, how to test solid paraffin for insulation?—C. J. E.

[48553.]—**Oval Mounts.**—Will someone kindly instruct me how to make an instrument for cutting out oval card mounts for pictures—bevelled edges?—E. S.

[48554.]—**Determination of Carbon in Cast Iron.**—Will any practical analyst kindly explain in detail, the simplest correct and expeditious method for the determination of carbon in pig-iron—such as is used for the manufacture of steel?—A. B. C.

[48555.]—**Fire-Lights.**—Will some of your readers inform me how fire-lights are made, and what appliances would be required for that purpose? As I have a large quantity of saw-dust and rosin by me (of which I believe they are made), and it is cheap in this country, I think it might be made use of for that purpose to advantage.—Thos. Gilbert, Timashava, Russia.

[48556.]—**Pellety Castings.**—I work for a firm who employ some moulders' iron, and when the work is finished it is full of little holes, and what is termed "pellety." Can anyone give a cause for this, and the way to prevent it?—Iron Casting.

[48557.]—**Boat.**—I have a boat 28ft. long, 8ft. beam, drawing about 9in. of water, in which I am about proceeding up the rivers Darling and Murray, and in which I want to put motive-power. I do not wish to put an engine into her on account of the space required for the boiler, wood, &c.; but would prefer moving her (against a four-knot current) by hand-power. Please advise me the best and easiest plan to adopt.—Murray and Darling.

[48558.]—**Weak Sight.**—My eyesight has been getting worse for the last two or three years. I cannot see to read the "E. M." with lamplight without spectacles. I might see for two or three lines; but then my eyes get so dim that I cannot make out a letter. I always see worse when I work too hard or get excited. My age is 30, and have been smoking nearly half that time. Has this been injuring my sight? Practical advice will be thankfully received.—A. B. C.

[48559.]—**Dynamo.**—Will any electrician well up in the management of dynamos give me a little information on the following points in the management of dynamos?—I have a Bürgin dynamo running four lights on a short circuit, which is constantly running hot after working a short time. The bearings seem quite free and easy, and nothing that I can see accounts for the fault. Is it wise to put a little oil on the commutator? I have been doing so. What is best position for brushes to touch commutator, so as to prevent sparking as much as possible? I presume the machine will get heated by the commutator sparking, as I find the machine very hot near the brushes.—Verax.

[48560.]—**Obtaining Heat by Chemicals.**—Some time ago a new method of obtaining heat was described in the "E. M." A chemical salt was put into a closed vessel and heated in boiling water. It then continued to give out heat for a length of time. Will any one who has tried it kindly say whether the plan was successful, as since my return to England I can see no symptoms of its having got into circulation. I want to heat a dressing-room. Will a petroleum stove do so? I have no gas.—I. O. U.

[48561.]—**Induction.**—Would an electrical friend tell me how to connect the primary wire of an induction coil? I have looked in my back numbers, and cannot find anything plain enough for a beginner. Also, if there is a special way to wind on the secondary wires round the core? I have used paper covered with glue on both sides for insulation. The secondary wire is covered with cotton. When I have connected the two primary wires, the hammer is attracted to the steel piece at end of core, and will not leave it; but if I keep touching the terminal, then it will keep vibrating. Also, could any reader tell me how to construct an indicator to tell the time by electricity actuated from another clock which sends a current every second or minute to the indicating dial, and the kind and number of batteries required to work it? A sketch would answer my purpose better than a lot of words a novice would not understand. Friend Lancaster promised a paper on induction coils. Has it appeared? If so, I cannot find it in this year's numbers.—Induction.

[48562.]—**Cartridge.**—Will some kind reader of "E. M." give me a simple and cheap method for making cartridges for blasting? Also, title of a good treatise on explosives?—Miner.

[48563.]—**Rain-Gauge.**—Will some of our meteorological friends kindly give me the rule to calculate a rainfall of 1in. from a square gauge whose sides are exactly 9in. long each way? I can find in back volumes how to do it for round ones. It is the corner pieces I cannot calculate for in this.—M.M.I.Sc.S.

[48564.]—**Worn-Out Plumbago Crucibles.**—Can any one tell me if old plumbago crucibles are of any value, and what they are used for, as I have some hundreds by me?—Garnet.

[48565.]—**Steel and Copper Etching.**—I have some steel and copper to etch, and I want to know the best combination of acids, &c., to do it. I want to etch a line as near as possible to a graver cut. Would any reader kindly oblige?—E. O. B.

[58566.]—**Zinc Cleaning.**—I want to know the best way of chemically cleaning zinc, similar to brass-cleaning?—E. O. B.

[48567.]—**Tripod Stand.**—Will any reader give me directions for making a folding tripod stand? Such a one that will look like a walking-stick when folded up.—Tripod.

[48568.]—**Lantern Dissolver.**—Has Mr. Lancaster any objection to giving me full particulars of his dissolver for single-view lanterns, as I should like to try and make one.—Grapho.

[48569.]—**Millstone Fixing.**—Will any reader kindly give instructions for fixing bottom stone? Are they wedged in anyway?—A Constant Subscriber.

[48570.]—**Circular Bellows Making.**—Will any one kindly give me directions for making above? I can use almost any tool, but do not understand the principle on which these are made. I wish to put under portable forge. What size is required to weld 1¼in. iron rod? A sketch would oblige others, perhaps, besides—Billie.

[48571.]—**Magic Lantern.**—I have been anxiously awaiting the reply to "Poor Amateur Glass-Grinder" from the pen of our kind friend Mr. Lancaster. I am in want of the same information, as I purpose making a lantern this winter with 4½in. condensers. Will Mr. Lancaster please reply, or if he has done so already, will some one show me where to look for reply, and oblige?—One Who Wishes to Grind Glass.

[48572.]—**To Mr. Evans.**—Will Mr. Evans kindly help me? I have been trying for some time to turn some slender, oval pieces of iron. They are too long to be held by one end only, so I have been turning between centres, and using the oval chuck to work the slide-rest. This, however, does not do, as the tool cannot cut all round, but scrapes just before it reaches the highest point. Will you please shed a little light on the mind of—Amateur?

[48573.]—**Spindles in Woollen Mills.**—Of what kind and quality of steel are the spindles used in the woollen mills at Bradford made? I have some worn out ones about 24in. long, and a little over ¾in. in diam. Are they sufficiently good to make screw-cutting taps from?—B.

[48574.]—**Mending Fishing-Rods.**—Will some reader kindly tell me the best way to splice the top joint of my fishing-rod which I have broken? It is a fly-rod. I have tried several ways, but they are not satisfactory.—Mechanical Puddler.

[48575.]—**Legal.**—To Mr. Wetherfield.—I sent my slide-rest to a lathe-maker to have an addition made to it, and it was to have been returned in six weeks. Four months have now elapsed, and though I have written repeatedly, I cannot get the work done; or, what is of more consequence, the slide-rest returned. Can I, without much legal expense, oblige the lathe-maker to return the slide-rest, and can I fix a time in which the work must be completed under pain of cancelling the order and leaving the work on his hands?—M. A. P.

[48576.]—**Legal.**—To Mr. Wetherfield.—A private road some 20ft. wide divides my factory from a smith's shop. I am occasionally annoyed by dense volumes of smoke being driven into my premises, the smoke emanating from my neighbour's chimney. I have complained to the landlord, but he holds out no hopes of remedy. If I should be compelled to proceed to law, could I do so with any prospects of success. Are any further particulars necessary to elucidate the case?—A. P.

[48577.]—**Microscope.**—Will some one kindly advise?—I want a microscope principally for examination of starches and other occasional use, and from what I gather from back numbers of "E. M." I think a Swift's "Student," or one of that class, would be suitable; but I should like to know if such an instrument is suitable for the addition of higher power, &c., at a future time? Also, what accessories are most useful at first, keeping cost as low as possible? The polariscope seems generally advised. I think I could make many of the extras, as I have lathe and tools. Hints as to books will oblige—Nemo.

[48578.]—**Distilling.**—I wish to distil some leaves and flowers of herbs, &c. Would some of our readers kindly inform me how to go about it? Also inform me what apparatus is required on a small scale?—One in a Fix.

[48579.]—**Sudden Loss of Eyesight.**—Will any one explain the following disagreeable phenomenon?—After taking my usual bath immediately after rising from bed my left eye became gradually overcast (not by a film), till on closing my right eye I found I was totally blind; but I still had the certain feeling that this darkness would pass; gradually it did so. I began to see the white pictures in frames as if black ones; and in ten minutes my left eye could see as well as the other. Was this a clot of blood from the brain? I am aged 40; of abstemious and regular habits for years. Have had no illness except Crimean fever in my life, and am ignorant of dyspepsia; in fact, sound in mind and body—eyesight particularly good. If this may happen to one eye, why not to both, which might be awkward and dangerous? The darkness did not last more than five minutes. I have been certainly latterly exposed to glare of Egyptian sun. I suppose non-smokers will say it's from smoking, anti-alcoholists to drinking, and vegetarian disciples to meat. In the two first I indulge very little. For the last fortnight, for curiosity, I have tried vegetarianism: perhaps that accounts for all. I have certainly had a bad cold and cough for four days, but it is gone.—J. C.

[48580.]—**Skin of Feet Peeling.**—If any medical reader could help or advise as to the above I should be glad. The patient is a young labourer (agricultural), and his feet sometimes peel so much as to bleed.—F. E. L.

[48581.]—**Legal.**—To Mr. Wetherfield.—Is my information correct that I can use a vehicle (under weight) in my professional work? Also for any member of my own family, without a licence, so long as it is neither let to any, nor strangers allowed to ride in it? I am informed that the law provides for that; but I wish to be safe.—Clericus.

[48582.]—**Granule Cells.**—Will some one kindly give me his opinion of Dale's granule cells, and whether they are equal to Bunsens for electric lighting?—Granule.

[48583.]—**Indicator.**—Will some correspondent tell me how to make, fix, and keep going an indicator worked by, and five yards from, a clock? The indicator hands, longest 6in. long, the kind of dial best suited for it (as I want it to hang in window), hand to move at each minute, number of teeth in driving-wheels? Also pinions, the best batteries without fumes, and how many? Also how to make and break contact? A sketch would make matters clearer than technicalities.—Indicator.

[48584.]—**American Cloth becoming Sticky.**—Is there any way to remedy this on chair-cover—otherwise than putting on new covers?—F. C.

[48585.]—**Oil and Fat.**—I have a quantity of oil, fat, and benzoline mixed up together. Will Mr. Allen say how I can distil the benzoline off? I have tried, but there always remains a trace of benzoline.—Saddler.

[48586.]—**Voss Multiplate Electrical Machine.**—Having read with much interest the animadversions of Mr. Molison on the Wimshurst machine, I should feel much obliged if he would tell us how he makes his double-plate Voss electrical machine, especially how the multiplate machine is constructed? I am sure that such a communication would be very acceptable to many of your readers—to me especially. I have already made one of the single-plate machines, and would make a multiplate one if I had the needful instructions.—John C. Frank.

[48587.]—**Extracting Copper.**—Can any of your correspondents inform me how to extract the copper from the pulp which is formed by grinding copper rollers with stone? It is very fine, and will not melt in a ordinary brassfounder's crucible; for when subjected to heat it forms a solid mass. I have also tried it in water, thinking that the copper would settle at the bottom; but that also proved a failure through the copper and stone being about the same weight.—Copper and Stone.

[48588.]—**Gas-Engine.**—I have a pair of ½ horse-power steam-engines just upon being finished, but am afraid I cannot use steam, as my work is so intermittent. Could I convert them into gas-engine? I want them to work my 6in. lathe. Or, would it be best for me to go in for a set of Mr. Dorrington's 15s. set of castings? Would that size work my lathe? And are they very difficult for an amateur to put together?—F. T. N. B.

[48589.]—**Legal.**—To Mr. Wetherfield.—Would you kindly advise under the following circumstances?—Having ordered of a canvasser a work entitled "Modern Steam Practice and Engineering," to be delivered in 14 numbers monthly, and at the same time signed a form to that effect, I also inquired of the canvasser if I could at any time decline to take in the work or a part, to which he replied in the affirmative. Now, having taken in one number, I declined to take any more, after which I received a letter from the publishers informing me that they would put the matter in the hands of a solicitor. Can they make a claim for the full amount, or could I make a plea of infancy, being only 19 years of age? Any information as to the best course will be thankfully received by—A. W.

[48590.]—**Flywheel for Lathe.** A structural peculiarity in the room into which I am about to move my 5in. lathe renders it desirable that the crank should, if possible, be done away with, so I have thought of mounting the flywheel (27in. diameter and about 56lb. weight) on a ¾ diameter steel stud screwed into the standard, being the same plan as that adopted by Tangye Bros. for their small lathes. But before committing myself to this, I should be very glad of a little practical advice as to the soundness of the scheme, for I have some doubts whether so heavy a wheel would be quite safe, and whether the wear would not be excessive.—South Eastern.

[48591.]—**Screw Taps.** I have a screwing stock, to hold the ordinary two-part dies, and wish to fit some extra ones to it for gas threads, &c. Are these tapped with the usual working taps, or must I get master taps, and if so, how much larger should they be than the intended screw?—South [illegible].

[48592.]—**Electric Light.** Will any correspondent explain how the electric light answers in the Brighton Pullman train? Is it a success? How is the electricity conveyed to the train, charged, and stored?—A. S. H.

[48593.]—**M. R. Engines.** Will any correspondent inform me what engines are now used to work the Scotch express from St. Pancras, a great change having been made? Also has engine No. 66 been rebuilt, and with what brake?—A. S. H.

[48594.]—**Half-Round Boring Bits.** In turning half-round bits, how much should the semi-cylindrical part be tapered? Say how much the slide-rest should be set per foot from the straight line? Any other hints will be most acceptable.—F. Seaman.

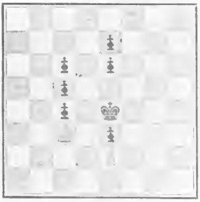
[48595.]—**Spoilt Miniature.** I had sent me to photograph an ivory miniature painted in water-colours, and by accident it was left near an open window, and got spotted with rain. The rain seems to have dissolved a kind of glaze with which the picture was covered, and has left a dull spot, surrounded with a slightly-raised ring of shining glaze. Will some kind reader suggest a remedy, and oblige?—Miniature.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXCVII.—By S. S[illegible].

Black.

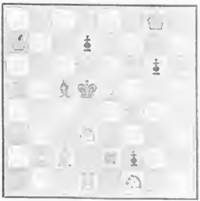


White.

White to play and mate in four moves.

PROBLEM DCCXCVIII.—From [illegible]. Motto "[illegible]."

Black.



White.

White to play and mate in two moves.

SOLUTION TO 793.

White.	*Black.*
1. Q to K Kt 7	1. Anything
2. Q or B mates	

SOLUTION TO 794.

White.	*Black.*
1. Kt to Q B 4	1. Anything
2. Kt or B mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 793 and 794 by "S[illegible]," W. T. Raynes and T. Mackay; to 793 by W. Stevens and Seymour Fodwell.

T. Mackay.—Thanks for problem. It shall be examined, and if up to the mark, inserted.

Thomas Stone.—With regard to 781, Q[illegible] is correct, but [illegible] should be [illegible]. A notice appeared about 781 to the effect that a Black pawn was accidentally omitted at Q Kt [illegible]. On the other matter you should communicate with the editor.

[illegible] game between Messrs. [illegible] and W. T. [illegible]

(Irregular Opening.)

White. F. [illegible]	*Black.* W. T. [illegible]
1. P-K B 4	1. P-K 4
2. P takes P	2. P-Q 3
3. P takes P	3. B takes P
4. Kt-K B 3	4. Kt-K B 3
5. P-Q 4	5. B-K Kt 5
6. P-K 3	6. Q-K 2
7. Q-Q 3	7. P-Q B 4
8. P-Q B 3	8. Kt-Q B 3
9. B-K Kt 5	9. P-B 5
10. B takes Kt	10. P takes B
11. P-Q 5	11. Castles (Q)
12. P takes Kt	12. B-Kt 6 (ch)
13. P takes B	13. R takes Q
14. B takes R	14. Q-Q 3
15. P takes P (ch)	15. K takes P
16. B-K 2	16. Q takes P (ch)
17. K-B sq	17. R-K B sq
18. R takes P	18. R-B 2
19. Q Kt-Q 2	19. Q-R 5
20. R-R 4	20. P-K B 4
21. K-B 2	21. R-K Kt 2
22. P-K Kt 3	22. Q-Q B 2
23. R-K Kt sq	23. P-K B 4
24. P takes P	24. Q-Q 2
25. P-B 6	25. R-Kt 3
26. R-Q sq	26. Q-B 4
27. Kt-Q B 3	27. Q takes P
28. K B-K Kt sq	28. R-Kt 2
29. R-Q 6	29. Q-K B sq
30. K R-Q sq	30. R-K B 2
31. Kt-K 5	31. R-K 2
32. R-R 6 [illegible]	32. K-B 2
33. R-R 8 [illegible]	33. K-Kt sq
34. Kt takes B	34. P takes Kt
35. R-R 8 [illegible]	35. Q takes R
36. B takes Q	Black Resigns.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, *31, Tavistock-street, Covent-garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

We receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 718, 719, 721, 723, 729, 731, 734, 7[illegible].
Bellows, [illegible]: Nos. 475, 480, 684, 807.
Cements: Nos. 677, 729.
Coils, induction: Nos. 613, 628, 636, 640, 7[illegible], 77[illegible], 8[illegible].
Coils, [illegible]: Nos. 844, 808.
Copying processes: Nos. [illegible], 731, 761, 762.
Electric bells: Nos. 545, 558, 776.
Electric machines: Nos. 308, 581, 628, 730, [illegible].
Electro-magnets: Nos. 735, [illegible], 783, 844, 8[illegible].
Lacquers: Nos. 429, 475, [illegible], 866.
Varnishes: 321, 478, 619, 655, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 8, and unacknowledged elsewhere:—

G. Mo[illegible].—J. Robinson.—F. A. Moilliet.—W. A. Smith.—S. Lancaster.—K. B. Williams.—H. Milnes.—Jas. Murray.—T. Riley.—C. Notara.—Pearl Assurance Co.—Singer and Co.—T. B.—D. R.—E. T. Scott.—W.—Clyde.—Scotus.—J. W. Z.—Amateur.—Plateman.—Xmas.—J. S. B.—Bell, C.E.—W. H.—C. Rabucke.—A Fellow of the Royal Astronomical Society.—Negative.—W. E. H.—H. S.—Altair.—Pivot.—An Amateur.—T. W.—J. Y. McClellan.—F. Walker.—A. N. H.—Capt. Cuttle.—E. O'B.

Subscriber. (Presumably by a pin on a wheel, which is practically a crank.)—Dry Bulb. (In wet weather there is less or no evaporation, for the atmosphere is saturated with moisture; hence there is no abstraction of heat from the wet bulb.)—C. J. R., Ventnor. (Try heat, and then add a little oil.)—Felstead. (There is no such work.)—Bees Bee. (Melt in hot water, strain, remelt, and cast into cakes. If wanted white, cut into thin flakes and expose to sunlight, and the effects of wind and rain. Remelt several times, exposing in thin flakes each time until the whole substance has been bleached.)—R. F. B. (Any medium size will do. German tinder is [illegible], a [illegible] fungus, Polyporus fomentarius is the real amadou, but it is made from several species of fungi found on trees. They are cut into slices, beaten until soft, and then soaked in saltpetre and dried.)—J. B. (You want a clock train, or, as is frequently used, a bottle jack.)—A. T. W. (You will find plenty of information on Windmills in back volumes. Illustrations in Nos. 325, 504, 510, 511 may help you.)—Kilo. (No definite information can be given on the point; perhaps [illegible]. See a discussion on the subject in Vol. XXXIII.)—Working Blacksmith. (See p. 101, No. [illegible], and the indices of recent volumes. The second question has been frequently answered.)—J. S. Cunnington. (If fixed level, it would not rise.)—E. Just. (You cannot do it unless you are allowed to run a wire between the two shops.)—Brothers Subscribers. (Messrs. Bolse and Horne, 31, Aldermanbury, advertised it not long ago.)—A Constant Reader. (It is bad as you say, it wants repolishing. You might try what you can do with rouge or putty powder.)—Hal[illegible]. (We can only refer you to our advertisement columns, last number, p. [illegible], for instance.)—Garnet. (Described many times in back volumes. The metal must be thoroughly cleaned, easiest by pickling in dilute acid, then washed, and afterwards boiled in a mixture of [illegible] tin and cream of tartar in the proportion of 4 of the former to 3 of the latter. Water quant. suff. or practically *ad lib.* The acid mixture generally employed is two parts nitric to one part sulphuric, and the time depends on the dilution. The metal must be carefully rinsed in several waters.)—An Old Subscriber. (Unless you have a very large quantity to do, it is cheapest to procure a bottle of Stephens's stains. Several recipes in back volumes.)—Anon. (You can rub them over with a little benzoline or pure methylated spirit, and expose as much as possible to the light behind a window. We presume you mean that the ivory has become discoloured.)—H. W. H. (It is not unlikely that they are varicose; but it would be advisable to take the advice of a medical man.)—Hydrostat. (The power would depend on the fall or head of water. See the papers on hydraulic machinery now appearing.)—Thomas Collins. (If not japanned—that is, stoved—on, either turpentine, or mineral naphtha will remove it.)—Ables. (See the articles and letters on Watch Repairing, published in recent numbers and volumes.)—W. W. W. (The best way is to read a book or a newspaper, and with the aid of any grammar you ought not to have much difficulty.)—A Bicyclist. (The best thing would be to polish those parts bright and lacquer them. There is no thorough remedy but replating.)—Granite. (We have no analysis giving the percentages. The preparation of the alkali from that source has been practically abandoned since the discovery of the potash deposits in Germany.)—W. H. (Certainly, it would be an infringement, but there are many machines practically as good which are not the subjects of a patent.)—Hilda. (Procure a bottle of Stephens's stain or use a stain of dragon's blood and methylated spirit—1oz. to the pint.)—E. P. B. (No; they would produce an arc, but not of that power. They are not suited for the work, as, independently of quickly failing, the plates are not of sufficient size, and there would consequently be excessive internal resistance.)—J. A. D. (We must refer you to back volumes. See pp. 15, 16, of the last volume for plain directions for two coils, and the indices for details of others.)—Amateur Gilder. (Full instructions in recent numbers. The battery named is useless for the purpose.)—[illegible]. (Repeat the query, giving as clear details as possible.)—B. Wellington. (Try the varnish mentioned on p. 601, No. for Sept. 1, last.)—F. C. [illegible]. (See p. 156, No. 801.)—M. I. C. E. (The ethoxo-limelight was described in No. 822, p. 609. See also the last index.)—A Weaver Youth. (The art of hard and soft soldering was fully described in Nos. 839, 841, 846, and [illegible].)—W. (Benzoline or preparations; rouge, emery, &c. See previous answer, and the indices of recent volumes.)—D. D. Lancashire. (See pp. 85, 181, last volume, and p. 42 of the present. Pantograph in Nos. [illegible].)—A. [illegible] R. (We do not know of one.)—R. C. K. (On p. [illegible], Vol. XI., you will find an illustration of a spring-driven vehicle, which did actually work about the streets of London. On p. 525, Vol. XXI., you will find some account of M. Levaux's experiments with a tramcar. The note to which you refer is simply an account of an American re-invention. The idea is very old, but it can never be a commercial success.)—[illegible] O. (The information you require has been frequently given in back numbers. See the indices of the last volume.)—A Reader. (We should say not; but it depends entirely on the lenses.)—D. S. (A combination lens with "improved photographic lens, 1718," upon it may or may not be a good one; but we take the figures to mean the number, not a date. Show it to an optician or a photographer.)—G. L. B. (Certainly, if you don't understand the rule, it is very easy to be led astray, but why not purchase one of the handbooks on the slide-rule and study it?)—G. T. O. (It will do, but not so well, and as to cheapness, that is a very small matter.)—W. S. N. (We give all available or useful particulars every week.)—Londoner. (About 1·2 volt. 2. Certainly; it is preferred for pocket medical coils.)—Quatorzième. (Too vague.)—Quatre Visors. (Inquire in the neighbourhood.)—Thorics. (Possibly "Steam and the Steam-Engine," by D. K. Clark, will meet your wants. It is published by Lockwood and Co., Stationers' Hall-court, E.C. If a more theoretical work is required, the same publishers issue Goodeve's textbook.)—Cumoso. (You will find a good account of the process in No. 816, p. 238.)—A Subscriber. (There are many recipes in back volumes.)—

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 17, 1882.

HOME CHIPS.—III.

TIMBER used as a brace may become either a strut or a tension bar, according as the strain brought upon it tends to compress or elongate the fibres. The diagonal bar of the gate already described is a strut, because the pressure upon it directly tends to compress it. But we can supply its place under certain conditions by an iron rod or by a piece of timber of smaller sectional area, if we can so arrange matters as to bring the strain in such a direction that it shall only tend to stretch such bar. To effect this we must endeavour to suspend the weight by this tie-bar or rod, instead of supporting it upon it. I may illustrate this principle by the wheel of a bicycle as a suspension wheel, and a cart-wheel which acts as a support. The weight in the latter case rests chiefly on the spoke which is for the moment below, and perpendicular to the axle, while, on the former it is borne by the spokes which are uppermost, and is evidently suspended by them from the top part of the rim or felloe. And as either iron or timber will bear an immense strain in a direction tending to stretch the fibres, we can use wire or wood of very much lighter scantling. The elementary triangular frame of Fig. 3 is composed of the heel-post, and the *bottom* bar with an iron bar (or wood) C. A weight suspended from or supported by B brings a strain on C, and if A is securely fixed by the top hinge C will bear any strain likely to come upon it, even if it be but a bit of nail-rod or stout wire. For Home Chips it will very likely be of wood, which will answer as well. Now in this gate matters are reversed, and so far as the frame or truss is concerned, B will be the stout bar, as we shall practically build upon it, and the top rail might be very slight. But here comes into consideration the practical purpose of the frame, which is to restrain cattle, and therefore the top bar must be able to bear the pressure of such would-be trespassers. Adding the head-post to shut against the fixed gate-post, we may complete the structure with vertical bars, as shown, or with horizontal ones, as before. Suppose, now, that the usual gate-destroyer, or idle boy, sits on the top bar (he is sure to sit at D, because it is the weakest part, being the furthest from the hinge), his weight will be communicated by the head and upright bars to E, and will then bring strain upon the tension rod, and this again carries it to the top of A, close to the upper hinge. If this is sound all will be well. In a gate of this kind the main frame is mortised as before, but the upright slats are notched into the upper and lower rail—flush or otherwise; they may be of ½in. stuff and 2½in. wide, or 3in. if a long gate. This is a good form because it cannot easily be climbed, especially if the top rail is made of the shape shown in section at E. Indeed, both rails are often so made, a bit of 4in. stuff being sawn lengthwise, as shown in section F. If anything will puzzle a climbing urchin, this will, especially if the upright slats are just too close to allow his highlows room between them. If a gate of this kind is very long or unduly heavy, the tie-bar C may possibly be at too small an angle with the horizontal line to give adequate support. This is in such a case often counteracted by using a high heel-post as dotted, by which means the angle of the tension rod is considerably increased. But now it will be seen that the heel-post itself is weakened, unless the hinge-post is also carried up, and the hinge placed higher. This may or may not be convenient, and if not, a strut will be needed at H. The whole is often modified by making this gate of wood like Fig. 4, in which, keeping the same principles of construction, we get a more ornamental structure. With the exception of the top and bottom rails, round ones are sometimes used, giving a lighter appearance. There is really no great difficulty in making gates; but the principle should be well understood, or else struts and braces will be put where they are absolutely useless. The labour, however, is quite heavy enough, if 3in. stuff has to be ripped up at home. Still it is just the work we shall soon need to warm us, and is good exercise at any time. Bent struts, or, properly speaking, curved ones, sawn out to shape, such as Fig. 5, which represents one of a pair, are a mistake, being weak in the direction of the thrust or strain. If a strut is needed, let it be straight. Curved ones are, besides being wrong in principle, a deal more trouble to cut out and fit. As to the matter if ornament, it is a question if anything structurally wrong can be an ornament.

FIG. 3.

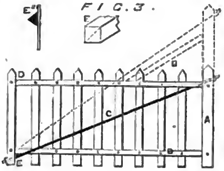


FIG. 4.

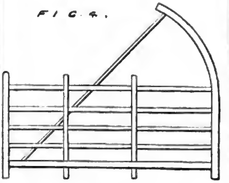


FIG. 6.

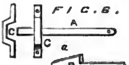


FIG. 7.

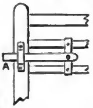


FIG. 5.

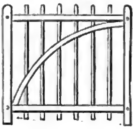
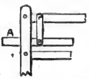


FIG. 8.



A word as to hanging gates. In some soils—notably the stiff clays of Essex, known as loams, all building operations are difficult owing to the alternate swelling and shrinking of the soil according as the weather may be wet or dry. In spite of all care in securing a good foundation, walls will crack, and gate-posts shift, so that, however well gates may close when first hung, a change of weather is sure to make them jam or swing freely past the latch-post. There is only one way to meet this difficulty, and that is by having the upper hook on which the weight chiefly hangs, made to pass through its post, and to fasten with nut and screw. But the hook must not be made (as so often done) with a shoulder. The screw is also to project some 2in. or 3in. beyond the nut, which latter should have a washer underneath it. When the gate swings past the latch-post the nut can be unscrewed, and the top bar of the gate allowed to fall forward a little. On the other hand, if the gate jams, the nut being tightened, draws it back, and remedies the defect. In any case this affords a mode of nice-adjustment, even if the soil is of a less treacherous character. So careless are people generally about gates that you may go over a dozen farms and find every second or third gate more or less out of position, requiring to be lifted or manipulated in some way, best understood by the tenant or his labourers, before it can be opened; moreover, gates are seldom renewed before some ingress of cattle to hayfield or standing corn or seed clover has taught the occupier the true value of a stitch in time. If a bar gets broken, a bit of thorn is wattled in, or a broken hurdle tied on, or some such unworkmanlike patch is attempted. All gates should not only be hung so as to fall to when allowed to swing, but, if possible, to fasten themselves, as sometimes a man passing through with a waggon and team cannot leave his horses to go back and secure the gate. The swing-to is easily managed by allowing the gate to hang downward a little from the top hinge or by putting the hinges a little out of line with each other. Of self-acting gate latches there are many made of cast or wrought iron, which are, however, no more certain nor more durable than some of the old-fashioned wooden ones, and these are perhaps more in accordance with the principle of Home Chips, by which I designate all kinds of rough and ready contrivances that can be made at home. One such is represented in Fig. 6, A, B, and C. The first being a flat bar of oak or ash about ½in. thick, 2 or 2½in. wide, and 1ft. or 14in. long, hinged to work easily on a stout nail or screw, a block is first nailed to the gate-bar to bring it up to the thickness of the front or head-post, or across two bars like Fig. 7, and another piece, like C of Fig. 6, is nailed over it upon the head-post, under which retaining piece it falls freely up and down. B is the catch or hook cut off a bit of 1in. stuff, of ash or oak preferably, which is nailed to the side of the latch-post just so high that the hinged piece A, Fig. 7, strikes on its sloping face A, as the gate swings together. It then falls into the notch and securely holds the gate. Some cattle grow very clever in the art of unfastening gates; but if a wooden pin is stuck in just above this falling latch (which is but a door latch as commonly made, but on a larger scale), it will be found to puzzle the most cunning of all the stock—at least I never knew one whose intelligence was equal to the occasion, although I once had a donkey that was apparently capable of opening anything, from a stable-door to his own mouth, and was a daily truant in spite of all dodges and contrivances.

A somewhat similar wooden fastening is represented in Fig. 8, where the flat bar A passes easily through a mortise in the head-post of the gate, and is suspended to a rail of the gate above it, sometimes by a sort of link made of a shorter flat bar, moving easily on a couple of nails or rivets, as shown in the figure, or by a bit of tar-twine or leather, or raw hide. The catch-hook is made as before, like B, but is put on the other way, so as to bring the sloping part *a* in front and facing the end of the swinging bar, which is thus pushed back until it is

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able to fall forwards into the notch. The only place I ever saw this form was on a Berkshire farm, where I tried it and found it very effective. Possibly experience has proved it a puzzle to the oxen used there for ploughing and other field operations. It is, at any rate, very easy to make, and from the way in which it is freely suspended it works very easily, and is not likely to fail if the wood swells by getting wet. Moreover, if a tolerably deep piece is used to cut the hook from, the catch will continue to act if the gate should fall forward or become slightly displaced; nor is the flat bar so likely to get knocked off in such case, as it is in the previous arrangement, by the slamming of the gate. Being so loosely connected, it will give at once, on striking the slope of the hook, and is easy to re-adjust at any time.

(*To be continued.*) J. L.

ELECTRICAL MEASUREMENTS.—III.

By John T. Sprague ("Sigma.")

THE Farad is the unit of *capacity*, and its value is coulomb ÷ volt, or C.G.S. 10^{-9} units (M.G.S. 10^{-7}). That is to say that the capacity of a condenser for charge is the number of units of quantity it will receive under unit force. The value given is that of the electro-magnetic unit system. In the electro-static system "*one unit of electric quantity* (commonly called electricity), *is that quantity which, when placed at the distance of one centimetre from a similar quantity, repels it with a force of one dyne.*" As electricity upon a sphere acts as if concentrated at its centre, the unit capacity is defined as that of a sphere of one centimetre radius, and we are taught that the capacity of spheres is as their radius; so it is calculated that the capacity of the earth is 630 millions of units (electro-static.) *But all this belongs to the electricity which has been invented by the schoolmen*; in the *electricity which exists in Nature, a sphere, considered by itself, has no capacity at all.* Electricity cannot be put upon *a* sphere, or upon any other single surface. Capacity or charge involves, of necessity, *two surfaces*, and a dielectric inclosed between them; it involves a field of force, in which electric energy is stored, in the form of molecular stress; just as it is stored in the secondary battery in the form of chemical decomposition. The surfaces in static electricity correspond exactly to the electrodes in electrolysis, and to talk of putting electricity upon one surface is like trying to deposit metal with a single electrode. As to the earth, there is not an iota of evidence that it has any static charge at all as a whole—i.e., as a sphere in space: it has many local charges, constantly varying, set up between parts of its surface and the surrounding atmosphere and clouds. Its capacity is imaginary.

That the mathematical definitions accord with experimental facts (upon which they are, of course, based) is due to the circumstance that in experimenting with charged spheres we are really dealing with a condenser of which the sphere forms one coating, the surfaces of the room the other, the air being the constant dielectric between them. Under these conditions, the surface of the sphere is so small compared with that of the other coating, that the imaginary law holds good.

Capacity is a function which varies *as the surfaces and inversely as the distance between them*, and subject also to the specific power of any particular dielectric; that is, to its *specific inductive capacity*. These are exactly the same conditions which govern current in conductors.

In the case of two surfaces, one inclosed in the other, as with spheres, or as with cylinders in batteries or in telegraphic cables, these surfaces hold a relation to each other which is expressed by the formula used practically for the electrostatic capacity of cables, k = log. D ÷ log. d, these being the relative diameters (which are double radii), and consequently the relative surfaces. It will be seen at once that in a large room, the surfaces of which act as the outer sphere, it is only the inner or experimental sphere surface which is varied appreciably, because the thickness of dielectric is but slightly altered, therefore the capacity of the spheres will vary as their radii (within the limits of experimental accuracy); but this is not a law of nature; it is simply a circumstance attending this particular class of experiment.

For practical purposes, the Farad is too large a unit: the actual unit employed is the *micro-farad*, which is one millionth. The micro-farad is represented by a length of average telegraph cable of 3·5 miles.

Now that the system of units is explained, it may be as well to explain some of the misconceptions about the system, consequent upon the circumstance that the whole system is an artificial and mathematical one, and that the artificial expressions employed in it are often regarded as natural truths. There is nothing in nature corresponding either to electro-motive force or to electric resistance. They are very convenient tools for calculation—nothing more. The one thing which we do find in nature is *current*, and to maintain this we must expend *energy*. Now, these two are so related as to be inconvenient of expression, because energy is as the square of current (other conditions being unchanged, or in unit conditions). The absolute system is really one based upon *energy* though starting from *force*. But force is usually only a mathematical expression for energy, and, as a matter of simple fact, unit force and unit energy are nothing but different expressions for different aspects of the same thing or value. Of course, this may be heresy in the mathematical courts; none the less it is truth: it follows from the law of the conservation of energy, that *cause and effect must be equal*, though expressed in different terms; and on the mathematical system the cause is called *force*, and the effect *work* or energy, and these must be equal.

Force is expressed in terms of the velocity it generates; the acceleration is only a mode of expressing this. But the work done by a force is as the square of the velocity. It follows, then, that if (as is common) the word "force" is simply an expression for some action of energy expended, we have this quantity of energy expressed in two forms.

$$\left.\begin{array}{l}\text{Force}\\ \text{Velocity}\end{array}\right\} = \left\{\begin{array}{l}\text{Energy.}\\ \text{The square of velocity.}\end{array}\right.$$

But if the real *thing* behind both expressions is an equal quantity of energy, the fact is evident that force is just a term expressing the square root of the energy creating it.

The facts and laws of falling bodies prove this; and these are merely the phenomena of the one natural force—gravitation, as exerted by the earth. I will show this in a simple table.

1. Time in seconds....	1	2	3	4	5
2. Velocity per second	32	32	32	32	32
3. Total velocity......	32	64	96	128	160
4. Space fallen........	16	64	144	256	400
5. Space divided by 16	1	4	9	16	25
6. Square root of space units	1	2	3	4	5

Line 1 represents a period of 5 successive seconds during which gravity is acting, producing in the first a unit velocity of 32ft., and a unit energy of 16ft., which, with a weight of 1lb., gives us unit momentum 32, and unit energy 16 foot-pounds. The forces acting are, therefore, in the mathematical sense, as the time in seconds; each second is a force generating a velocity of 32ft. as shown line 2, accumulating as in line 3. Now, if we please, we may express this velocity of line 3 in units, which, being effected by dividing by 32, brings us back to line 1. Now *current* is merely another name for a velocity: it means the rate of a certain action. Therefore we see that current varies as the forces. In line 4 we have the space fallen, which, taking the weight as one pound, represents foot-pounds = *energy*, or as it used to be called "vis viva." We reduce this also to unit conditions by dividing by 16 in line 5. Here we have at once the well-known facts, that space fallen is as the square of the time, which, looking at the matter as we now are, is as the square of the *forces*. In hydraulics, all these laws play an important part, though they are employed in a different manner. Head of water is the thing usually employed in formulæ, and head of water is simply the height, the space fallen, as in line 4. But the velocity imparted is not as the *head*, but as the *square root of the head*; 16 is the unit head, and line 5 the number of such units, and line 6 is the square root of these. Again we are brought back to time, for line 6 is line 1 reproduced. Therefore, we have here shown us, that force is variously expressible in terms of lines 1, 3, and 6 as times of falling, as velocity, or as momentum imparted, or as square root of space = √ energy.

The conditions are identical in electricity. Line 6, expressed as mechanico-motive force, is identical in principle with electro-motive force. The advantage gained by this expression is that both elements of the formulæ are expressed in concordant terms. When we need an answer in terms of current or velocity, we have—M = V, or E = C; when we are considering energy, we have—$E^2 = C^2$.

It must be remembered, however, that this relates to unit conditions, especially as to unit resistance; the whole system is based upon the unit relations; if under altered conditions of resistance E and C do not vary in equal ratios, another condition arises. Part of the energy which is expressed in force remains *potential*. If we reduce the velocity due to head of water, by means of a length of piping, the weight falling through the space is reduced below that corresponding to the unit action, and the energy corresponding to the reduction of weight remains potential in the source.

Exactly the same principles hold good with a steamship or railway train: their speed answers to current; the work to be done increases as the square of speed. Now, power is not force, as most ordinary people would imagine; we express the energy or work capacity of a steam-engine in horse-powers, which are 33,000 ft.-lb. per minute: this is energy. But we can express horse powers of engines in terms of force, and to do so (under fixed conditions) we have only to take their square root. Thus for a ship or train, assuming that 1 H.P. gave a speed (current) of 1 mile per hour, we have:—

1. Speeds........	1	2	3	4	5
2. Horse-power..	1	4	9	16	25
3. √H.P. = force	1	2	3	4	5

All these considerations have for object the gaining of a natural—a physical—conception of the meaning conveyed by, but none the less hidden by, the mathematical expressions, and the relegating of these to their proper business of calculation.

OBJECT-GLASS WORKING.—II.

By "Prismatique."

THE best quality discs can be procured with both sides roughly polished flat: this is a great advantage over the old system of polishing a few patches on the edge, as it gives a good chance of selecting the sides in the first place, and of testing for annealing in the second. If there are defects that will not grind out they should be returned. A good plan is to make sketches to size of a section of each lens, allow the crown lens a thickness of 3-16th on the edge for 3in. diameter, and the flint 7-16th; these dimensions may be reduced or exceeded without doing harm. It is better, however, to have stout glasses in the amateur's case, as he may have much re-grinding, and consequent thinning down. To test for annealing, a "Nicol" prism is used with a blackened glass reflector, placed at the polarising angle behind the disc: a well annealed disc shows the light and dark shades regularly; a badly annealed one is patchy. In the glasses now supplied by Messrs. Chance and M. Feil, it is extremely rare to find imperfect annealing; so this may be omitted, if a difficulty, without much danger. With regard to the refractive indices, the glasses supplied by all good makers are so very close to the figures given in their lists, that the amateur can start off, without using any test for refraction, with a certainty that three of his surfaces will not require alteration if he gets the curves practically to his figures. The ordinary heavy flint of Messrs. Chance, density 3·64, and hard crown from the same makers, are the two glasses that have proved for many years the best, the flint standing climatic changes better than any flint of the same sp. gr., and as it is highly dispersive, the curves can be shallow, thus causing the least loss of light by reflection outwardly, when the most concave surface is to the light. That position is still the one used in English o.g.'s, although Continental makers of great repute have for some time reversed the position, with, I believe, a gain in light-grasp. There has been a general complaint by amateurs that professionals give figures they understand themselves, but are a perfect mystery to anyone else. I will endeavour in this place to give in plain figures the proportions of curves that suffice for the heavy flint and hard crown. Say x is the focal length required, then the crown lens curves are—1st, or outside surface, $\frac{x}{3}$; 2nd surface, $\frac{x}{2}$, convex; 3rd, or most concave surface of the flint lens, $\frac{x}{2}$ —·025 for each inch of focal length; $x = 10''$, then $\frac{x}{2} = 5''$, ·025 × x = ·25, 5 − ·25 = 4·75″; or this surface may be $\frac{x}{2}$ if the fourth surface is made proportionally deeper; in that case the surfaces must be kept from scrubbing each other by gumming three small pieces of foil round the margin. The fourth surface is usually made about $\frac{x}{3} \times 7\cdot5$ concave (all figures represent radii); but as all alterations for achromaticity are made on that surface, there is a considerable departure from this in many cases; but of this matter I will treat further on. With glasses of M. Feil's make, flint of 3·58 sp.gr., and crown of 2·49, will make a good glass up to 3in. diameter with curves of the simple form I give; both inner curves being of the same radius, the flint concave, and both outer curves of the same radius, and convex in form. Thus x being the focal length, the inner curves are $\frac{x}{4}$, the outer $\frac{x}{4} \times 3\cdot25$. The flint lens is outwards in this construction. These glasses are capable of making o.g.'s of much larger aperture than 3in., but it seems necessary to have a little difference in the outside curvatures. In the case of larger aperture there is no better form than the first I give here. It will be seen that fewer tools are wanted for the second form. In the latter case all alterations for achromatising must be made on *both* outside surfaces; but as this only requires the alteration of one pair of tools, it must be considered economical.

(*To be continued.*)

ON THE ORIGIN OF CYCLONES.

In the views hitherto expressed regarding the origin of cyclones, so many essential phenomena, according to Herr Andries, remain unexplained, that there is a strong necessity for further investigation. As unexplained facts, he adduces the parabolic path of cyclones, their great velocity of propagation, and the source of the energy required for production and maintenance of the vortical movements. In a recent paper to the Austrian Meteorological Society, he describes an attempt he made at elucidation of the subject by means of experiment.

He procured a large glass bell jar with horizontal bottom, filled it with water, and with a view to observing movements in the liquid, added various substances of approximately the same specific gravity—among others, fine cigar-ashes. Then he pushed a board vertically into the liquid to a certain depth, and moved it parallel with itself in a straight line, or in an arc of 50°—100° more or less quickly through the water, then drew it quickly out again. In doing so, he observed the following:—

In prolongation of the arc, and behind the board, were formed two whirls with vertical axes, which were propagated downwards. The light particles in the water began to move in spiral, and nearly horizontal lines towards a centre. The whole whirl moved on in the arc, while the spiral motion continued. After a longer or shorter time, a kind of cone was formed in the centre, and from this cone the lightest particles rose in spiral paths. The heavier particles sank gradually to the bottom, and no longer shared in the movement. When the movement with the board was properly done, the light particles rose quite regularly out of the inner part of the still progressive whirl in fine spiral lines. If the vessel was gently shaken, one observed the movements that had been regular become deformed; loops and knots were produced, and the motion of the entire whirl was changed. If the motion of the board was somewhat stronger, the paths of the particles in the water were more circular; but there was always formed a cone open above, out of which the lighter particles rose. On the bottom was produced a flat conical heap, pretty still, consisting of the heavier particles. If a slight shock was given to the vessel, or the latter was inclined somewhat, one saw distinctly how pieces were detached from this heap, and secondary centres of rotation were formed, which presented, on a smaller scale, the phenomena described. A deformation through shock or an obstacle caused a bending inwards of the curves.

This experiment, which was modified in various ways, served Herr Andries as a starting-point in explanation of the production of cyclones: but first he deduces from it an explanation of the origin of hail. When the air, he says, is strongly heated in summer, and saturated with aqueous vapour over a large region, this air gradually rises to a certain height. If it there meet with a comparatively cold current moving in a horizontal direction with some velocity, and so penetrating it, there must arise, through the unstable equilibrium, a vigorous whirling motion, which carries this moist, warm air, perhaps several thousand metres up, and so occasions the formation of ice-spherules, which continually increase in size, till, on the one hand the decreasing vertical motion, and on the other the increasing weight of the particles, render their fall possible. This conception Herr Andries regards as explaining the screw-like form often observed in hailstones, the zig-zag parts of barometer curves, during hailstorms, the shifting of the wind often to all the points of the compass, and long, narrow hail-regions often observed.

The same processes as occur in the glass of water occur, he considers, on a much larger scale, in the atmosphere; and owing to the greater elasticity and mobility of the air, as compared with water, the conditions are, in general, much more favourable. There is only required a powerful air-current at a certain height, such as may be actually observed, with different directions according to the latitude, and can furnish abundantly the energy necessary for production and maintenance of the whirl.

"If such a current of a certain breadth and depth commences, it produces at its anterior end and two sides, in pressing forward, a whirling motion in the still air about it. With its advance, the whirling movement also advances, which is gradually extended downwards, widened like a funnel. Only that one of the two whirls on the northern hemisphere, whose direction of motion is opposite to that of the hands of a watch, comes to completion; the other, with anticyclonic motion, is mostly exhausted before reaching the earth's surface. The former is aided in its whirling motion by the difference of rotation of the air-masses at its northern and southern sides, due to rotation of the earth, and so dependent on the latitude. The latter is in the same measure retarded in its motion. Only after the first whirl has reached the earth's surface, do the proper phenomena of cyclones begin, the spiral motion of air-masses towards the centre, the bending inwards or inclination, which must be greater in the part before than in that behind, the rise of air in the interior, and outflow laterally, and so on. We can, as has been said, exactly imitate all these phenomena in water. If, e.g., we present some obstacle to a moving whirl, by inserting a rod, or by suitable movement of the whole vessel, we see distinctly the individual spirals bent inwards. If the cyclone, then, encounter in its path, an unequal resistance, through inequalities of the ground or unequal distribution of air-pressure, these loops or knots must be formed, which have in fact been observed.

Further, as regards the diminution of air-pressure in the interior of cyclones, it is simply a result of the mechanical whirling motion of the air. Herr Hann and Herr Ferrel are also of this opinion.

Also the gradients increasing from within outwards are merely the consequence, and not the cause, of the whirling motion. This is a necessary result of mechanical laws. (Herr Ferrel also holds this view.) The diminution of air-pressure within the cyclone, caused by mechanical action, has, as a necessary result, a rising of the air, and outflow above.

The whirl, having at first arisen at a height, will describe a very nearly circular path. Ere this whirl has been propagated as far as the earth's surface, the air-pressure below must necessarily have diminished, and the air will, therefore, by reason of its great mobility and elasticity, be pressed upwards and outwards."

Several cases of the phenomena (it is represented) may occur in nature. If the whirl arise at a comparatively small height, the kinetic energy communicated to it above is propagated downwards with little alteration. This kind of whirl occurs especially in hot regions; where, in the cyclones, very cold blasts of wind are often observed, which can only be the cold air of the upper regions carried off by the whirl. Similarly, the heavy rain-showers, which nearly always accompany tropical whirls, are to be explained by a carrying down of cold air-masses into the lower warm moist air.

A second possible case is that in which the whirl originates at a great height, and in its propagation downwards widens greatly funnel-wise. In this case, the phenomena on the earth's surface are very weak and indefinite.

A third case is that of the extremely flat rotatory wind-discs, which have been several times observed with a ratio of diameter to height of 500 : 1. Such a flat disc is nothing but a flat cone, which is to be regarded as the continuation of a whirl produced at a small height by a weak current.

As regards the paths which storm centres are often accustomed to take with great regularity, the ground of this regularity lies in the upper currents, which, so far as is known, keep quite determinate paths. To explain that which is apparently arbitrary in the direction of the upper air currents, we should require to know the heat conditions of these strata from the pole to the equator (which we do not). The storm-paths must, therefore, still have an appearance of arbitrary character.

The second whirl, which is produced by every upper air-current, the anticyclone, likewise plays a *rôle* in the atmosphere. In it occurs a slow spiral motion of the air downwards; but the intensity of the motion is, for the reason above given, considerably less than in the cyclone. The down-directed motion results in an increase of pressure, as that directed upwards within a depression results in a diminished pressure. Thus, the surfaces of level descend, and so form an outflow region for the air flowing off from the cyclones above (as has been affirmed for maxima of air-pressure). Further, Herr Andries considers that the air-current of anticyclones directed outwards next the ground is produced, at least partly, by the suction force of cyclones. And, by the way, the word anticyclone first acquires, through the view here advocated, its true meaning, as the opposite of the cyclonal rotations. Besides, it must here be further emphasised, that *every cyclone must be accompanied by an anticyclone*. This is also Herr Ferrel's view. That the anticyclones are not so evident, owing to their much less active character, is easily intelligible.

If we would, in general traits, sketch for ourselves the movements within the air-ocean, we might say: "Besides the regular Trade winds, we find at a height a powerful and extremely rapid air motion of general easterly direction. These two represent the principal movements in horizontal direction. In the vertical direction, on the other hand, we find near each other an upward motion in cyclones, and a downward in anticyclones. Cyclones, tornadoes, and waterspouts differ from each other only in size."

The above hypothesis of Herr Andries, developed from a few simple experiments, essentially agrees (it is pointed out in *Der Naturforscher*) with the largely controverted theory of M. Faye regarding the origin of cyclones. In both it is supposed that the whirls arise in the upper strata of air, and are propagated downwards—a difference between the views only appearing in the fact that M. Faye denies the upward motion within the cyclone, and (maintaining the circle theory) also the spiral motion, whereas Herr Andries combines both in his view. Herr Andries does not, however, regard the difference between the circle theory of M. Faye and his own supposition of a spiral motion of the air, as very essential. It seems to him possible, that in the case of powerful vertical movements in the Tropics, where, in consequence of small diameter and low latitude, the influence of the earth's rotation is less sensible, the motion of the air may take place in nearly circular paths. It is otherwise, however, in high latitudes, where the influence of the rotation is so much the stronger because the cyclones of those latitudes are not so powerfully developed; hence, the constant oval form of the isobars, and the fully developed spiral motion.

PRACTICAL NOTES ON PLUMBING.—LI.*

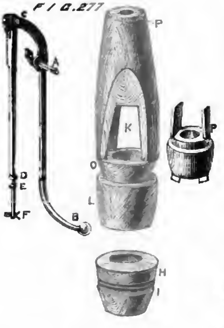
By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 221.)

Sucker Boxes.

WE have seen how to fix the leathered clack to an old-fashioned wood pump, but there are others yet to be seen, as, for example, the wood sucker box, H, Fig. 277. This box is firstly leathered in the following manner. Cut a piece of leather the shape of E F G H J, Fig. 275, then lay it over the hole in the box, and with a scriber or pencil from below, mark the leather all round the hole, lift the leather off, and prick the centre of the hole; next cut the hole for the rivet, but let it fit middling well. Then place the lead clack upon the outside part of the leather, and with the rivet through, place the back of the lead clack upon something hard, such as an anvil or large stone, and turn the rivet nice and true as shown at Fig. 274. The rivet, if properly turned will expand, and so fit the leather tightly. *N.B.—Always put the flesh side of the leather downwards to fit over the seating, or in other words, with the grain or smooth side upwards. All bucket leathers have the flesh side fixed to rub against the barrel.* Having turned the rivet, next take a few good clout nails, for 2½in. and 3in. suckers ¾in. long, and with a fine bradawl bore the holes through the leather, but not into the wood, then nail the leather on to the sucker box, as shown at Fig. 275 and at F, Fig. 278.

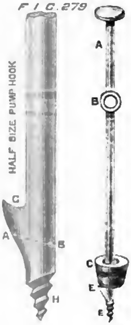
FIG. 277



Towing or Cementing Sucker Boxes.

Next in order is the fixing the tow round the sucker box: this is very simply done, but requiring great care; it is done as follows. Take a handful of tow, spunyarn, or flax, the longer the better, and bring the ends to points as though you were going to thread the eye of a needle, now wrap it nice and true but tight round the centre of the box, as at A, Fig. 278. Let it bulge in the centre as shown, and with some fine twine tie it round. See that your tow is not too large or bulky to enter the pump barrel, nor too small so as to render it useless.

FIG. 279



Pump Hooks.

Now you require a pump hook. This is well illustrated at Fig. 279. H is the taper screw for screwing into the lead clack, as shown at F, Fig. 278. A B C E F, Fig. 279, illustrates the sucker hook, the end of which is passed through the hole in the sucker box, as when in the act of drawing the sucker box.

FIG. 278.

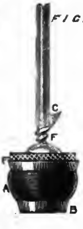
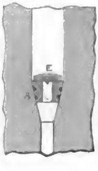


FIG. 280



Fitting or Setting Sucker Boxes.

Now let us proceed to fix the sucker box into the pump barrel as at A E, Fig. 280. First throw a pailful of clean water down the pump to wash out all grit, &c., from the barrel; then take a small ladleful of mutton suet and make it boiling hot; place the sucker box, Fig. 278, upon the floor, and hold it there between the feet. Now take the sucker hook and screw it into the top of the clack, not too far, but just sufficient to carry it. Be careful not to lean too much on one side with the sucker hook when screwing the screw into the clack, or the box will overturn, and the chances are that the point of the screw will break or run into your foot. Now take the sucker hook and sucker in your left hand, and the hot suet in your right hand and pour it over the tow, at the same time turning the sucker box round to prevent the fat running off the tow, *but keep the fat off the leather and face of the clack*. When you have poured in as much suet as the hemp will absorb, turn the sucker downwards and carefully put it into its place, as shown at A, Fig. 280; then press it down; this will prevent the box turning round; now quickly unscrew the pump hook, pull it out, turn the hook as at A, Fig. 279, and with the flat part knock the sucker box down with, say, three sharp blows; this will set the sucker box, and the pump is ready for the putting in of the bucket.

There are other kinds of sucker boxes (see B, A, C, Fig. 280.) B is a brass sucker box with lifting spur or bow for the pump hook. A is the same kind of thing, but with different grooves.

(*To be continued.*)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman.

Associate of the College of Organists, London.

uuu. A FEW words must now be said in criticism of the *Design*: in connection therewith first turn back to what was said with the preceding one (especially at *u*, ante, 1st paragraph).

The present Treatment of course secures, as before, the Clear Coupler for the Supplementation of the Pedale, and it also includes various other good points shared in by the first five of the Treatments given (see therefore again with regard to these, as at *e*, ante and on). Of the special Advantages which the next *preceding* Scheme is the first to secure (see at *r*, ante, 14th parag.) the *present* Treatment retains Nos. 1, 2, and 7 intact; it does not really sacrifice No. 3, because a Forking and Notching of the Key-tails is so simple an operation (see next parag. but two); and it enjoys Nos. 5 and 6 in an actually more available manner; and the Participation of the Swell-Org. Keys in coupling them to the Pedale is of course retained by means of the Forking. Thus, of these seven advantages possessed by the next preceding Treatment, only one, No. 4, is really sacrificed in the present Scheme. It is, however, well to remind the reader of what has been already said (at *u*, ante) with respect to a *disadvantage* which makes its appearance here for the first time; that is to say, the lowering of the Great-Organ Backfalls to a level with those of the Coupler Great-to-Pedale will take up the room that has, until now, existed behind the rear ends of such Coupling-Backfalls,—so possibly rendering the vertical space beneath latter really the measure of the only vertical space available for the *Bellows*. Three *Advantages* which are entirely confined to the present Treatment will be found stated at various points now following.

In remark upon the preceding paragraph it will suffice to observe as follows:—The increasing of No. 5 (facility in Removal of Swell-Org. Keys) is of course of real value; see also concerning this at a little on (next parag. but one). The similar increasing of No. 6 (the keeping down of that portion of the Action which leads from the Key-tails) is as manifestly still more favourable to the placing of the Claviers in a Detached Buffet, while at the same time it gives an advantage in Instruments of restricted height in which a Whole Roller Board is yet demanded beneath both of the Manual Windchests,—because it is desirable that the Squares or Backfalls which act on such Rollers shall be placed below even the lowermost one of the latter. The sacrifice of No. 4 (the Removability of Great-Organ Keys without any disconnection of their Action) is of little moment, because such Keys, being the lowermost ones, will obviously not require taking out before *other Keys* can be got at; and the removal of a Great-Org. Key, when necessary, is here very easy, for there is nothing but a single Button to be unscrewed, and the Cranking of the Wire prevents any difficulty in such unscrewing; also the replacing of the Key is equally free from difficulty, because the Catch-Button (see *uu*, ante, 4th parag.) renders impossible any slipping away of the Wire out of sight or reach; and yet again, it must be remembered that the said Button may be made to partly compensate for its trifling obstructiveness by being utilised for the *Regulation* of its Key (see, however, on this point also in next parag. but one). The taking up of the space formerly existent behind the Man.-to-Ped. Backfalls is a point of somewhat more consequence; but even this is of little real weight, because, whenever it is inevitable that the Bellows be placed inside the Organ proper, they will generally require to extend into the space beneath the Manuals, and in such event the lowering of the Man.-to-Pallet Backfalls to only the level of the Man.-to-Ped. Backfalls, will manifestly not practically limit the actual Bellows-space by one iota.

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With respect to the *Defects* existent in the *foregoing* Treatment (see comm. at *s*, ante), and their retention in or excision from the *present* one, it is to be noted,—that No. 1 (the absence of Participation in the Great Organ Keys as Coupled to the Pedals) is—as before—of course inevitable whenever the present *Clear* Coupler is secured,—that Nos. 2 and 3 (the hindrances which the Stickers of the Swell-Org. Keys present in respect of the Removal and the obtaining of Participation of such Keys) are completely got rid of, and this without involving extra workmanship,—and that No. 4 (the absence of Front Regulation) is or may be much mitigated, if not altogether removed.

In Remark upon the preceding, observe as follows.—For No. 1, see, as before (at *s*, ante, 2nd parag.) for the two ameliorating circumstances. As regards Nos. 2 and 3, it may be considered that the Forking of the Tails of part of a set of Keys, and the requisite treatment of the Square and other Noses entering such Forkings, do not, together, involve palpably more workmanship than the provision of a Sticker Register for the same number of such Keys. The mitigation of No. 4 is brought about in this way:—as there *must* be a Screw-Button on the Great-Org. Key-tail (see again *u u*, ante, 4th parag.), such Button can as easily be made a Regulating one as not; and as the Swell-Org. Keys are now—through the absence of any Sticker either between or connected with them—so very easy of removal in the lump, and the Swell-to-Great Coupler also retains its facility in this respect, manifestly such Regulation of the Great Manual is rendered quite feasible; and this being so, and the said Swell-to-Great Coupler remaining also a Front Regulating one, it becomes quite admissible to complete the Trio by providing the Square-Noses of the Swell-Org. Action with Regulating Buttons (see descrip. at *h*, ante, 9th paragraph—noting the last part of it—and on),—of course securing the Participation of the [Swell-Org.] Keys with the Pedals by providing such Keys with proper Button Clips (see *j*, ante). And such admissibility is still further increased by the fact that although the Swell-Organ Stickers are now again dispensed with, yet the Great-Organ Stickers are not re-introduced, and, therefore, there is nothing to interfere with access to the aforesaid Nose-Buttons, and so to tend to still further elongate such Noses themselves (see again at *u u*, ante, 5th parag.); also the width of such Clip is not here restricted by its having to be contained between two Stickers. It must not, however, be forgotten that the employment of these Clips—though they will of course be applied only to those Keys which Couple to the Pedal-board (see *u u*, ante, 3rd parag.)—will render the *Replacing* of the Key-board more difficult (see again at *j*, ante); and for this reason, and on account of the slight extra cost then involved in the mechanism, the writer does not recommend, even in the present Treatment, aiming at the Front Regulation of either the Swell or the Great Manual, unless the adjustment of such Keys from the *Inside* of the Organ be found impracticable,—or very difficult.

At this point see what was given under the last Design (at *t*, ante), with reference to the *Part* Coupler,—all that is there said holding equally good in the present case.

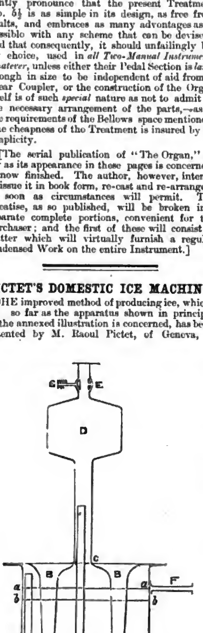
uuuu. As a *Summary* of the present Treatment we may say that all the Advantages existent in the last one are retained here, *excepting* the Freedom (of trifling moment) of the Great-Org. Keys with their Action, and the securing of a little vacant space at the rear of the Backfalls of the two Couplers Manuale to Pedale (such space being only *possibly* of any value). And against these we have to set the facts that two of the said former Advantages are, in the present Treatment, intensified, and that, out of four *Defects* existing in the previous Treatment, two are now entirely got rid of, one is always partly—and may be almost entirely—nullified, and the remaining one is far more than counterbalanced. To all this is to be added the consideration that the present Treatment introduces three entirely new Advantages,—viz., that the Backfalls of the Great-to-Pedale can be removed with increased facility, that the Front Regulation of the upper Manual is also rendered easier, and that a larger amount of vertical space is secured for a Manual Whole Roller-board.

For all the foregoing reasons we may confidently pronounce that the present Treatment No. 5½ is as simple in its design, as free from faults, and embraces as many advantages as is possible with any scheme that can be devised; and that consequently, it should unfailingly be, by choice, used in *all Two-Manual Instruments whatever*, unless either their Pedal Section is *large* enough in size to be independent of aid from a Clear Coupler, or the construction of the Organ itself is of such *special* nature as not to admit of the necessary arrangement of the parts,—as in the requirements of the Bellows space mentioned. The cheapness of the Treatment is insured by its simplicity.

[The serial publication of "The Organ," so far as its appearance in these pages is concerned, is now finished. The author, however, intends to issue it in book form, re-cast and re-arranged, so soon as circumstances will permit. The Treatise, as so published, will be broken into separate complete portions, convenient for the purchaser; and the first of these will consist of matter which will virtually furnish a regular condensed Work on the entire Instrument.]

PICTET'S DOMESTIC ICE MACHINE.

THE improved method of producing ice, which, so far as the apparatus shown in principle in the annexed illustration is concerned, has been patented by M. Raoul Pictet, of Geneva, is intended more especially for domestic use, about two pounds of ice being produced in ten minutes with the minimum of labour and at slight expense. The freezing liquid is anhydrous sulphurous acid, which rapidly extracts heat from surrounding substances as it vaporises. The apparatus is composed, as usual, of a freezer, a compressing pump, a condenser, and a distributor working under the ordinary conditions: but the freezer has peculiar arrangements for constantly supplying the loss, which however is very slight, of volatile liquid, and so the apparatus remains ready for work without any fresh supply for a long time, say, for example, a year. The freezer is represented in the annexed drawing. It consists of two superposed chambers of which the lower is the refrigerator properly so called, working between two levels very close together, and of which the upper chamber is the provision made for reserve.. The refrigerator consists of a cylindrical receiver A, within which an annular vessel B is formed, and from the centre thereof a column C springs, it communicates with the receiver and is swelled out at the top forming an enlargement D furnished with stop-cock E having a nozzle G. The receiver has on its side a small passage F. The apparatus is filled by introducing the volatile liquid by the passage G to fill the whole interior capacity of the refrigerator A to the top of the column C, where it is terminated by the stop-cock E; this forms the charge of the apparatus. When the distributing cock is adjusted, which puts the refrigerator in communication with the condenser, all the excess of volatile liquid above the orifice of the pipe F runs into the condenser to the level indicated by the line *a a*. The liquid evaporating from all its free surface, it is necessary to insure constant equilibrium between the inclosed part of the receiver and the interior of the column C by means of one or more curved tubes of U form as the drawing indicates. The vessel B receives three conical annular moulds filled with water to be frozen; they fit almost exactly against the sides of the vessel B—which, however, contains, as is usual, a small quantity of uncongealable liquid, such as glycerine, to insure the interchange of temperature. When the ice is formed the moulds are taken out and treated in the usual way to remove the ice.



The abstraction of heat necessary to freeze the water in the moulds corresponds to the evaporation of a weight of volatile liquid equal to the difference between the original level *a a* and the level *b b* to which it descends after the freezing. The refrigerator is completely enveloped in a wooden case packed with cork dust to insure its isolation. Its total capacity for the work proposed should be 15 litres of volatile liquid, and each of the three moulds will contain 330 grammes of water—say, together, about one kilogramme.

IMPROVEMENTS IN SECONDARY BATTERIES.

AT a time when secondary batteries are beginning to find their proper level, even in the commercial world, students of this branch of electricity will read with interest accounts of any real improvements which have been made in them.

So long ago as the year 1863, Mr. Fitzgerald described the effect of red-lead in batteries, and suggested its use; but little was done with it until lately, when the Faure accumulator was introduced. Mr. Tribe, who has been engaged on a series of elaborate experiments with secondary batteries, has taken out a patent, in which he claims the employment of a negative plate, composed of, or consisting of, peroxide of lead, substantially as described.

In carrying out the invention he employs a negative plate consisting of peroxide of lead in a solidified or compressed condition, or in any other convenient form, the same being contained in a perforated or porous vessel or receptacle, not being a conductor, nor easily acted upon electrically; or the peroxide of lead may be either employed direct in the condition before mentioned, or precipitated peroxide of lead may be deposited upon the surface of the peroxide of lead. This invention may be carried into effect in the following manner:—

A rectangular frame may be employed, having three sides of prepared wood, slate, porcelain, or any non-conducting substance not easily acted upon by dilute sulphuric acid. The fourth side is completed by the employment of a suitable conductor projecting out of the liquid, and insulated on those parts which are in the liquid, and not in contact with the peroxide of lead. Into or upon this, or some equivalent form of frame, he places peroxide of lead, which, if for example in the form of powder, may be placed into or upon the retaining frame, and subjected to pressure. The peroxide of lead may be employed in a dry or in a moistened condition, either with water or with dilute sulphuric acid. Or one or other of the non-conducting lead compounds—such, for example, as the monoxide of lead, or the sulphate of lead—may be mixed with peroxide of lead, and be subjected to pressure in the retaining frame, and then be converted into peroxide of lead by electrolytic action; or a core of compressed peroxide of lead may be fitted into the centre of the retaining frame, and covered with some suitable lead compound, which may be then converted into peroxide of lead by electrolytic action. The negative element, when prepared, may be sheathed or inclosed in artificial or vegetable parchment, felt, porous earthenware, or other equivalent materials.

When the negative plates, composed of peroxide of lead, are employed in secondary batteries, the positive plates employed therewith may be of any suitable element, and the exciting liquids or electrolytes may be similar to those now employed in secondary batteries.

Mr. W. B. Brain, of Cinderford, patents a method of constructing secondary batteries of a thin strip of lead, folded up with a band of porous material, coated on both sides with red-lead. The porous material may be asbestos, felt, spongy indiarubber, flannel, &c. The lead is poured into chambers, bags, or closed envelopes, which hold the oxidising and deoxidising agent, and holes are punched through from each side roughly, the burred edge and the bulging on the punched side serving to keep the red-lead within the envelope, and in metallic contact with the lead walls, which are thus rendered more rigid.

A greater departure has been made by M. de Lalande, who, in conjunction with M. G. Chaperon, of the Mines d'Alonso, Spain, has patented a new battery, in which oxide of copper is the depolarising agent. The negative element is formed of a rod of gas carbon in a porous cell packed with pieces of carbons, the interstices being filled with oxide of copper. The positive element is of zinc, in a solution of caustic soda or potash. This arrangement is intended for use as a primary battery, but it may be employed as a secondary. Mr. Brush, of Cleveland, Ohio, has obtained an American patent for a secondary battery, in which the plates are formed with receptacles for the oxide of lead, which is compressed after filling.

From these selections it will be understood that recent improvements follow rather the endeavour to hit upon the best shape to work up the lead and its peroxide into convenient forms, than to discover other combinations more efficient and less troublesome, if more costly, than the recent designs. Meantime, it is worthy of note that in several cases the simple Planté is preferred, probably because there are no royalties to pay.

ANIMAL PARTNERSHIPS.

AN intimate connection subsisting between different animals is that known as *Commensalism;* commensals being creatures which may be said to sit at the same table, but which do not prey upon one another. Of late years naturalists have become acquainted with numerous examples of this form of animal partnership, and in the newly issued volume of the "Transactions and Proceedings of the New Zealand Institute," a fresh instance occurring where they seem to be rarest, namely, among the higher animals, is recorded. In one of the Chicken Islands, off the New Zealand coast, lately visited, a curious lizard known as the tuatara and certain species of petrels were found inhabiting the same burrows, apparently on the best of terms. In rare cases the burrow, which consists of a passage 2 or 3ft. long, ending in a chamber 1½ft. long, 1ft. broad, and 6in. high, is the work of the bird; as a rule, however, the lizard is the excavator. Each builds its nest on opposite sides of the chamber, the lizard almost invariably choosing the right, and the petrel the left side. The former sits with its head close to the entrance so as to defend it, and if a hand or a stick be inserted into the passage, the creature bites at it furiously. The Tuatara feeds partly on worms and beetles, and partly on the remnants of fishes and crustaceans brought to their common table by the petrel; both animals being thus benefited by the co-partnery. So much probably cannot be said of the prairie dog, whose underground home on the plains of North America is frequently shared by the rattlesnake and the burrowing owl. These were at one time supposed to form a "happy family," but considerable doubt has been cast on the point by the discovery of young prairie dogs in the stomach of the rattlesnake. In certain parts of South America the rabbit-like viscacha has a messmate in a little burrowing owl, which is thus saved the labour of excavating a home for itself; but in Banda Oriental, where the viscacha does not occur, the owl has to do its own burrowing. Among insects a few cases of commensalism are on record; but the first known instance of its occurrence among caterpillars was recently recorded by Fritz Müller. He found two caterpillars in Brazil living on the leaves of the mulberry. The larger one was protected by a covering of long stinging hairs or thorns; and like most caterpillars similarly protected, its colouring was exceedingly bright and conspicuous. The other—a small blackish form—sat across the back of its gaudy partner, enjoying the protection afforded to both by the surrounding stinging hairs. On removing the smaller caterpillar from its retreat, Mr. Müller found that it made its way back again as quickly as it could. Under an anæsthetic administered to it, the larger caterpillar died, and its hitherto attached friend was then observed to leave it, and to make its way to the back of a living specimen. It is among marine animals, however, that the phenomenon of commensalism has been most frequently observed. The remora is a feeble fish, little able to make its way alone in the world of waters, yet there are few fishes which have a wider distribution. It owes its success in life to the powerful alliances it form. One of its fins has been transformed into a sucker, placed right on the top of its head, by means of which it attaches itself firmly to any passing shark, whale, or even ship—no doubt taking the latter for some huge sea-monster. By these it is transported, without further exertion on its part, over great distances, meanwhile picking up such food as may come in its way. According to Beneden, the fishermen of Mozambique make use of the remora for fishing purposes. Passing a ring, to which a cord is attached, through the tail of the creature, they send it in pursuit of any passing fish or turtle, and so tenacious is its hold, that the object of its attachment is usually secured. Few fishes are better fitted to succeed in the struggle for existence than the angler or fishing frog, which, hiding itself for the most part in the mud of the sea-bottom, hangs out its fishing-rod with tempting bait, right over its capacious mouth. In the branchial sac of this fish, as found in the Mediterranean, an eel is said to reside, and to share in the abundant food supply of the lucky angler. Several small fishes have also been found habitually to lodge in the mouth cavity of a Brazilian catfish, sharing such food as the latter may succeed in capturing.

The marine enemies of the smaller fish are so numerous that it is only by retreating to places inaccessible, or at least distasteful, to their foes that they have a chance of survival. A favourite shelter with many small fishes is the umbrella-like disc of the larger sea-jellies, the stinging properties of which probably cause them to be avoided by the other denizens of the deep. As many as twenty fishes have, according to A. Agassiz, been counted swimming within the fringed margin of one of those pulsating umbrellas. Dr. Collingwood, when sailing in the China seas, once observed a large number of individuals of the sea-jelly popularly known as the "man-of-war," each of which had beneath its bladder, and protected by its long tentacles, a cluster of about a dozen small fishes. He also observed that while every "man-of-war" had its shoal, the fishes under small specimens of this sea-jelly were small, while those under larger ones were correspondingly big. The same naturalist-traveller was among the first to notice the existence of a fish-sheltering sea-anemone. He discovered on a reef in the neighbourhood of Labuan an anemone which, when expanded, measured fully two feet in diameter. Over this monster zoophyte there hovered a pretty little fish, which, when driven off, invariably returned to its former position. Suspecting some connection between fish and anemone, he began raking about with a stick in the body of the latter, and succeeded in dislodging six similar fishes from the body cavity of the zoophyte. From the ease with which they allowed themselves to be captured, they were evidently unaccustomed to swimming far beyond the protection of the stinging tentacles of the anemone. The holothurians, or sea-cucumbers, are another group of lowly marine forms which afford shelter to fishes. The eel-like fishes forming the genus *Fierasfer* have this habit; but they are not the only commensals of those accommodating sea cucumbers. Professor Carl Semper, when investigating this subject among the Philippine Islands, found shrimps and pea-crabs as well as the *Fierasfer* living within the respiratory cavity and sharing in the food supply of a single holothurian. He further states that he has seen specimens which, in this matter, bore a considerable resemblance to an hotel with its table d'hote. A co-partnery, profitable to both parties, exists between several species of crabs and sea-anemones. In the China seas there is a crab which invariably has the same species of anemone on its back, while the latter, it is said, is never seen apart from the crab. By this association the normally sedentary anemone becomes as locomotive as the roving crustacean, while the crab gladly bears the burden for the protection its commensal fortress affords. Further, there is the hermit crab, which tenants a molluscan shell, but which also contrives to have a particular species of anemone always attached to its adopted home. How friendly the two are was shown by Mr. Gosse, for when he removed the anemone he found that the hermit invariably took it up again and held it patiently, in its claws, against the shell, for about ten minutes at a time, until it had fairly taken hold again. There are other two species of crabs noticed lately by Professor Möbius, which have the singular habit of taking a sea-anemone in each claw and of thus carrying them about. With their tentacles expanded, these zoophytes probably serve to screen the crabs from the observation both of their enemies and of their prey, just as certain other crustaceans cultivate a colony of polyps on their backs with the view, or at least with the result, of deceiving the creatures for whom they lie in wait. Other instances might be given, such as that of the little pea-crabs found occasionally in mussels and other bivalve shells, which, in return for the protection afforded by the molluscan shell, gives its host a share of the food it captures. These, however, will suffice to show how widely prevalent commensalism is throughout the animal kingdom.

HYDRAULIC MACHINERY.—VIII.[*]

By Prof. PERRY.

(*Concluded from page* 223.)

IN commencing the last lecture of the course, Prof. Perry stated that it was no part of his object to discuss structural details, but he referred to the main features of such hydraulic works as the lifts at Seacombe pier on the Mersey, the famous canal lift on the river Weaver, the machinery for elevating heavy guns, and the hydraulic dock, by means of which a vessel can be elevated bodily above the surface of the water. He then proceeded to describe the principles of transmitting power by means of water, taking the work of the Hull Hydraulic Company as the example. The idea was first mooted by Bramah in 1802, but it was not carried out until, many years later, Sir W. Armstrong took it up, and applied it over considerable areas. Prof. Perry thus described the Hull works:—

Here you see a station where two centrifugal pumps bring water from the river to a tank. Two pairs of reciprocating-pumps supply this water to an accumulator, at 700lb. per square inch. The ram is 18in. in diameter, stroke 20ft., total load 80 tons. A 6in. cast-iron pipe leads off the pressure-water from the accumulator, just as gas is led off from a gas-holder. Any person living near this line, who wants to work a hoist or crane, to drive a water-pressure engine for any purpose, such as that of haulage, can get a supply of this pressure-water which will do work for him when he opens his tap. And pray remember that every cubic foot of water he draws from the main can give up for his benefit 100,800 foot-pounds of work; that is, can exert a horse-power for three minutes. Remember, too, that the instant a person closes his tap, that instant he ceases to receive power. His crane or other engine works only when he keeps his tap open, and whether he keeps it working regularly or intermittently, he wastes no energy, and nobody is the loser by his working by fits and starts, instead of in a regular manner. If he used a steam-engine to drive his hoist or other machine directly, he would waste a great deal of energy by his intermittent action. Each consumer makes a yearly payment for a certain specified quantity of pressure-water, and beyond this quantity is charged at the rate of 4s. per 1,000 gallons, that is, he receives one-horse power for 6d. an hour.

I have one more fact to put before you. Mr. Ellington says, in a paper published last year, that for the eighteen months previously no repairs had been needed in this mile of 6in. pipes, sunk two feet below the street, and meandering in the most confused manner among gas and water mains, under exceptionally unfavourable conditions of soil and traffic. And now, supposing it is easy to get such a supply of pressure-water, what, besides cranes, hoists, and pressure-engines, can be worked by means of it? All forging and welding machines, which with moulds and dies properly shaped and pressed together with enormous steady force, seem, for objects of settled shapes, to be a very great improvement on any method of hammering; stamping machines, for all sorts of purposes; bending machines, for joggling and bending angle-irons, rails, and beams, and for riveting. It is, perhaps, in looking at the little hydraulic riveter, rather than in any other example, that you will be struck by the simplicity of hydraulic working. The flexible pipe transmits power more faithfully than huge beams and cog-wheels would do.

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[*] Condensed from a series of Cantor Lectures delivered before the Society of Arts.

I pointed ont, in my last lecture, that the total weight of water in a tank A, at a short distance, may be made to act like the total weight placed on an accumulator. This water flows from A to D, or from D to A, but is not wasted. E is the accumulator-press. The pressure-water is pumped into E by means of a portable engine, or by a horse gin, or in any other suitable way. The accumulator may move about along with the riveter, so long as we do not go very far away from the fixed tank. A, and so long as the pipes, B, are wide, aud have easy bends. Now you will observe that in no case does Mr. Tweddell endeavour to drive lathes or planing machines which have pretty regular speeds, but vary in the power required. The machines to which he applies his hydraulic methods of working are very different. A punching, or shearing, or stamping, or riveting machine, driven by shafting, repeats its stroke at regular intervals, and the workman cannot arrest a stroke. He wastes time in waiting for a stroke, but when a stroke is being made, and he sees that his plate has been wrongly placed, or has shifted its position, he must just as patiently watch the inevitable completion of the stroke. With the hydraulic punching-machine, on the contrary, the workman can stop the motion at any instant, even if the punch has made its mark on the surface of the plate. He can start instantly from a condition of rest, he has not to wait till he pulls the belt on to the fast pulley, or starts the donkey-engine, and he knows that when there is no stroke being made, there is no power being wasted. Then, again, all the shafting and other machinery of a large shop have not to be set in motion, or varied in their motion, to punch a ⅞ths of an inch hole. A man wastes just the same energy in punching this one hole as if it were one of a hundred he was punching. Suppose, again, that a man carelessley puts a 1¼in. plate under a punch arranged for a ⅞ths inch plate. The sudden blow of an ordinary punching-machine, with its fly-wheel, would produce a fracture somewhere. In a hydraulic-machine there is a simple stoppage. Think, too, of the strength of roof and columns needed to carry shafting; of the trouble in the use of overhead cranes when there are many shafts and belts, and, above all, think of the noise, in comparison with the invisibility of pressure mains, and the dead silence of hydraulic tools. Observe, too, that these hydraulic machines need but little foundation.

We are compelled, however, to come to the conclusion that with nearly the same velocities in any hydraulic arrangements, we have far more frictional loss when the pressure is great than when it is small. If you ask me how I can explain this apparent discrepancy from received ideas, I can only say that to me the subject is quite chaotic. It seems certain that when the flow of water is unsteady, there is far more loss of energy when the pressure is great than when it is small. It would seem also that, when the fluctuation originates in places of higher pressure, there is less loss than when it originates in places of lower pressure; for a reciprocating pump is always more efficient on high lifts than on low lifts at the same velocity.

In the absence of experimental evidence, we can only fall back upon our knowledge of such pressures as are common in town water supply, and our knowledge of reciprocating pumps, and continue to assume that water friction, when the motion is steady, is independent of pressure. What is the reason why we get such good results in working hoists and cranes by water? The water which comes along these pipes possesses great pressure energy. The more water that flows in these pipes, the more less there is in friction; but the power sent along depends on two things—the quantity of water per second, multiplied by its pressure. Increase the pressure then, and send the same amount of water; you have the same total loss of energy by friction, but you have transmitted much more. Suppose Mr. Tweddell can make his joints as safe from leakage as Armstrong can his, every pound of water that Mr. Tweddell sends, at 1,500 pounds pressure, contains 3,400 foot-pounds of energy; and every pound of water that Armstrong sends, at 750 pounds pressure, contains 1,700 foot-pounds of energy. Suppose they send the same quantity of water steadily along the same pipes, and that Armstrong loses 300 foot-pounds of energy per pound of water, then Tweddell loses the same amount. That is, the one wastes 18, and the other 9 per cent. of his total energy in transmission along the same pipes. But there is really more than twice the efficiency, for if Tweddell sent only the same amount of energy as Armstrong, he would use only half as much water, that is, the velocity everywhere would be halved, the kinetic energy would be quartered, and, as frictional loss in steady motion is proportional to the kinetic energy, there would be only 75 foot-pounds of loss in friction, with the high pressure arrangement, and hence, instead of 9 per cent., we have only 2¼ per cent. waste. In fact, then, Armstrong would have 18 per cent., and Tweddell only 2¼ per cent. of waste. Of course, however, Tweddell's pipes, being of the same diameter, would have to be much thicker and more costly.

To take the general case of transmission of power by water, Darcy's experiments tell us that each pound of water loses $f\frac{4\,L}{d}$ times its kinetic energy in flowing along a straight pipe of diameter d feet, length L feet, where f may be taken for a new 6in. pipe, 0·0058. Or if Q cubic feet of water flow per second, and if P was the original pressure in pounds per square inch, then ·262 P Q is the horse-power which enters the pipe, and $\cdot000665\ L\ Q^3 \div d^5$ is the the power lost on the way. Thus, if E is the horse-power entering the pipe, the power lost is

$$\cdot00025\frac{L\ E^3}{d^5\ P^3}$$

Hence, taking a 6in. pipe with the pressure of 700lb. used by Sir William Armstrong, we obtain the above results.

With high pressures, it is possible to transmit an enormous amount of horse-power great distances, through moderately small straight pipes, with but little loss. Neither mere distance nor cost, then, introduces obstacles to the transmission of the whole power of Niagara over the United States. It is the bends, the shocks, the difficulty of using the power when it arrives, by means of quick-moving engines—these are the things to fear in such transmission of energy.

Remember that we convert our energy at a place, A, into pressure energy of water, and this must be performed by pumps which move with only a moderate speed. If our source of power is a waterfall, this works a turbine; the quick-moving turbine has to work slow-moving pumps. Then at the distant place, B, to be sure, we receive the water with only a small diminution of its pressure energy; but you saw that in cranes and hoists, and even in those beautifully arranged tools, it was not so much economy in use as something else that made the use of water so convenient.

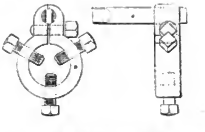
But while I think that general transmission of power will in the future be effected electrically, I know that for special cases of power transmission hydraulic methods have the advantage. I cannot imagine pressing machinery worked by electricity, nor any one of the tools of which I have spoken to-night. As I have already hinted, I believe that turbines have a great future before them, not in opposition to, but in consequence of, electrical development. Electricity cannot work canal lifts, nor do I see any chance for it in crane work; and when certain sanguine electrical people speak of electrical methods of working hotel hoists, I feel that, if such a useful future is in store for them, they must be as the adjuncts of Mr. Ellington's hydraulic balance method. Hydraulics will do the balancing, and electricity will produce the motion.

IRON-MAKING DIRECT FROM THE ORE.

A PROCESS for making iron direct from the ore has been patented by Mr. J. C. Bromfield, Hove, Brighton, and is thus described. The iron ore and coal are reduced to a powder by a machine such as Blake's crusher after having been calcined in ovens above a tank filled with water, into which the roasted ore passes direct from the ovens. The ore then becomes disintegrated and friable, and the cost of reduction is afterwards very small. The crushed iron ore and coal dust are then mixed, and to them is added carbonate of lime, which is also powdered ready for mixing, as well as alumina or sand. The proportions of each depend on the quality of the material used, and vary according to the nature of the iron in the different districts. The materials are then passed through a mixing machine and brought into a plastic state by the admixture of mucilage, obtained from steaming seaweed in a close jacketed boiler, the seaweed being afterwards submitted to hydraulic pressure. The mucilage thus obtained has the effect of cementing the pulverised materials, which are discharged at the end of the cylinder into the hopper of a brick or tile-making machine. The compressed materials issue from the machine, either as bricks or continuous solid cylinders, into trucks or barrows, and are removed at once to the retort, there to be consolidated into coke by a process of distillation in a furnace, from which the gases are led and disposed of, either for lighting purposes or for being burnt as a fuel under the furnaces. The retorts are made in two parts; the lower, which is used as a cold coke chamber, is made of wrought iron; and the upper, which is conical in shape, is of fireclay, in combination with either carbonate of lime or calcium oxide. The object is to absorb the sulphur given off from the material being coked during the process of gas distillation. The lime, which should be in a caustic state and thoroughly blended with the particles of the fuel, should arrest and combine with any sulphur which may exist in the incorporated materials, whilst acting still more efficiently and quickly than it ordinarily does in forming a flux with the intermixed silica. Each block or brick of the compound will thus be subjected to cementation in a carbonaceous matrix, which is firmly held together by those ingredients, which are intended to flux the whole mass when the melting zone of the furnace is reached. The saving in fuel and the increase in the output of each furnace are due to the same cause, the greater quickness with which the smelting reactions take place, and the much lower temperature required.

DOG FOR MILLING MACHINE.

MR. A. B. LANDIS contributes to the *American Machinist* the following sketch of a dog for use on planer, shaper, or milling machine centres, which is new to him, and is he thinks a very convenient tool.



The convenient feature is that the same distance is always retained from the centre of the work, or mandrel, to the tail of the dog, by means of the three set-screws, by which the work is always held central in the dog. The device on a planer centre for securing the dog is generally a fixed distance from the centre, and with this tool, for the different sizes of work, the tail will always come in the same place. The body of the dog, B, is made of wrought iron or steel, with three set-screws equally divided, and has a lug, of proper distance from the centre to suit the centres it may be made for, with a hole bored through it of suitable size to receive the tail A (which is a piece of turned steel flattened on one end). The metal is sawed through from this hole to the centre or large hole of the dog, and a screw used between the two for the purpose of clamping the tail, as will be readily seen by the sketch. By this separate or adjustable tail, the flat part of it can be turned to suit the clamping device on centre, and can also be made long or short, by moving it back and forth, to suit the work. Or, if required, two separate tails can be made—one long and one short one.

HOW IS MILK MADE? *

By Dr. G. C. Caldwell.

THE essential milk-producing part of the udder is made up of a series of ducts or tubes branching out from reservoirs at the heads of the teats, joining one another at little sub-reservoirs, and separating and uniting again, till finally they end within minute organs called vesicles or follicles. Both Dr. Sturtevant, of the New York Experiment Station, and Mr. Arnold, have traced these ducts to their sources. These follicles are the fountain heads whence the milk is collected by the ducts and carried through one reservoir after another to the teat. The three essential ingredients of the milk, besides the water, are the fat, in the form of minute globules, suspended in the liquid: the caseine, partly in solution in the water of the milk and partly in solid grains suspended in the liquid; and the sugar only in solution. Nearly all authorities agree that the formation of the milk is attended with a rapid production of new cells, very rich in fat, in the follicles; and the most generally adopted view is that these cells drop off, and fall to pieces by what is called fatty degeneration, and that their investing membranes or cell-walls become dissolved; thus, especially, the fat of the milk is produced; and some think that all the constituents of the milk are really nothing but cell ruins, taken up by the water that must come directly from the blood even if nothing else does, and conveyed away through the ducts and reservoirs to the teats.

But Dr. Sturtevant maintains that the fat-globules of the milk are really the cells themselves that are so rapidly multiplied in the follices—that each globule began as a bud on a parent cell in the follicle, grew and then dropped off, and was taken up and washed along by the water containing the caseine and the milk-sugar in solution, which has been transuded from the tissues; with him Mr. Arnold agrees. This theory requires that each milk-globule shall consist of a membranous sac inclosing fat; but the existence of such a membrane or envelope around the fat-globule is almost universally disbelieved by microscopists, for nearly all who have given the subject their careful attention fail to find satisfactory evidence thereof; it will be, therefore, a battle of a few against a multitude to establish the fact of such a structure of the milk-fat globule; but in a battle fought with such weapons the victory is not always with the party that is strongest in numbers.

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* From the *New York Tribune.*

Fleischmann, than whom there is no better authority on matters pertaining to milk, is not entirely satisfied with the theory that the milk is made up of cell-ruins alone. He shows that if this were so, in the case of a good milch-cow the dry weight of cell substance broken down every day would be not less than 5·5 pounds, or more than twice the weight of the dry substance of the milk-glands of a well developed udder. While allowing that there is much strength in the position of those who argue for milk production by cell destruction, he claims that there must be some secretion, or straining through as it were, of a part of the substance of the milk, directly from the blood which circulates freely and abundantly through the glands.

But even with this partial acceptance of both explanations we are not yet altogether enlightened as to the manner in which the milk is produced. Unquestionably, however, an important and a peculiar work is done in these glands; there is produced that mixture of the three essential ingredients of food, the albuminoids, the fat, and the carbhydrates, which makes milk the type of a perfect food; and there originate those substances peculiar to butter fat, the butyrine and its associates, which are not found anywhere else in the animal body; they distinguish this fat in a marked manner from any other fat, whether animal or vegetable, and enable the chemist to tell with unerring directness whether a sample called butter is butter or something else.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE first meeting after the summer vacation was held at the Society's rooms, Burlington House, on Friday, November 10th, at eight o'clock. E. J. Stone, Esq., F.R.S., president, in the chair.

Prof. Pritchard read a paper, entitled "On Certain Deviations from the Law of Apertures in Relation to Stellar Photometry, and on the Applicability of a glass wedge to the Determination of the Magnitudes of Coloured Stars." He said: I have been engaged for some time in the examination with a wedge-photometer of the relative brightness of all the naked-eye stars, from the Pole to the Equator, down to the fifth magnitude. In the course of this research, a doubt arose as to the perfect accuracy of the law which expresses the ratio of the amount of light transmitted by varying the apertures of the object-glass. Hitherto the perfect accuracy of the assumption that the light transmitted varies with the aperture has been assumed. I was led to doubt the accuracy of the assumed law from a consideration of the complex construction of the object-glass consisting virtually of a series of reversed wedges of two different kinds of glass, and of different thicknesses. The late Mr. Johnson found, from a series of experiments, that one of the halves of his heliometer transmitted more light than the other, in the ratio of 1,000 to 924: probably the central parts of the Oxford objective are more transparent than the outer parts. In order to test this it was necessary to ascertain, by means of my wedges, the relative amount of light transmitted—first, by the full aperture of 4in.; secondly, by the reduced aperture of 2in., and thirdly by the full aperture, having a circular patch of 2in. in the centre cut out. But instead of having recourse to this process, which would have required time and many observations, I thought it better to examine the different parts of my wedge by a method similar to that which has been so successfully employed by Professor Pickering—namely, by means of a double image prism of quartz, and a Nicol prism. The wedge was examined at every tenth of an inch throughout its extent, and its general uniformity was established to a degree which I had hardly ventured to expect. The conclusion I arrived at was that on the hypothesis of the practical uniformity of the wedge the measures of light would not be affected by an error greater than $\frac{1}{10}$th of a magnitude. While engaged in the foregoing inquiry as to the capacity of the wedge as regards the uniformity of its absorption of ordinary light, I availed myself of the opportunity of examining its effect on lights of different colours. With this view I interposed coloured glasses and other coloured media between the sources of light and the wedge, and I ascertained that within the limits of our unavoidable error, the same thickness of wedge practically absorbed the same proportion of light, whether its colour was red, orange, green, or blue. Another question remaining for consideration is the effect of the atmosphere on the light of stars seen at different altitudes. When above 50°, the difference in the amount of atmospheric absorption is too small to be allowed for, but at lower altitudes the effects are so variable that sensible errors might easily be admitted from that cause. In order to make observations in regard to this I intend to go to some southern station, probably Cairo, and collect additional information.

Mr. De La Rue asked whether Prof. Pritchard had made any experiments as to the diminution of aperture with reflectors as well as with refractors. Mr. Christie asked Professor Pritchard whether he had been able to take into account the different size of the diffraction images of stars as seen with a large aperture and a small, and how that would bear on the different ratios of brightness as estimated from the different thicknesses of the wedge necessary to reduce them to an equality.

Professor Pritchard: First, with regard to Mr. De La Rue's question, our work has been very laborious, and we have not had time to go into the question of reflectors as well as refractors. I cannot see that any great difference need be expected except what may arise from differences of polish of different parts of the reflector. It was very probably a difference of polish that caused the difference between the two halves of Mr. Johnson's heliometer, for the glass of the two halves would probably be equally translucent. With regard to the Astronomer Royal's question, we must be careful to avoid the use of very small apertures, which would cause largely diffused discs. We have not experimented with small limiting apertures. We occasionally halved the aperture, and went on with the work, without taking the consequent size of the diffraction discs into account. I suppose the results must be correct, because they agree with the measures made by Prof. Pickering, many thousand miles away. With the help of this method we shall get a catalogue of stars which can be depended upon to within one-tenth of a magnitude.

Mr. Knobel read a paper by Mr. Gill, "On Observations of Comets, 1881, II. and III., of Wells's Comet, and of the Great Comet of 1882," made at the Royal Observatory, Cape of Good Hope. Mr. Gill described how he saw the comet on returning home from the observatory on the 8th of September. The next day it was only necessary to hide the sun with the hand, and the comet was seen as a sharp and bright object. He secured meridian observations of it, as well as observations with the great Indian theodolite. On the 17th and 18th the nucleus appeared like a star of the first magnitude seen in the day time; as seen with the telescope, the change in the form of the nucleus from day to day as it approached the sun were very interesting.

Mr. Finlay, first assistant of the Cape Observatory, described several observations he had made. On Sunday, Sept. 17th, the comet was visible all day, and was observed with a 6in. equatorial with a power of 110 and a neutral-tinted wedge. At 4h. 40m. the sun's limb was visible at one edge of the field, and the silvery light of the comet was visible at the same time. The comet was approaching the sun's limb very rapidly. He kept the sun at one edge of the field, and followed the comet right up as it approached, until it came right up to the boiling limb, when he lost sight of it suddenly. He thought for a moment that he had a glimpse of it three seconds later, but afterwards could not detect it; the sun was then very low, and the definition bad. Mr. Elkin's report stated that on the 8th of September the comet appeared about as bright as a star of the 3rd or 4th magnitude, with a tail 2½ or 3 degrees in length; the breadth of the coma was estimated at 40 or 50 seconds of arc; the southern edge of the tail was sharply defined, but the northern faded away more rapidly. The comet's light appeared simply white. With a power of 60, and the light of the sun screened down with wire gauze screens, the amount of false light rather impeded the visibility of the comet.

Mr. Elkin also watched the comet up to the sun's limb, on the Sunday, and saw it disappear at 4h. 50m. 52s., Cape time. The observation was made as accurately as the observation of the occultation of a star of the 4th magnitude can be made at the limb of the full moon. Before coming up to the limb, the nucleus and a small portion of the tail which were visible, seemed scarcely inferior in brilliancy to the sun's surface itself. It was not possible at the time to say whether the comet was passing between the sun and the earth, or behind the sun's limb; but the former has subsequently proved to be the case. The comet's invisibility on the sun's disc would therefore seem to show that observations of comets seen as dark bodies on the sun's disc are improbable.

Mr. Knott asked if there were not observations by Mr. Finlay and Mr. Elkin which did not accord with Mr. Hind's orbit, as deduced from the observations made since the perihelion passage.

The President said: There is another paper by Messrs. Finlay and Elkin, which gives an orbit which agrees within about five seconds with the later observations. This is a quantity which is quite within the errors of observation.

Mr. Penrose said he had been unable to get observations of the comet previous to perihelion besides those telegraphed by Mr. Gill. Crull's observation was totally discordant with any possible orbit deduced from recent observations. He had worked out the orbit of this comet graphically, and found that there was a difference between the observations since perihelion and those made by Messrs. Finlay and Elkin before perihelion, which could not be reconciled without supposing that there was a shift of more than a couple of degrees in the place of the node, which must have occurred at about the time of perihelion passage.

Mr. Ranyard said: It must not be assumed that, because this comet was not seen upon the sun's disc while it was passing between the earth and the sun, that no other comet could be seen under similar circumstances. There was an observation of Pastorf, in which he drew a nebulous object with a bright nucleus upon the disc of the sun, which was supposed to be the comet of 1819 seen in transit. There were facts which threw doubt upon this observation; but the fact that this comet had not been seen in transit must not be taken as conclusive evidence that Pastorf could not have seen such a body. The relative brightness of the comet to the sun would no doubt depend upon the comet's distance from the sun. We had had an instance of a comet which was seen as a dark object projected upon the corona of 1871, and another comet which was seen as a bright object with the corona in 1882. We cannot suppose that this comet was as hot as the sun, and yet here was an instance of a mass of comparatively cool gas between us and the sun which did not sensibly absorb the light from the hotter background.

Mr. Brett showed a picture of the comet in which the brightness of the further end of the tail degraded very rapidly, showing a sharp-pointed spike with an excrescence on the northern side of the tail.

Mr. Common described upon the black board the appearance of the nucleus, as seen in his great reflector. It was at first decidedly elongated, and afterwards became double. The southern edge of the tail was decidedly brighter and more defined than the northern edge.

The meeting adjourned at ten o'clock.

PRACTICAL RECIPES.

Yellow Dye from Poplar Twigs.—The young growth of the poplar tree yields a dye which may be extracted as follows: The young twigs and branches are bruised and boiled for twenty minutes with a solution of alum, 10lb. of wood requiring 1lb. of alum, in 3 gallons of water. The solution is filtered hot and allowed to cool, and, after standing some time, is again filtered from a resinous deposit. On exposure to air and light it develops a rich gold colour, and may be used directly for dyeing orange and yellow shades upon all classes of goods.

Artificial Gems.—The following formulæ are used in Bohemia for making imitations of some of the precious stones:—Imitation agates.—10 kilos quartz, 17 kilos red-lead, 3·2 kilos potash, 2·2 kilos borax, 0·1 kilo arsenic. The quantity of chloride of gold added is equal to that obtained from 0·4 of a ducat. Agate glass.—10 parts of broken glass is melted, and to it are added 0·15 part suboxide of copper, the same quantity of the oxides of chromium and of manganese, 0·02 part each of oxide of cobalt and nitrate of silver, 0·01 oxide of uranium 0·4 red argols, 0·3 part bone-meal. Each oxide is added alone and at intervals of ten minutes. After heat-for an hour, 0·3 or 0·4 part of fine soot is put in. Red Marble.—80 parts of sand, 40 of potash, 10 of lime, 2 of table salt, 1 of saltpetre, and 0·1 of arsenic. The mixture is melted, and then 25 parts of suboxide of copper and 1 part of saltpetre mixed in. Artificial turquoises are made in Paris and Vienna from phosphate of alumina and phosphate of copper mixed together and subjected to hydraulic pressure. Even in chemical composition it resembles the natural mineral, which is a hydrated phosphate of alumina with 2 per cent. of oxide of copper.

A New Vegetable Styptic.—A recent number of the *Neue Freie Presse* states that during the French expedition to Mexico a plant was discovered, called by the natives by a name which may be rendered as "Fowlwurt" (Tradescantia erecta, Jacq.), which has the property, when chewed or crushed, of stopping any hæmorrhage. A specimen planted in 1867 by the discoverer, in his garden at Versailles, has not only flourished, but flowered and fruited, without having its peculiar properties as yet appreciably diminished. Although no exotic, or remarkable for particular beauty of bloom, it, nevertheless, deserves a wider extension on account of its valuable properties, especially as its acclimatisation may be regarded as having been fully established. Its action exceeds that of all styptics as yet known, as, for example, perchloride of iron, and it can, moreover, be very cheaply procured.

SCIENTIFIC NEWS.

THE anniversary meeting of the Royal Society will be held on Nov. 30, when the medals for the year will be presented as follows:—The Copley to Prof. Cayley, F.R.S., for his numerous researches in pure mathematics; the Rumford to Capt. Abney, F.R.S., for his photographic researches, and his discovery of the method of photographing the less refrangible part of the spectrum, especially the infra-red region; a Royal medal to Prof. W. H. Flower, F.R.S., for his valuable contributions to morphology and anthropology; a Royal medal to Lord Rayleigh, F.R.S., for his papers in mathematical and experimental physics; the Davy Medal (in duplicate) to D. Mendelejeff and Lothar Meyer, for their discovery of the periodic relations of the atomic weights. At the same meeting the council and officers will be elected. The following is the list proposed:—President, W. Spottiswoode; Treasurer, Dr. J. Evans; Secretaries, Profs. G. G. Stokes and M. Foster; Foreign Secretary, Prof. A. W. Williamson; other members of council, Prof. W. Grylls Adams, J. Ball, Dr. T. L. Brunton, Prof. H. Debus, F. Galton, Prof. O. Henrici, Prof. T. H. Huxley, Prof. E. Ray Lankester, Prof. J. Lister, Prof. J. Prestwich, Prof. O. Reynolds, Prof. H. E. Roscoe, the Marquis of Salisbury, O. Salvin, W. W. Smyth, and E. J. Stone.

Dr. Oppenheim, of Berlin, has computed an orbit of the small comet discovered by Dr. Schmidt, of Athens. He gives the date of perihelion passage as Sept. 24, near midnight. Some elements present a similarity to those of the Great Comet, but considerable difference is found in others, so that the direct connection of the two comets is at least doubtful.

The steamer *Neptune*, carrying supplies for the Arctic observing station at Lady Franklin Bay, has returned, having failed to reach a higher latitude than 79° 20' N. On the 24th of July she was beset with ice, and a few days later found an unbroken ice barrier extending across Smith Sound. On the 9th of August the vessel was beset with heavy ice, and narrowly escaped the fate of the *Eira*. By the 25th of that month there were already signs of approaching winter, and on the 4th of September, new ice having formed, the ship's head was turned southwards, the stores and boats being landed on Cape Sabine and Lytellton Island, about three degrees south of Lady Franklin Bay.

The various offices, the engine-room, and part of the works of the Amsterdam Gas Company are illuminated by Maxim incandescent lamps, the dynamo being driven by a gas-engine. A battery of 36 Planté accumulators is interposed between the machine and the lamps, for the purpose of obtaining steadiness; and it is found that it is capable of supplying the current required during the night when the engine is stopped.

M. Marcel Deprez's statements as to the energy transmitted by electricity over an ordinary telegraph wire between Miesbach and Munich are criticised by M. Hospitalier and others. M. Deprez claimed a return of 60 per cent.; but such a result is found to be impossible under the most favourable conditions as to insulation. M. Deprez calculates that the return is equal to the ratio of the speed, where the dynamo machines are exactly alike. M. Cabanellas has recently presented to the Academy of Sciences, of Paris, a paper, in which he holds that "in the transmission of mechanical energy by means of two identical dynamo-electric machines, the ratio of the speeds does not express the value of the return. The return is equal to the product of the ratio of the speeds into the ratio of the fields"—a theory which tends to show that only 20 per cent., instead of 60, was returned in the experiments of M. Marcel Deprez.

In Lowell, Mass., there is a telephone for every 62 inhabitants, although the population numbers some 20,000 mill-hands. In Portland, Maine, there is a telephone for every 50 inhabitants. The telephones do as much business as the telegraph lines between those cities, and yet the telegraph company does 50 per cent. more business than it did two years ago.

Mr. Stroudley proposes to work signal and point levers by means of compressed air, the object being to relieve the men of the heavy labour now required, when signals and points are at a distance. As the invention received only provisional protection, there are presumably some insurmountable difficulties in the way of a reform which would be gladly welcomed.

Mr. J. Morris, of Uddingston, has patented a method of obtaining aluminium. Alumina and carbon, or carbonaceous substances, are submitted to a temperature of ignition in a close vessel, and subjected to the action of carbonic acid. Carbonic oxide is produced, and the alumina is reduced in whole or in part to aluminium. The specification (No. 1058, 1882), was "out of print" soon after it was published, and has not yet been reprinted.

At a recent meeting of the Manchester Geological Society, Mr. Joseph Thompson described an ingenious arrangement for indicating on the surface the quantity of air passing through a mine. It is an adaptation of the Robinson cup anemometer, which by an electric contact arrangement would indicate a revolution by the blow of a little dead-beat hammer on the glass or porcelain dial in the office. Counting the beats in, say, 30 seconds, the manager would readily calculate the volume of air passing through the working in which the instrument was placed.

A system of transmitting energy by means of air is, according to the *Times*, about to be tried in Paris. There is a central station with engines keeping in the system of pipes a vacuum of about 22in. of mercury, and in the houses of the subscribers are "rarefied air motors," by M. Tatin, which are arranged to work at an average speed, so that there will be an easy method of charging subscribers for their consumption of power. Apparently this method of transmitting "force" is to be applied over a distance of 600 metres.

A lightning-conductor of very faulty nature may *sometimes* protect a building. Such a case lately occurred (M. Hirn says) at Colmar; a thin iron rod about 26ft. long had a conical brass point screwed on the top, and was connected below by means of a series of pieces of thin wire, having terminal eyes, with a block of iron (about 20in. long) in the ground. In a violent thunderstorm the brass point was fused, but the current seems to have nowhere left the conductor. The mere fact of a lightning discharge on the point of a conductor is proof (M. Hirn insists) of vicious construction. During more than 40 years' observation he has never seen lightning strike one of the 40 or 50 lightning rods on the factories of Logelbach. Yet, during a thunderstorm, these rods are in active operation. Through wires, led round iron bars, from the conductors uninterrupted magnetising currents flowed, M. Hirn found, nearly always, on passage of a thunderstorm. He was even so bold as to separate a conductor with a fine piece of caoutchouc, and connect the ends means of thin copper wire to a current-electrometer. The needle generally oscillated in a thunderstorm, and the bar in the helix was strongly magnetised; but the copper wire was never fused.

Abbé Gras has sent the editor of *Les Mondes* an account of a grey parrot of remarkable intelligence, which he got from the Gaboon four years ago. It was extremely wild and timid at first. "Coco-Gris" (as he is called) has now more than fifty phrases at his command, which he gives perfectly; and he sings and whistles many airs. His remarks are strikingly apropos. When going to his cage, he says (in French, of course), "We'll go to the cage." When he swings: "Coco-Gris is swinging." When Cocotte (a green Brazilian hen-parrot given him for companion), screams, he says: "Come, Cocotte, you must not scream; sing." If she sings: "You sing well, very well, indeed." On asking "Who sings?" the reply is, "It is Cocotte." If Cocotte goes into the cupboard, Coco leans forwards, and says: "What are you doing there, Cocotte?" When the Abbé speaks somewhat loudly to his servant, Coco breaks in: "How—what—don't you understand?" Coco was lately taken on a railway journey, and after some hours' silence, came out of his cage, and asked, in a frightened way, "What have they done"? He repeated this several times, and said hardly anything else. At the end of the journey, he was reproached for not eating; but said: "I was not hungry." Other examples are given. The Abbé says he can produce numerous witnesses to the truth of his account.

One result of the Munich Electrical Exhibition has been the formation of a (so-called) Consortium or company, with a view to promoting the application of electricity to practical requirements. It is presided over by Herr v. Maffei. In the first place, where the introduction of electro-technical methods is regarded as possible, the company will offer a helping hand either by directly undertaking to work out the problem proposed, or by initiative inquiry into the utilisation of coal-beds, water-power, &c., for electro-technical purposes. Next, assuming necessary help to be given by the State, by cities, societies, and scientific corporations, it is proposed to found an *Electro-Technical Experimental Station for Bavaria*, the object of which will be to give authorities and private persons contemplating electro-technical arrangements, opportunity of informing themselves as to the questions involved, and different systems, on the basis of impartial experiments, and of obtaining a satisfactory idea as to cost and feasibility of arrangements proposed. Opportunity will also be given for testing new machines and apparatus.

A movement is in progress on the Continent towards an international agreement as to the colouring matter that should be allowed for toys. The President of the syndical chamber of toy manufacturers in Paris lately invited delegates from Germany and Austria to a conference at Strassburg on the subject. A preliminary conference of Germans was held, as to what they should propose; and it was agreed to aim at an alteration (both on the German and the French side) of laws as to colouring matters that were more stringent than the corresponding laws of neighbouring countries. From this point of view, it was thought zinc-white should be more freely allowed in Germany as a water or distemper colour—viz., where the proportion of zinc oxide or sulphide did not exceed 20 per cent. Further, arsenic or tin, as an impurity of colouring matters, should be unpermissible, only where exceeding a certain percentage (to be determined). France should in future allow the use of cinnabar unconditionally, and that of chrome-yellow under conditions, and the mode of treatment at the hand of French experts, of German wares imported into France, should be thoroughly rectified.

The reckless hydraulic mining carried on in California, resulting in the obstruction of channels of navigable streams, and the laying waste of farm lands, is become a serious evil, the repression of which is demanded. The general method of operation is to collect a mountain stream in an iron pipe and carry it to some place where it can be directed through a movable nozzle against a gravel bank. The hydrostatic pressure often gives immense force to the stream, tearing away the bank rapidly; the heavy particles of gold fall into receptacles prepared for them, while the lighter débris is carried down into the nearest watercourse, and so to the rivers. It is estimated that one hundred thousand acres of the finest land in the State have been covered with gravel and ruined. As the product of these fields, if kept in order, would probably be worth a hundred dollars an acre every year, clear of all expenses except ground-rent, the annual value in perpetuity of the land so destroyed would be ten million dollars, and the State, through its citizens, would be so much richer. It can be easily shown that the hydraulic mines have been worked at a manifest loss to the community.

At an agricultural gathering recently held at Lundenburg, in Germany, some interesting experiments have been made in the use of electricity instead of steam for the threshing of wheat. MM. Piette and Krizik lit up electrically the space reserved for machines, and at the same time utilised the current to drive an ordinary threshing-machine. The cylinder of this machine attained a speed of 1,400 turns a minute.

The town of Besançon (Doubs) is the centre, it is known, of the watch and clockmaking industry in France. It furnishes, indeed, every year, more than three-fourths of the total number of watches supplied to the French market. Notwithstanding trade depression, this industry maintains all its vitality. From Jan. 1 to September 30, this year, there were submitted for warranty in Besançon, 358,816 watches, of which 124,476 were gold. This shows an increase of 38,548 watches on the correspond-period of 1881. The fiscal duties, during the period referred to, have exceeded 740,000 francs.

While ammonia exists in but very small proportions in the air, it plays an important part in the growth of plants. M. Schloesing has shown that it is carried down by rains, &c., absorbed by humus, and even directly fixed by the organs of plants. The sea is a great reservoir, which restores to the air the ammonia it has received from continents. MM. Muntz and Aubin lately measured, during a week in August, the amount of ammonia in the air at a great height—viz., that of the Pic du Midi, 2,877m. above the sea. The numbers obtained do not differ sensibly from those got on low ground. The general average was 1·35 milligrammes per 100 cubic metres of air. The authors also examined meteoric waters for ammonia—viz., 13 rains, 7 snows, and 5 mists. The figures obtained were considerably less than those of M. Boussingault for the lower strata of the atmosphere. In the case of rain, this is attributed to the rarefaction of the air, and so of the ammonia, and to the absence of nitrate of ammonia in the air-layers traversed. The snow was nearly always dry and incapable of condensing ammonia which is in tension (snow on the low ground is generally moist). The mists had not had time to condense much ammonia by successive condensations.

M. Virlet d'Aoust mentions, in a note to the Paris Academy, that in 1830, when cruising in a cutter among the islands of Greece, an ineffectual attempt was made to land on the harbourless coast of Samothrace in stormy weather. The voyage was continued to Thasos, and there the captain took in a supply of oil, with which, on returning to Samothrace, a "sea of oil," as the sailors called it, was produced, whereupon a landing was effected with ease and safety. The author also gives an observation he made in Central America, in 1852; petroleum arose in the bed of a Mexican river when a neighbouring volcano was in action, and had a calming effect on the bay of the Atlantic into which the river entered.

USEFUL AND SCIENTIFIC NOTES.

Railway Signals with Automatic Action.—The Chemin de Fer de Lyon is at present trying a hydrodynamic apparatus, devised for automatic working of fixed and detonating signals. This is placed on the line, and consists of two pedals supported by solid springs on the top of two piston rods working in cylinders which contain glycerine, and communicate with each other by valves. When a train passes, it produces on these pedals at the side of the rail, a movement like that of a balance seeking the position of equilibrium. It is the last wheel of the train that causes the signalling action; impressing the second pedal, which it touches, it drives the liquid into the other cylinder, and the piston in that being connected by a jointed rod with a disc or with a detonating signal, the latter is affected. In the case of detonating signals the inventor provides a sort of toothed wheel carrying 60 of them. The signals, which have central percussion, are replaced automatically by a simple mechanical arrangement.

A Double Human Monster.—M. Paul Bert has lately sent the editor of *La Nature*, from Geneva, two photographs of a human monster exhibited there, living and aged five years, having been born at Turin in 1877. It has two heads, four arms, and two chests, but one abdomen and pelvis, and two legs; that is, it is double above the middle of the body. The fusion of the two bodies begins at the sixth rib. From due examination and from what has been observed in previous monsters of the kind (they were named Xipodhyme by Isidore Geoffroy St. Hilaire), it may be affirmed that there are four lungs, two hearts, and two stomachs; the small intestine is double at it commencement, but in great part simple. There are really two individuals. The right leg obeys only the right individual, who alone feels pinching of it; and similariy with the left. The sensibility of each half of the body is in exclusive *rapport* with the head of the same side. The two individuals were baptised doubly under the name of Jean and Jacques. They are equally developed from physical points of view (except a slight club foot on Jacques's leg), and intellectually they are much alike. Their intelligence is normal; they reply to questions of visitors, in French, Italian, and German. They seem gentle and amiable, also lively, often playing together while lying on cushions, or on the knees of their reputed father. It is said they have never been ill. It has been shown, in the case of other double monsters that one may have an inflammatory fever, while the other continued well; but the like would not occur with infectious disease or poisoning. Several cases of these Xiphodyme monsters have been recorded in history; but very few have lived.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

FLAMMARION'S STAR MAGNITUDES—OCCULTATION OF ε ARIETIS—THE MILKY WAY IN CASSIOPEIA—THE GREAT NEBULA IN ORION—MEASUREMENT OF A DEGREE ON THE EARTH'S SURFACE—THE CHICAGO ASTRONOMICAL SOCIETY; AND THE DEARBORN OBSERVATORY—PHYSICAL OBSERVATIONS OF JUPITER AT CHICAGO AND O'GYALLA—AMERICAN INSTRUCTIONS FOR OBSERVING THE TRANSIT OF VENUS—A "PERSONALLY-CONDUCTED" TRANSIT PARTY—A NEW AND SIMPLE STAR-FINDER—THE GREAT COMET—RAIN-GAUGE—ANNALS OF THE HARVARD COLLEGE OBSERVATORY.

[20724.]—IN redemption of my promise to "Draco" (letter 20635, p. 159), I append, in a tabular form, the magnitudes of the stars as given in Flammarion's "Les Etoiles," for which he asked (in query 48169), on p. 123:—

Star.	Magnitude.	Epoch.
α Ophiuchi	2·0	1880
δ Arietis	4·1	,,
ζ Arietis	4·9	,,
ε Aquilæ	4·1	,,
β Aquarii	2·6	,,
ζ Aquarii	3·5	,,
α Delphini	3·7	,,
β Delphini	3·3	,,
θ Pegasi	3·6	,,
56 Pegasi	5·0	,,
* β Trianguli	Not given	,,
η Cephei	3·9	,,
ι Cephei	4·0	,,
κ Cephei	4·5	,,
α Cygni	2·0	,,
γ Boötis	3·6	,,
ξ Boötis	4·5	,,
ι Piscium	4·3	,,
θ Ursæ Majoris	3·3	,,
κ Ursæ Majoris	3·4	,,
ο Ursæ Majoris	3·8	,,
θ Draconis	3·4	,,
μ Draconis	5·5	,,
π Draconis	4·9	,,
τ Draconis	5·0	,,
χ Draconis	4·0	,,
15 Draconis	5·3	,,

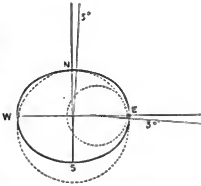
* Argelander classes β Trianguli as a 3rd mag. star.

On reference now to my observatory book, it appears that I did not observe the occultation of ε Arietis on the evening of January 20th, 1880, of which "H. S." speaks in letter 20615 (p. 135). Why, at this lapse of time, it would be difficult to say. I find, by the way, a note appended to the record of my observations of Klein's New Lunar Crater (?) near Hyginus, on the preceding night (that of January 19th in that year) these words: "I cannot draw this region this evening as, owing to the intense frost, the Equatoreal clock will not drive it." If a similar condition of things obtained on the 20th, this—or cloud—may have had something to do with my failure to see the occultation referred to.

The charming weather with which we have been blessed (or cursed) since the appearance of query 48257 (p. 146) has effectually precluded me from examining the region about Cassiopeia until the night before last (that of the 8th). I do not know what maps "Draco" has been comparing; but I may say that Map I. of Proctor's large "Star Atlas" represents the course and configuration of the Milky Way in this part of the sky with considerable accuracy. As I see it, it involves α, β, γ, and δ, but does not quite extend to ε Cassiopeiæ; passing just south of that star. It is very narrow and bright about the so-called "Sword-Handle of Perseus," and then becoming fainter, spreads out over Cassiopeia, widening (and brightening again) as it approaches Cygnus.

I have not yet seen Professor Holden's "Monograph on the Central Parts of the Nebula in Orion," referred to by Mr. Brashear in letter 20623 (p. 139). When—or if—I do, I shall be very glad to adopt his suggestion, and give a short *résumé* of its contents in these columns.

The difficulty of "M.I.C.E." (query 48463, p. 215)—perhaps he will forgive me for saying—really seems wholly of his own creation. Does he not see that the flatter any part of the earth is the larger the circle is of which it forms an arc? A plumb line does not point to the centre of the earth at all parts of her surface; but is really perpendicular to the tangent to the elliptical outline of our globe at the point immediately beneath it; or, as it is said, is normal to the curve at this point. A very exaggerated figure may render this clearer.



Let N.E.S.W. represent a section of the Earth, N.S. its polar axis, and E.W. the Equator. A glance will show that if we had to describe this with compasses, the arc E.N.W. must be described to a considerably longer radius than the arc N.E.S., the latter being visibly a portion of a much smaller circle than the former. Evidently, then, as every circle, great or small, is divided into 360 parts or degrees, we must travel for a longer distance over the arc of the larger circle before two plumb lines are inclined 1° to each other, than we must over the latter. It is by such deviation of the plumb-line—or its equivalent—that geographical latitudes are measured. Occasionally, for purely astronomical purposes, the *geocentric* latitude of a place is required, and tables are given in works on practical astronomy for the necessary reduction. The angle made by a plomb-line with the Earth's radius produced, is called the angle of the vertical, and a glance at the figure will show that, save at the Poles or on the Equator, the plumb-line continued downwards will not point to the centre of figure of the Earth, nor consequently coincide with a terrestrial radius.

The Annual Report of the Chicago Astronomical Society, accompanied by that of the Director of the Dearborn Observatory, once more shows what really admirable work has been performed in that monument of judicious private munificence. In addition to the ordinary meridian observations made with the Repsold circle for the automatic distribution of time-signals, the great 18·5in. Clark Equatoreal has been industriously employed in the observation of various celestial phenomena; the following objects having been specially studied: (1) the Great Comet of 1881; (2) the planet Jupiter; (3) the Satellites of Uranus; and (4) difficult double stars. The main interest of these observations centres in the exhaustive examination of the physical details visible upon Jupiter, which occupies by far the larger part of the report, and is illustrated by ten large sketches of the planet in different stages of rotation. Discarding eye-estimations as untrustworthy, micrometrical measurements were invariably employed, with the most valuable results. It is noteworthy that the periods of rotation of the planet, derived from observations of the great red spot, and from those of well marked white and dark spots, differed perceptibly *inter se*. The red spot, as observed between Sept. 25, 1879, and March 29, 1882, gave a mean period of 9h. 55m. 35·9s. If, however, the mean rotation period deduced from the observations of 1879 and 1880 be compared with the more recent ones, the rotation period of Jupiter would seem to have increased some 4 secs. since 1879; or, to put it another way, the great spot must have drifted 40,000 miles in longitude in two years, showing conclusively that it forms no part of the solid body of the planet, as asserted by some astronomers. The approximate rotation-period deduced from an equatorial white spot was 9h. 50m. 9·8s., and so on. With reference to this, Professor Hough remarks, "From what has already been said, you will infer that the true rotation period of the planet Jupiter is yet unknown. It is possible, however, that the rotation of the surface varies with the latitude in a manner analogous to that of the sun's surface." I need scarcely point out what strong confirmation this affords of the views long since expressed by Mr. Proctor as to the condition of this Giant Planet. The copious descriptive and tabular details in connection with the observations of Jupiter are illustrated by 12 large lithographed facsimiles of drawings made at the telescope, drawings whose truthfulness must at once strike every observer familiar with the splendid object they represent. The volume also contains photolithographs of the Dearborn Observatory and of the Great Equatoreal; and a description and engraving of the observing chair in use, which is appended, is substantially a reproduction of the article and illustration which appeared in Vol. XXXIII., p. 155, of the ENGLISH MECHANIC.

Apropos of Jupiter, by the way, I may mention that the part just issued of the observations made at the well-known Observatory of Dr. Von Konkoly, at O'Gyalla, in Hungary, contains numerous drawings of the planet made during the opposition of 1881, with accompanying descriptions. Four views of the planet Mars, taken during the same year, are also given; as are delineations of the Great Comet of last year, and of its spectroscopic aspect. Sunspots also appear to have been sedulously observed, &c. Here is another notable instance, which Mr. Mundella might study with advantage, of the admirable work which is being done by private enterprise.

With the near approach of the Transit of Venus comes the volume of instructions prepared by the American Commission for the observing parties belonging to their own nation; instructions which may be read with profit by every one who purposes to view this (so far as living men are concerned) unique phenomenon. It would seem that the photoheliographic method employed in 1874 is to be again used by our American confrères; a circumstance on which they may well be congratulated, inasmuch as it was really the only scientific application of photography (save that of the present Earl Crawford) to the determination of the Solar Parallax that was made at all. The dismal and hopeless fiasco of our own Government photographic arrangements must be fresh in the memory of all my brother-readers. Eye-observations, however, will be simultaneously made, and the directions and cautions to those who propose so to view the Transit, render the work before me so really valuable to the intending observer. The elaborate description of the phenomena of contacts and of precisely what the observer has to look for and note, must be read in its entirety to be appreciated. I think that this might advantageously be reproduced in the form of a little pamphlet. The directions for obtaining the time, determining the geographical co-ordinates of the stations, &c., excellent as they are, are less needful to be reproduced: inasmuch as all working astronomers are more or less familiar with them. Whether anything akin to this most indispensable volume has been issued by the British authorities I do not know. If it has, I have not been fortunate enough to see it.

Talking of the Transit of Venus, I was amused to receive a circular intimating that a well-known firm of tourist agents are organising personally-conducted parties to proceed to Southern Europe to view this phenomenon! Welcoming heartily anything which tends to stimulate or extend a popular taste for science, I hope that these gentlemen will find a very large party indeed willing to avail themselves of a reasonable chance of witnessing a spectacle which they can by no possibility hope soon to see again. But I shall not go myself, all the same.

Beginners in Astronomy, and especially incipient naked-eye observers of the heavens, often have a difficulty in identifying objects. Especially do the published ephemerides of new comets and the like puzzle them. The co-ordinates of Right Ascension and Declination given representing nothing to them when referred to the face of the sky. In the current number of the capital little serial, *Ciel et Terre*, published fortnightly in Brussels, is a paper by the eminent Belgian astronomer, M. Ad. de Boë, describing an instrument which he calls an "Equatorial populaire," which seems the very thing needed by the tyro. It consists, in effect, simply of the mounting of an ordinary globe, with the globe removed, and its place supplied by an axis consisting of two parallel brass rods. Between these is a needle, which moves stiffly on an axis situated at the common centre of the two circles of brass and wood which represent the meridian and the horizon respectively. To adjust this, the horizontal circle is first made really so by the aid of a spirit-level and three foot-screws at the base of the frame. Then the brass circle is placed in the meridian by the aid of a compass (allowing for the magnetic variation), or by other methods familiar to all astronomers. A meridian mark set up will, of course, determine, once for all, the direction of the meridian. Then we have nothing to do but to incline the axis so that it shall be parallel to that of the Earth—or, in other words, to make the angle of elevation of its north end equal to the latitude of the place, and it will be adjusted. The graduated brass meridian will show Declinations, and the little hour-circle found at the pole of every globe, but which must now be made to move with stiff friction round the axis, will point out hour angles—or, if properly adjusted, right ascensions, directly. If the polar axis be placed vertically (instead of being inclined so as to point to the pole of the heavens), the instrument may be used as an altazimuth. The cost of such a simple and instructive piece of apparatus must obviously be very trivial indeed, as the framework of any broken globe, celestial or terrestrial, will at once supply nearly the whole of it.

The comet this morning (Nov. 10th) presented a splendid appearance. Its brilliancy has certainly diminished, but its size has scarcely done so at all. The tail was traceable with ease for 23° or 24°, with the naked eye. The nucleus appeared as a mere linear condensation of nebulosity, presenting something of the effect which would result from viewing a bright nebulæ through a cylindrical lens. The division of the nucleus, spoken of in some of the published accounts of the comet's aspect, was imperceptible. Viewed in the spectroscope, three conspicuous bright bands were seen, the middle and brightest one coinciding, as nearly as I could determine, with the solar line D. Those on each side of it I was unable to localise, as the brightness of my spectrum of comparison extinguished the cometary one. The sky at 4h. 50m. a.m., presented a splendid spectacle. The comet between the S.S.E. and the S. by E., approaching the Meridian; Jupiter, Sirius, and Saturn blazing in different parts of the heavens, and in the E.S.E. the Zodiacal light rising as a blunted cone, brighter than the Milky Way. Observers who wish to see the marvellous member of our solar system now adorning the early morning sky, must lose no time in looking out for it, inasmuch as it is travelling pretty rapidly southward.

The most simple way for "M.M.I.Sc.S." (query 48563, p. 23), to measure the rain which falls in his 9in. square gauge, would probably be to get a truly cylindrical glass measure, of ascertained diameter—say, 2in., and graduate it in some such way as this. The superficial area of his gauge is, of course, 81 square inches. Well, first and foremost, what is the diameter of a circle of this area? By very elementary calculation, we find this to be 10·1554in., as nearly as may be. Then, as the area of circles vary as the squares of their diameters, we have now the ratio of $10{\cdot}1554^2 : 2^2$ to deal with; and, by the aid of a formula to be found in your back volumes, we find that in the 2in. measure 12·892in. = half an inch in the large one. This divided by 50 will obviously give the length of the divisions on the glass vessel, which will measure ·01in. caught in the large one, and 12·892 divided by 50 is, very approximately, ·258in. If then, your correspondent will get a tall glass cylinder of exactly 2in. internal diameter (it must, as I have said above, be truly cylindrical), and engrave divisions on it = ·258in., each of such divisions will measure ·01in. of rain caught in his gauge 9in. square.

I must not conclude this letter without reference to the recent issue of another American volume of great interest to astronomers. I refer to the first part of Vol. XIII. of the Annals of the Harvard College Observatory, containing a mass of details of Micrometric Measurements made with the 15in. equatoreal there between the years 1866 and 1881. It commences with an exhaustive description of the large filar micrometer which has been employed in making the observations, and of the elaborate investigations which have been made to determine its constants and its errors (if any). The sentence with which Professor Pickering concludes this section of his work speaks volumes for Transatlantic instrument-making. "This discussion results," he says, "in the conclusion that no correction for irregularities in the screw are required, and that the value of one of its revolutions may still be regarded as 9·8" under all ordinary circumstances of observation." Following this account of the micrometer employed is a list of measurements of double stars, occupying 45 pages. These were principally made by Professor Winlock between 1866 and 1872. Among these are 179 stars first discovered to be double at Harvard. A few of these have been independently discovered by that very eminent observer, Mr. S. W. Burnham; but by every one who can appreciate that gentleman's unceasing labours in this field, this was only to be expected. Of course, the great and enduring value of such a list as that of which I am speaking lies in its use for comparison with past and future measures of binary star systems. 402 Nebulæ, too, have been examined both micrometrically and spectroscopically. Then follow numerous measures of the satellites of Saturn, Uranus, and Neptune: all of them of great value for the correction of the theories of those bodies. After these, we have a chapter devoted to the accurate determination of the places of a large number of the principal asteroids. Following this again, come the observed places of the Comets which have appeared since 1867; as also observations of 137 occultations of stars and planets by the Moon, visible at Harvard from 1866 to 1876 inclusive. Some corrections to the Harvard zone observations complete the volume. The précis which I have given of the contents of it will enable the practical astronomer to judge of its great value for reference and comparison.

A Fellow of the Royal Astronomical Society.

BRIGHT TAURIDS.

[20725.]—AT 16h. 36m. on Nov. 6 I saw a fine meteor nearly as bright as Jupiter. It began in the W. extremity of Leo Minor, and after traversing a path of 39°, disappeared when it reached a point about 7° E. of β Leonis. It moved rather slowly, and left a bright train of sparks.

At 13h. 44m. on Nov. 11 another bright meteor, about 1st mag., was seen here, resembling in all its visible features the one previously described. The path, as I recorded it, was from α 152°, δ 79°+, to α 208°, δ 55°+, so that the meteor was traced along some 30° during the time it remained in view.

There is no doubt that both these meteors belonged to the now well-known shower of Taurids, which occurs every year in November, though with varying intensity. This shower was favourably seen here on Nov. 8th and 20th, 1876, when it supplied some very fine meteors. But, in the following year (1877), it seems to have been an utter failure, for, of 508 meteors, which I observed between Oct. 14th and Nov. 14th, only about 15 could be definitely referred to this shower, though my watch was almost invariably directed towards the region of Taurus! In 1879 the shower was much better defined, for I saw 25 meteors belonging to it on the nights of Nov. 12—14th of that year. In 1880, I re-observed it on the night of Nov. 27th, when it was certainly the most active shower in progress. The present year again, it seems to have returned with marked brilliancy; but I fear that it cannot have been observed with any completeness, as this department of astronomy has recently been much neglected by observers.

I believe the chief radiant point of these November Taurids is at α 62°, δ 21°; but there are several sub-radiants, especially to the westward. Notably, there is a rich display of bright meteors from a point S. of Musca at α 43°, δ 22° +, at the end of October and beginning of November, which vies with the true Taurids as to the splendour of its meteors. The precise epochs of these displays cannot, however, be certainly ascribed, as the fall of meteors is continued intermittently for several weeks, during which the same radiant points are manifested.

Bristol, Nov. 13. **W. F. Denning.**

THE NEW PRINCETON TELESCOPE.

[20726.]—MESSRS. ALVAN CLARK AND SONS, of Cambridgeport, Mass., have recently completed a large refractor, for the Halsted Observatory, at Princeton, New Jersey. The *Scientific American* gives a short description of the instrument, together with an engraving showing the telescope in position. Professor Young, the director of the Observatory, has done good service by publishing the foundation curves of the object-glass. In inches, they are are as follows:—

Diameter of o.g., 23; focus 361.

Crown lens.		Flint lens.	
Both sides convex.		Both sides concave.	
1st radius,	265·8	3rd radius,	73·4
2nd „	81·9	4th „	222·2

Lenses distant apart, 7·5.

Expressed in terms of the focal length, these numbers give:—

Aperture, ·063; focus 1·00.

1st radius,	·736	3rd radius,	·203
2nd „	·226	4th „	·615

Separation ·02.

No particulars of the optical properties of the glasses used are given, which is to be regretted; but whatever they may be, the combination is a somewhat remarkable one. It will be noticed that the last curve is much deeper in its concavity than what is generally used. Theoretically, this arrangement is admirably adapted for securing completeness of achromatism. A deep outer concave surface is often found in object-glasses of English manufacture, and they are generally very satisfactory in respect to the elimination of aberrations. Some time ago, Professor Young published an account of the comparative chromatic corrections of two telescopes; one of which—a remarkable arrangement with a very deep back curve—was said to be "remarkably excellent in every respect, especially in the darkness of the field and the power of exhibiting faint objects." It is to be hoped that the learned professor will test the new refractor in a similar way, and publish the comparative results.

Orderic Vital.

BICYCLE-HEAD.

[20727].—Having seen letter No. 20017 some time ago, in reference to bicycle-head, I send sketches of what I think would be an improvement, for the following reasons: perfect adjustability in all working parts, can be fitted with very little trouble to existing machines, does not make the machine look clumsy. The hole into which handle-bar goes is bored out to ⅞ diameter, and the outside projecting ends are slightly tapered; on to these 2 tapered ends are fitted pieces of iron about ¼in. thick, ¾in. wide and 2in. long, with holes in each end, one end coned to fit as above, the other ⅞in. to take handle-bar A D, or square shaped bolt ⅞ diameter goes through the late handlebar hole and the two pieces of iron (they having likewise D shapes at smallest ends) with lock nuts at end to tighten up pieces of iron. The handle-bar is now the other side of head i. e. next to you, and can be moved up and down. In the space remaining in late handlebar hole is fixed a spiral spring, one end of which is securely fastened to head of machine (inside late handle-bar hole) the other end is bent tight round D-shaped bolt. The handle-bar now springs upwards by the action of the spring, untwisting or twisting up similar to some door-springs. On to inner side of head is firmly fixed a projecting stop for handle-bar to press against when going uphill or pulling hard. I do not know whether a spiral spring ⅞in. diameter and ⅛ thick could be made strong enough to bear about 50lb. (as fixed in position above described) as that is about the weight put on handle-bar when going legs over handles. If it is not there might be another stop lower down head, with a piece of rubber fixed on. I am having the above roughly fixed to my machine without the spiral spring, as there is not enough metal in handle-bar hole. I should think that if bearings were allowed to slide up and down, a U shape piece fixed to fork (like Hillman and Herbert's style) and a piece of rubber placed between upper bearing and U shape piece, it would tend to lessen a great deal of vibration. Description of drawings. The letters in each case refer to the same thing. A, centre screw and lock nut; B, head, and late handle-bar hole; C, projecting stop; D, handle-bar; E, E, 2 pieces of iron; F, ⅞ D shape bolt; G, metal left undrilled in late handle-bar hole, to fix the spiral spring; H, spiral spring; I, two lock nuts to tighten up pieces of iron; L, spiral spring bent round D shaped bolt; , piece of rubber.

E. O. B.

FIG. 1

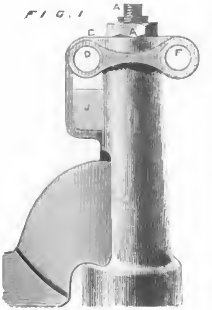
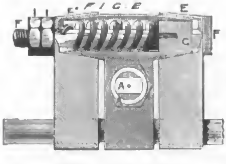


FIG. E



LOOPED FIGURES BY GEARING.

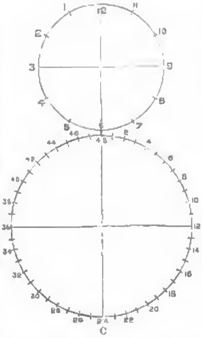
[20728.]—I have now seen the prints of looped figures kindly sent by "J. L.," and have quite recovered from my incredulity as to their production by the rose engine. I am bound to say, however, that they are not exactly the kind of loop figured at P in "J. L.'s" article, but they are true loops, and of very curious and beautiful forms.

Whilst studying how these curves could be produced, I discovered how to draw them on paper. The process is curious, and shows so well the working of the apparatus in question, that I send an explanation of it, together with some of the curves, which I hope your engraver will be able to copy. These curves are similar to those sent me by "J. L.," except that they are single, and in the absence of the blocks cut in the rose engine itself will help to show its powers.

It is, of course, only those curves which loop elsewhere than at the centre that I intend to deal with, as waves and loops meeting at the centre require no explanation. I find the whole secret of these seemingly impossible shapes is to place the tool or drill above the centre.

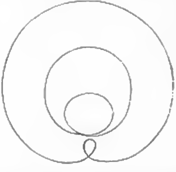
Let anyone who desires to investigate these curves take half a sheet of note-paper, pin it down on a small board, and draw down the middle a fine straight line, see Fig. 1. Now draw upon this line two circles, one of 2¼in. diameter, quite at the top of the paper, and one just below it of, say, 3¼in. diameter. Divide the upper circle into 12, and the lower into 48 divisions; number these divisions, and when you have marked a point C, close to the bottom of the line, for the centre of oscillation, the figure will be complete. Cut out now several circles or discs of paper of the size of the larger circle, and pin one of these upon it by passing a pin through the central holes. Mark upon this disc an index point, and you can turn it round in the same way as the work turns in the lathe, the angular movements being regulated by the 48 divisions. To determine the movements of the tool (and we suppose for the sake of simplicity that it is the tool which oscillates instead of the work, the effect produced being the same), take a ruler and lay it from the centre C to any one of the divisions on the circle at the top of paper, then measure off upon the ruler the height of the tool from C, and you have its position upon the disc. Your readers will now see how it is possible to find each point in the path of the drill, for each corresponding position of the two revolving circles.

FIG. 1



Now, to produce the curves of Fig. 2, the lathe and rosette shaft must revolve turn for turn. Let them start at the top at 12 and 48. Make a ruler by folding a strip of paper, mark off upon it the distance from C to the centre of the paper disc, pricking these marks through that they may appear on both sides, set off from the centre on the ruler upwards two other marks, ¼in. and ¾in. above it, and prick them through. Lay the ruler on the diametral line again, and mark off upon the disc a point ¼in. and one ¾in. above the centre, join these with a line ½in. long, and the extremities of this line will be the starting points of the two curves. Now move the disc round four divisions; the rosette shaft revolving the same angular amount will have moved one division; lay the ruler from C to 1 on the upper circle and draw again on the disc the short line from the ¼ point to the ¾ one, mark this line (1) and its extremities give the 2nd points of the two curves, which extremities can now be joined by a pencil. Repeat the process, moving the disc round four divisions each time, and you will have 12 short lines, the extremities of which being joined, complete the two curves. It does not appear to matter which way the shafts revolve, or whether the tool be above or below the centre; but it will be seen from these two curves that the height of the tool is important, as on it depends the relative sizes of the two loops in each curve, the two loops melting into one eccentric circle when the tool is placed at the height of the centre itself.

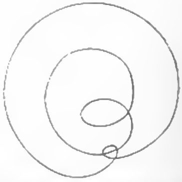
FIG. 2.



Equal revs. of lathe and disc in opposite directions, tool in middle; smaller curve, tool ¼in. above centre; larger curve, tool ¾in. above centre.

I send Fig. 3 to show the effect of placing the tool point to one side of the centre as well as above it. To work this out the diametral line with the upper circle and centre of oscillation must be moved ⅛ of an inch to the left.

FIG. 3.

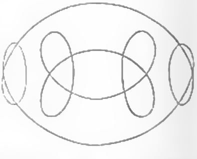


Equal revs. of lathe and disc in opposite directions, tool point ⅛in. to the left of centre; smaller curve, tool ¼in. above centre; larger curve, tool ¾in. above centre.

Fig. 4. was produced in the same way as Fig. 2, except that the disc was moved two divisions at a time instead of four, thus causing the upper circle to be passed round twice to one revolution of the disc. If the revolutions of the rosette shaft to those of the work are as four to one, the figure has four pairs of loops instead of two, and so on.

F. A. M.

FIG. 4.



Two revs. of disc to one of lathe in opposite directions, tool in middle; smaller curve, tool ¼in. above centre; larger curve, tool ¾in. above centre.

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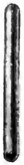

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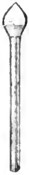

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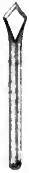

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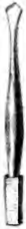

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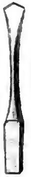

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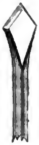

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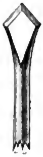

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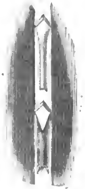

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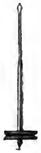

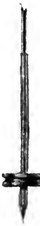

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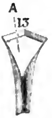

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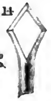

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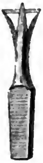

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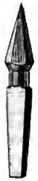

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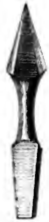

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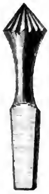

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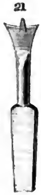

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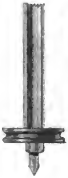

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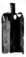

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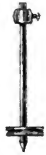

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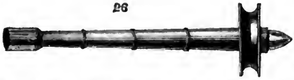

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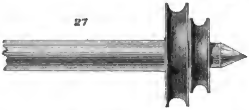


DRILLS AND CHAMFERS, AND HOW TO MAKE THEM.

[20729.]—In entering upon this subject I am conscious that I can in no wise exhaust it, or do more than traverse ground already well trodden by abler writers than myself. Yet, I think some benefit may accrue to a few readers—particularly to those who, as apprentices, are just entering the field of mechanics—if the work of tool-making and their uses receives a little reconsideration and attention. I am sure there are many readers of the Mechanic who could handle the subject of my article better than myself; so I hope that what I have to say will evoke something useful in the way of an extension of it.

Every young mechanic naturally takes a pride in tools of his own making; so anything that will further help him in such laudable work will, I am sure, be welcomed and fully appreciated. I can imagine some of my readers to say, "What difficulty can there be in making, or what can possibly be said of, such an insignificant tool as a drill?—a tool that anyone, with the slightest pretension to mechanical knowledge, could turn out." Nay, 'tis not so. To make a drill that shall cut, and be a drill in the truest sense of the word, requires more skill and thoughtful work expended upon it than at first sight appears to be needed. To sum up in a word, I may say there are drills and *drills*. I purpose, therefore, as far as I am able, to give a little practical instruction and advice as to the choice of material, and the preparing, shaping, hardening, and tempering of drills and kindred tools, such as chamfers.

First, let me say a little concerning the choice of steel. The metal selected for making the tools should be of the very finest quality, and should, when broken across the grain, present to the eye a silvery-grey and finely-granulated appearance. That which breaks rough and coarse, and has a dark colour, should be rejected, as it is impossible, more particularly in making fine tools, to get any that will do good work. No good cutting-edge can be maintained on tools made of such material. There is a kind of wire sold by dealers in watch materials, which is prepared specially for the purpose, and supplied in convenient lengths, and no better steel than this can be found. To take up by chance a piece of steel, solely because it is steel, and to make a drill of it in a sort of haphazard way, may more frequently than not result in loss of time and temper. A bad drill is a sore trial to a man's peace of mind, particularly if, as is often the case, either through common material or unskilful tempering, the drill breaks in the work. Such a disaster is one that all who have had to do with drills must, at some time or other in their lives, have experienced—oftentimes necessitating new parts, or else hours of patient labour in the removal, with the attendant possibility of irreparably disfiguring the work. Here let me say that with a properly-shaped drill, even though the metal may be bad, the chances of the point breaking off and blocking are reduced to a minimum. With good steel, the chances of breaking are almost nil. I have given an exhaustive series of original illustrations of drills and chamfers, to which I shall make allusion as I proceed. I will now describe the manner of making. Having selected an appropriate piece of steel, the diameter of which is about what the haft of the drill is required to be, make it red-hot to soften down, and allow to cool gradually, or plunge into sawdust then, with a smooth-faced hammer, spread one end into a fan-like form (Fig. 2) after it has been slightly rounded, as in Fig. 1. It is better to round the end off before spreading, as it not only more readily takes a correct shape, but also lessens the chance of cracking under the hammer. A large piece of steel should be annealed after every few blows of the hammer. The face of the hammer should not fall parallel to the wire but should be inclined downwards, over the end of it, and the wire should rest on the anvil-face or vice-bock at the end only, one end being held up. In this manner, by careful manipulation, the metal is spread forward and sideways, as in Fig. 2. With a sharp file the head should then be shaped, as in Fig. 3; the facets being struck off at the same time, likewise the flats. (A, Fig. 13.) As much finish as possible should be imparted to the drill before the process of hardening, as it is not so easily done when the steel is hard. Unless the metal is considerably overheated there is seldom much blistering produced; therefore, the labour of finishing-off afterwards is not great. More of this anon. The next process after shaping is the hardening, and this I hold to be the most important item in the work, as upon its correct management the chief success of the drill, as a cutting tool, depends. It matters little how frequently the tool may be sharpened. If the drill-point is soft, no sharpening in the world will make it cut. Obviously, a drill to cut soft metals, such as brass, copper, and the like, need not be so highly tempered as would be necessary where the material was hard steel or case-hardened iron: therefore, in adapting a drill to any class of work, the hardness of it should be ascertained, if it is not already known, and the drill-point should be made some degrees harder. It is not difficult to form a fair estimate of the hardness of a drill if the edges are brought against a file. The file will not cut anything harder than itself. If such is not the case, according to the softness of the metal, so will it be as easily cut away. In fact, to an experienced ear, the sound produced by the passage of the file over the metal is sufficient to indicate its hardness. Again, the colour produced by heat upon the metal, after it has been hardened to the highest degree, indicates the state of hardness reached in the letting down. Some workmen harden up, i.e., they heat the metal to a known temperature and quench off, leaving it at that, while others get the metal to white, or nearly white, heat, quench off, and let down by subsequently applied heat. I cannot say from my experience if one plan is better than the other, as I have always adhered to the latter mode, and have invariably succeeded to satisfaction.

The means employed to quench or harden drills and small tools are almost legion. I will give only a few: Oil—some kinds better than others; water—hot, lukewarm, and cold; water and oil together; soap, soapsuds, beeswax, borax, mercury, &c. Here, therefore, no difficulty is experienced, because an almost unlimited supply is at hand.

Taking them seriatim, I will speak of oil, and the best I have found for general purposes is common olive-oil or cotton-seed oil. If I wanted a drill to be extremely hard I should not use oil. Water will produce a much harder point; but some little care is needed as regards the plunging-in. If a large drill, intensely heated, is suddenly plunged into cold water it is likely either to crack, or, when in use, to crumble. To obviate this, the water is made warm previously, or a few drops of oil are floated on the top of the cold water, and the drill or tool plunged through the centre of the oil. The oil forms a sort of sheath, and being cooled to the temperature of the water, produces as hard a drill as water would, minus the risk attendant upon cold water alone. Anyone can satisfy himself of this if he places a drop of oil upon water and passes a nail, or anything of the kind, through the centre. As the object passes through the oil will go with it, and almost, if not entirely, disappear, to rise again as the object is withdrawn. Soap and soapsuds, from their greasy and watery nature, have a somewhat similar effect. Soap always holds a pretty high percentage of water before it reaches the housewife's hands. Beeswax is very useful for small drills, but requires a little care in the usage, owing to its close, hard nature when cold. Small drills easily become bent if they are not pushed in cautiously. The same remarks will apply to borax (lump). Borax is capable of producing a very hard drill indeed; quite as hard, in fact, as cold water; but, of course, cannot be used for large tools. Mercury, however, will produce an almost diamond-like hardness of point; but should be used with great caution, as, owing to its affinity for other metals, particularly gold and silver, much mischief may be done if it unwittingly gets spilled about. In hardening a drill, the cutting-point should receive the greatest heat, and that end should first touch the "quench"; otherwise the drill will be irregularly cooled. Having cooled the now hardened drill, the next process is to remove a portion of the scale with emery or oilstone; then, holding it by the haft or shank in a pair of pliers, let a lamp or gas-flame touch the centre of the shank: the heat will quickly produce the usual changes of colour on the part brightened off. The first to appear will be a pale yellow; then in succession orange, purple, dark blue, and light blue. If an exceedingly hard point is required, it should not be allowed to change colour, the part immediately behind it being made a pale yellow only. When the desired colour is got, the drill should be immediately quenched as before. A lesser state of hardness can be got by heating to any of the colours in the order given. A very safe degree of hardness, and one suitable for the general run of work, is that denoted by the purple colour, or a deep orange. It is necessary at all times that the shank or belly of the drill should be softer than the point, or there will be no elasticity, without which no drill is perfectly safe. This state is, however, brought about by softening down in the manner I have described.

Having arrived at this point in the work of drill-making, the next process is to remove all the scale and discoloration, which is easily done by a little flour emery, worked to a paste with oil, and applied with a piece of leather or soft wood; or oilstone dust, instead of emery. When all is made clean and bright, the cutting edges should be set true and sharp with Arkansas oilstone. The facets should be equally formed and pitched at the same angle. The importance of this part of the work cannot be over-estimated. If the drill is not held firmly and kept to one position while moving along the stone, the facets will become rounded instead of flat, and in that case good cutting edges cannot be got.

Figs. 3 and 9 show drills having four facets, while 6 and 8 have two each only. In the former, the drills have sharp points, while in the latter, flat, but sharp tips are present. The latter form of drill gives a better cut and does the work quicker, but possesses the disadvantage of not easily or reliably starting a hole without guiding or having an indent made in the materal to be drilled. It has, too, a tendency to work from the point started at, when the job is not fixed up solidly and the drill not set up in a rigid chuck. For this reason it is not found so suitable for hand-drilling. In making drills for either heavy or light work, some little thought must bestowed upon the length and substance of the shank. If the drill-shank has to be very long and yet slender, as much swell as possible should be given to the belly of it, as in Fig. 5; this prevents vibration and lessens the possibility of buckling if too much foward pressure is put upon the work. Taking two drills of the same substance but of unequal lengths, the shorter must prove the stronger, if the temper also is equal. In a short drill, as in Fig 6, the swell in the shank need not be made. No matter what the kind or shape of drill made, it should always be observed to have a good clearance behind the drill-head. In all the foregoing examples it will be seen that the drill-head is more or less formed somewhat like what is expressed by the word diamond. It is absolutely necessary that this shaping of the drill be observed or you will have a tool that, in all probability, will block up in the hole. In Fig 10 I have given examples of good and bad-shaped drills in position, supposing them each to be making the same sized hole. It will be seen that the upper one has a good clearance, to allow the particles of metal cut out to pass freely away. In the lower example the drill-head is barely larger than the neck: consequently the chips, not being free to pass, corrode the drill-head, and a block-up is the inevitable result, until a little oil is run into the hole. Great difficulty is often experienced in loosening and removing a drill blocked up in this manner, besides having the attendant risk of snapping the drill-head off. In such an event, the only way out of the difficulty is, by starting a fresh hole with another drill from the other side of the work, unless it can be induced to vacate its quarters by the application of a few vigorous taps on the opposite side with a hammer. I have occasionally withdrawn broken points by first oiling the hole a trifle, then applying a magnet to it, and knocking the work smartly with a hammer or against the bench. Obviously these remarks apply only to large jobs. The necessity of using every means to prevent such disasters, by correctly shaping the drill, will be apparent to all; so I need say no more upon its importance.

Occasionally it is found that, although a drill seems perfectly sharp, no work is done by it; and I think this can be accounted for on the supposition that there are hard cores sometimes in the body of the metal being drilled, or that a kind of case-hardening (if I may so term it) takes place. To overcome this, a drill of the same width, but with facets set at a different angle, should be introduced into the hole until the difficulty is passed. Figs. 13 and 14 show drills set at different angles, but of the same diameter at the head, and capable of cutting the same sized hole, yet one may do the work more expeditiously than the other. Fig. 13 is far more likely to cut better, and retain its point longer, than the other.

In Fig. 4 I have given the form of drill-shank to fit in stocks such as the Archimedean, etc. That seen in Fig. 3 would be suitable to fit in a stock illustrated in Fig. 26—close fitting, giving the necessary friction to grip and hold it in position. The best and most reliable form of all is that of Fig. 6, and others, where the shank is squared off. Where a flat-bottomed hole is needed, a bottoming drill, as in Fig. 7, should be used. In like manner, if a round bottom is wanted, a correspondingly-shaped drill should be used, be it concave or convex.

Fig. 11 is an example of a *large*-sized pivot-hole drill for watchwork. They are made so very minute that the unassisted eye could hardly discern their forms; yet, on inspection, they would (if correctly made) present just the same shapes as are found in the large examples. A workman who is capable of turning out a correctly-shaped pivot-hole drill, or one such as is needed for drilling the hairspring pins in the regulators of fine watches, needs no instruction of mine to teach him the art. When the body of the drill is long, it should be left as large as is consistent with correct proportion—not exceeding the diameter of the head, the part adjacent to the head being alone reduced in size. Fig. 12 is an example of a hollow drill, which of course can be made of any size. I give here the exact size of one used for drilling out the stumps of broken verge or lever top pivots, prior to the insertion of new ones. It is simply a tube of steel with the tip cut away on two sides, at an acute angle. The stump of the broken pivot passes up the inside of the drill when at work, as it removes the surrounding metal to the extent of its own thicknes, the stump being afterwards snapped out with the pliers or nippers. It is needless for me to observe that very many other forms of drills, besides these here given, are in constant use amongst mechanics, but a sufficiency of examples has been given to place before the readers of this paper a correct notion of their general shapes. Nor need I say anything more anent the shaping and use of them, so I will pass to another and more briefly told part of my subject, inasmuch as chamfers (of which I shall now speak) are very similar in many respects to drills, and are tempered in the same ways, the difference of the head-shapes being their distinctive features. A chamfer differs from a drill in that it does not make deep holes, but simply gives a certain form, as may be arranged for, to the outer parts of them, or produces a shallow sink or hollow upon the surface of the metal. In watch and clockwork of the best class, the holes are invariably chamfered, and it not only adds to the appearance of such, but is of the greatest use in forming a sort of cup to retain the oil at the pivots. Such a chamfer as is needed for this purpose will be seen in Fig. 25. This is a common form of chamfer, and consists of a small disc of hard steel pivoted in a suitable handle. The edge of it is left square or pointed, as may be preferred. Occasionally in clockwork, and always in good watchwork, the heads of screws are sunk into the plates or bars, and for these purposes some such tools are necessary whether used in a mandrel or by hand. Figs. 17 and 18 are examples of chamfers as are used for accommodating the heads of screws of the wood-screw type, or for removing the burred edges of holes broached out. Fig. 20 is another form—a rose head, used for similar work. Figs. 15 and 21 are examples of straight and convex chamfers or bottomors. In various sizes Fig. 15 is used to make a true flat to a sunk hole, or to a watch or clock pivot hole face. Fig. 21 in the same way, is particularly useful to produce a convex bearing for the pinion shoulder of a closely-fitted wheel, running near to the plate. In high-class Geneva work convex bearings are frequently met with. Although such bearings are doubtless turned up in the lathe, they may be readily made by the chamfer spoken of.

The little pivot in the centre is formed from the substance of the tool, and is made round and polished. It must, of course, be smaller than the hole to be chamfered, but a small-sized pivot will be equally suitable for a few differently-sized holes.

The pivot entering the hole, keeps the chamfer true to the work. In Fig. 28 we have an adjustable chamfer of actual size which is especially of use in giving end-shake or freedom to wheels bound between the plates. It has a sliding collar, fitted with a stop screw, which collar can be adjusted to various depths of cut.

The cutting edges are formed in a similar way to Fig. 24. Figs. 22 and 23 show the make of a kind of hollow chamfer which is very useful in forming the riveting piece on a mainspring hooking wire, Fig. 23 being the drilled cutting face. It is made of pinion wire, with the end of each leaf cut to a sharp edge, and a hole drilled centrally. In Figs. 16 and 19 we have conical rimers of a very useful kind, for enlarging screw-head holes, or for making a hole without the aid of a drill, 16 having a sexagon form, 19 having one flat side, and the other bevelled off at the edges and rounded over to give it the necessary strength.

Figs. 26 and 27 are examples of drill stocks, 27 being fitted with an extra speed-wheel. I desire here to call attention to a form of drill-holder which all amateurs should possess. It is illustrated weekly in this paper, and is called "Cohen's Drilling Machine." It will be found a very useful adjunct to a mechanic's stock of tools, and can readily be fitted up with a variety of drills to suit a multiplicity of purposes.

In conclusion, I trust that the foregoing remarks upon drills etc. will prove of service to such readers as are capable of profiting by it. I have been biassed by nothing that has previously been written upon the subject, this being simply the outcome of my own experience. Whatever it may lack, will I hope be supplied by one or more of the many able workmen who weekly peruse these pages.

Alfojoe.

MIRRORS OF REFLECTING TELESCOPES.

[20730.]—I REGARD the Gregorian as an interesting curiosity completely superseded by the ordinary day telescope (its principal merit being that it gave an erect image), but I should be very sorry to see this beautiful and perfect combination of two conic sections lost sight of.

To those who would construct a "Gregorian" I would say, Adhere to the parabola and ellipse; because, in my humble opinion, if any other figures are adopted, it ceases to *be* a "Gregorian." It is doing violence to the very principle of the invention; we have evidently two *rights* to make one perfect whole, and I quite agree with your able correspondent's remarks, that to use two *wrongs* would be wrong indeed.

It may perhaps be thought dogmatic and inconsistent to assert that the above remarks do not apply to the "Cassegrain" (as the one seems to be a sort of converse to the other); but as far as I can learn, the principal advantage claimed for it is the *fact* of the small mirror *helping* to correct the large one. I think, therefore, we are at liberty to accept this *help* and then do the best we can; the next thing to consider is how to use this *help*. Some time since, I thought it was a capital idea for amateur telescope-makers to be able to escape the labour and uncertainty of "parabolising," by adopting the "Cassegrain" form. I, therefore, ground and polished an 8in. to a spherical curve (and all agree that this is the first stage to be arrived at, even if you intend to parabolise), so I cannot think that a spherical curve is so difficult to make as the other conic sections. I then set to work to try and fit a small hyperbolic convex to it, but, after repeated trials, was obliged to give it up. I feel inclined to parody the words of the evil spirit, and say, An ellipse I know, and a parabola I know, but what is an hyperbola? It seems to me to be anything between the extreme limit of a parabola and a "boomerang." In the end I put a spherical one, and was surprised to find that was better than my "hyperbolic" attempts. I am now come to the conclusion that convex curves, other than the sphere, are very difficult to make; if it had been otherwise, lens-makers would have taken advantage of them.

It is, perhaps, needless to say that my ideas are now considerably modified. I believe the easiest way for an amateur to make a Cassegrain is to employ a spherical curve for the convex, and an under-corrected concave; my Cassegrain at present consists of two spherical curves, but as soon as I have time I intend to *slightly parabolise* the large mirror (if I may be allowed the expression).

I should like to add that no one more than myself would like to hear from "Hyperion." It was that gentleman's letters that first awakened in me the interest I take in those matters. **A. N. H.**

FLATS—TO MR. HOLMES.

[20731.]—MR. HOLMES, in his letter (20684), assumes a position to which he is not entitled regarding the colour-test. I originated the discussion, if any one has. Mr. H. is at liberty to consider me *hors de combat*—I am so thoroughly English that I do not know I am beaten. The colour-test is unworkmanlike in the first place, on account of its endangering the surface—a thing not to be tolerated by a practical man. In the second place, no *better* result is obtained than can be got without it. As to Mr. H.'s statement about uniformity of annealing, any one with the ordinary experience of a workman knows that plate-glass will not stand grinding and polishing unless it is well annealed. Opticians also test, with a Nicol prism, all glass before working, so they have no fear of "internal strains in different directions." Again, Mr. H. says "if I only try it." Good gracious! I wish I had as many pounds as I have experiences in that way—perfectly satisfactory, too. I do not think I shall have occasion to modify my views at present; should I in the future, I will notify Mr. Holmes of that fact. In the mean time, I fear this colour v. optical testing is degenerating into a "war of words." So I have resolved to argue the point no further than this—at the best it is merely a question of experience. I am not "resting on my oars" in the matter of tests, and shall get *perfect definition* without the colour-test in the future as in the past.

As to the question Refractor v. Reflector, I would sooner have a good 4in. of the former than a 6in. of the latter construction. I do not differ with Mr. Holmes on the economy question; that, however, is not likely to have much weight with those who live on the profits of the trade.

Prismatique.

THE SPECTROSCOPE—ITS ORDINARY USES.

[20732.]—The facility with which this instrument may be applied to the *measurement* of the lines in the solar spectrum, and the examination of the flames of terrestrial substances, has not been sufficiently pointed out in my last communication, so a few additional remarks may not be unacceptable.

For ordinary spectroscopic observations, the five-prism direct-vision instrument, supplied by Cooke and Sons, to which reference has been made, may be deemed adequate; but, to make it more efficient, I suggested and obtained three prisms more, placed in a cylindrical pocket between the telescope which is employed to view the spectrum, and the joint by which the telescope is attached. There was thus a battery of eight prisms; and when this was directed to the sun, with the cylindrical lens interposed to increase the intensity of the light, there was no difficulty in discerning the fine nickel line between D_1 and D_2, which is a very good test of the excellence of the arrangement. But these additional prisms are not absolutely necessary, and much useful knowledge may be obtained without them.

For the purpose of measuring the relative distance of Fraunhofer's lines, a wire micrometer, such as is usually applied for the determination of the distances of double stars, must be fitted to a diagonal eyepiece for convenience of posture, and the telescope thus arranged must be fitted into the main body of the spectroscope. Then, if the interval between B and G be considered as representing 1,000 equal parts, and the same interval be read off on the wheel of the micrometer, we can compute at once the scale according to which other intervals, as B to C, C to D, &c., are to be marked. The results obtained with the prisms and micrometer must afterwards be reduced to wave-lengths for the sake of uniformity (see "Index of Spectra," by Dr. Watts. London: Gillman, Ludgate-hill). If adapters be used, instead of screws, as is the case with Cooke and Son's instruments, holes must be drilled, and brass pins inserted, so as to keep the instruments secure and steady.

For practical purposes, in viewing the flames of chemical substances, the platinum spoon is most useful; but a piece of pumice-stone or mica, saturated with a solution of the drug, and held in position by a piece of platinum wire, will serve very well, and if exposed to a Bunsen burner, or brilliant gas-flame, will show for several seconds the distinctive spectra of sodium, potassium, barium, strontium, lithium, &c. The degree of separation between the D_1 and D_2 lines of sodium proves the power of the spectroscope employed.

James Pearson, M.A., F.R.A.S.
Fleetwood Vicarage, Nov. 3.

WORK-BENCH FOR AMATEURS.

[20733.]—Noticing the bench described under "Home Chips" p. 101, Oct. 6th, I think a description of my own may be valuable to many who have limited space at command. I designed and made it many years ago, and it has answered admirably. My object was to have the utmost utility possible in the smallest space possible, and to have also something which should be capable of moving about conveniently and cost nothing for removal. This latter desirable property, attained by making it (as I did all my shelving and fixings, which are many), so that they are packing-cases whenever a move is necessary. My bench consists, then, at first of three strongly framed cases, fitting firmly to each other; the two end ones are chests of drawers, the middle one is only half the depth and two-thirds the height, and is simply a cupboard with two doors, forming a recess in which one's legs can go, if one uses the concern while sitting, either for small work or to write at.

The top is a strongly made case, divided into four parts in its length, in three of which there are drawers, while the fourth space at the left end is occupied by the screw and its plate, which works horizontally, instead of vertically, and is fitted with a slide at the farthest end to balance the screw. The top of this is thick plank fitted with planing catch.

I have thus a bench every part of which is useful, as the drawers are divided to contain tools and all sorts of requisites. Planes, hammers, and so on lie on the top of the middle cupboard, and it contains also other bulky tools; saws hang in the middle space, racks in the ends hold small tools, or if it stands against a wall, a shelf and rack can be attached above it. To bear the strains of working, a piece of wood is fitted over the back of the middle cupboard, while in front two arched angles are screwed; screws also pass through the sides of the cupboard into the sides of the two end blocks, taking into the divisions which support the drawers, and strong screws go through the top of the drawer-cases and into the bottom of the upper case. When a removal occurs the screws are drawn, and it separates into four manageable packages all containing things which would otherwise have to be packed in cases obtained for that sole purpose. In use the drawers serve to support things, while planing, &c., by pulling them out a little, and occasionally they get unfairly treated by being converted into a sawbench. **Sigma.**

THE EARTH AND DYNAMO MACHINES.

[20734.]—There will be no difficulty in accepting one statement of Mr. Huxley, 20708, p. 228, viz., that the gas companies will suffer no loss through his invention. But you have been put to the expense of printing and wood-cutting, readers have probably wasted time in reading, and possibly someone may be weak enough to make an experiment, and I am now put to the trouble of correcting an absurdity which a proper study of principles or a test of the crude idea would have prevented its author from committing, at all events, to paper. I feel called upon to deal with it because it is based upon an error even yet taught in some textbooks and classes, though it is abandoned by all real electricians—a consequence of its exposure in my "Electricity," very likely. This error, which Mr. Huxley adopts as a truth for his foundation, is that the so-called "earth" connection has anything whatever to do with the generation of electricity. It was formerly supposed and "said to be pumped up" from the earth: better knowledge shows us that the earth connection is nothing more than a collective binding screw uniting several parts of the circuit. If Mr. Huxley will try a very mild experiment he will see what nonsense this earth idea is. Let him, with his friction machine, try to charge a Leyden jar, both jar and machine well insulated from earth: he will get very small effect. Now he connects his machine rubber to earth, he gets very little more effect, let him pump as he will. He connects the outside of jar to earth singly: still no result. He now connects both to earth and gets charge easily. What is the reason? He will say, on the old notion, he draws + electricity from the universal reservoir the earth, while to make room for it in the jar, − electricity runs away into the universal sink, the earth. But the earth takes no part in the transaction at all. Let him keep machine and jar perfectly insulated and connect the rubber to outside of jar, and he will get charge just as readily. In both cases the electricity is nothing more than a form of the energy he exerts, and the earth will give him nothing.

If we wish to charge a secondary battery, or light a lamp, it is not *electricity* we have to supply, but *energy*: electricity is only a word, a mode of converting and transmitting energy.

Some time since a gentleman came to me for advice as to an idea of his by which he was going to get electricity for nothing: by connecting a series of condensers (of course with earth also) he saw that the same quantity of electricity would charge the whole series: therefore he could use each condenser separately to do work. The idea is precisely the same as Mr. Huxley's. The premise is true, the deduction wrong. The same quantity of electricity as would charge one would charge six. True; but to charge them more than six times the amount of energy would have to be exerted.

Mr. Huxley says, "two secondary batteries may be charged with less expenditure of power than one can at present." As a matter of fact, it would require more than double the expenditure of power.

Sigma.

JERKS IN RAILWAY TRAINS CAUSED BY BRAKES.

[20735.]—I have read with interest the theories expressed by Mr. Brown and Mr. Molison, but I am quite unable to accept them as correct. These correspondents appear to think that the jerk caused at the moment when a train comes to rest is due to some unconscious action of the passengers themselves, whereas I maintain that the jerk is the result of the carriages "righting themselves," or "assuming their normal position when the train comes to rest."

If the jerk be caused by the *action of passengers*, it must follow that it will be in proportion to the quickness of the stop, irrespective of the carriages. Now, this is not the case. The short carriages assume a greater angle than long ones, or Pullman cars; therefore, the jerk given by a short vehicle assuming its normal position is much greater than that experienced in the long carriage. Let us for a moment leave passengers out of consideration.

When the brake is applied the front end of each carriage (in consequence of the alteration in weight upon each axle) will be found to be much lower, and the rear end higher, than its usual level, as I have before explained; the moment the train stops, the carriages right themselves. If this be not the cause of the jerk, why is it that a glass of water will overflow, or be spilt at that moment? I will give an instance which may be useful.

Take a train fitted complete with a continuous brake, but at the rear place a carriage without any brake. Now, if a quick stop be made the passengers in the fitted carriages will feel the jerk at the moment of stopping, but those in the last carriage will not feel any such sensation, and a glass of water in it would not be spilt.

The information I gave was based upon the results of practical experiments—some made by myself, and others conducted in my presence; and I find no reason to modify the views which I have expressed in my letter, page 185.

Clement E. Stretton.
Saxe Coburg-st., Leicester, Nov. 11th.

THE RECENT ACCIDENT AT LIVERPOOL AND THE MIDLAND TWO-MINUTE BRAKE.

[20736.]—In my letter, page 139, I gave some details of the accident which took place at the Central Station, Liverpool, on the 22nd September. There is a rule that trains must run into terminal stations at such a speed that they can be stopped by hand-brakes only, and drivers should be very careful to obey it, *especially when they have a continuous brake which is not safe to depend upon*; but, on the other hand, if drivers are intended to obey the rule, an extra minute should be allowed in the running time to enable it to be carried out.

Major Marindin's report is now issued, and it is satisfactory to know that his remarks upon the subject are engaging the serious attention of the chairman and directors. I have pointed out in my pamphlet, and in your columns, the danger of the modified vacuum brake used by the Midland Company.

Major Marindin remarks: "It would appear from the evidence that the brakes upon this train did not act as they should have done when they were last applied, for, if they had, the train brake, which was undoubtedly applied when leaving the tunnel-mouth, 311 yards from the buffer-stops, or very soon after, ought certainly to have so reduced the speed that the driver might without difficulty have stopped his train at the proper place, by the application of the steam-brake when he had still 140 yards to run."

He also states: "That the unsatisfactory manner in which the train brake behaved upon this occasion strongly supports the conclusion which was arrived at by Colonel Rich, when reporting upon the somewhat similar accident which occurred on the 25th April, 1882, at Portskewet, on the Great Western Railway, viz., that the efficiency of this class of brake is materially interfered with by the leakage hole in the piston-head."

This conclusion is perfectly correct; and the fact that Midland trains are constantly running past stations and signals is convincing proof that the brake is dangerous.

When this brake is in good order the power is practically gone in one minute, and the blocks will be clear away from the wheels in about one minute and a half.

The rule says a driver must have at least 10in. of vacuum before he starts from a station; now, this leads anyone to think that 10in. would at least be efficient in stopping a train, but from my own experience I am able to state that 10in. of vacuum leaks away so quickly that it is no use whatever.

Many drivers hold the opinion that the amount of vacuum shown upon the gauge is the actual power which they can bring to bear upon the brake pistons. This is not necessarily the case. For instance, a driver opens his large ejector and creates a vacuum of perhaps 15in. or 20in. in the brake-pipe and lower side of each piston; *this is* *shown on the gauge.* But at the same time there is not at first any vacuum upon the top side of the piston, and, therefore, no available brake power. A considerable time is required to create a vacuum in the top sides of the cylinders, because all the air has to be exhausted or drawn out through the small leak holes.

Trains often run past stations on both the Midland and Great Western Railways, the brakes fail to take any effect, but the drivers state positively that their gauges showed 20in. or 25in. of vacuum. Their word is sometimes doubted; but it will be seen that if the ejector be closed too soon, there is little or no available brake power, and yet the gauge has shown plenty of vacuum. Of course, it will be said that drivers must keep the large ejector open for a considerable time, but there are two serious objections to this—(1). The large ejector causes such a noise when used at stations (especially those which have glass roofs), that drivers are blamed "for making a disturbance in the stations"; (2) The ejectors use such a large quantity of steam, that if kept open for the proper time they reduce the boiler-pressure to such an extent, that the engines cannot keep time with the trains. The small ejectors for maintaining a vacuum when running, not only use very much steam, but the constant jet seriously affects the steaming powers of the engines.

The Midland Company possesses some splendid express engines; my letters in back numbers of the English Mechanic have frequently pointed out the first-rate work performed by them, and the small consumption of coal in proportion to the duty. Unfortunately, now these fine engines are crippled: the latest information furnished to me shows that they burn more coal per mile than any running out of London, in consequence of the use of the vacuum brake ejectors. Two engines now often have to take a train which one could work before this brake was fitted to them.

Clement E. Stretton.

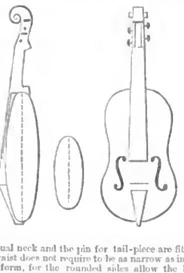
Saxe Coburg-street, Leicester, Nov. 11th.

GRINDING CHISELS AND PLANE-IRONS.

[20737.]—If "Amateur Carpenter" (20717) wants a grindstone, let him get a fair-sized one, 24in. or 26in. by 4in. Such a one on a wooden frame will cost about £2 or £2 10s., and can be worked by foot or hand. I also am an amateur carpenter, and since I adopted the plan of which I gave an account in Vol. XXXII. of the English Mechanic, page 212, I have had no difficulty with grinding plane-irons or chisels. The plan with the wheel is not, in my opinion, so good as my own, because you have not the same leverage against the stone, and because you cannot cant the holder to grind gauges. If "Amateur Carpenter" wants any further information, I shall be happy to give it if he will advertise his address. **T. K. W.**

NOVEL VIOLIN.

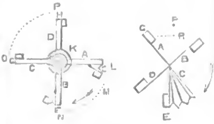
[20738.]—Herewith I send a very rough plan of a violin seen at the National Exhibition, Dublin. It is formed of two shells—one of hard wood for the back, the other of the usual pine, these being left sufficiently deep to form the violin without any intermediate ribbing. The shells of a walnut give a good idea of the plan, though, of course, much too deep in proportion. Projections are left to which the usual neck and the pin for tail-piece are fitted. The waist does not require to be as narrow as in the usual form, for the rounded sides allow the bow sufficient angle to clear the strings.



The cuts require little explanation, the second being intended to represent a section at right angles to the first, but they do not by any means profess to give the proper curves, which are pretty, for I only sketch from recollection, and the instrument, though not highly finished, looks very well. A rather clumsy holder for the chin has been attached to the tail-piece boss, but I would suggest that projections should be left for the purpose of forming a holder, and if well designed might be an ornament instead of an eyesore. I am happy to say the sound-post has not been discarded, so there is some hope for the tone. If I mistake not, the bass bar has been omitted, which would be an error, but the position of the instrument precluded a thorough examination, and, of course, did not allow sounding. I should remark that the pine of which the sound-board is formed is joined in the usual manner, the closer grain being in the centre. The back is also joined, but I think it might be cut from one piece with advantage. **Captain Cuttle.**

"A. S. L.'S" HYDRO-DYNAMIC PARADOX.

[20739.]—The following is the explanation of the above paradox.—The bellows E being full, F is empty,* and therefore counterbalanced by H. We



have then simply to deal with arms A and C. Let X represent the energy stored in E when it is in its original position; so X = E by distance L N; or X = E × L M + M N. Now E × L M represents the energy now stored up in the water W; so we have stored up in arm A no more energy now than when the weight E was in its original position, and then it had just sufficient, ignoring friction, to raise G from O to P. Now that I have given my explanation, here is a question for those who are *content* to believe in perpetual motion resulting from the action of gravity. Let A B C D represent the first drawing. Weight E now at bottom, and G still requiring to be raised distance R P. What will now cause any movement in the direction of arrow? This is where I expect the machine would stop, or a little before. **James Fearnley.**

NOTES ON DYNAMO MACHINES.

[20740.]—I think "E.," letter 20709, misunderstands me when I say "that magnetic or electrical retardation have nothing to do with the result." What I mean to say is this: To obviate the magnetic delay and electrical retardation, we give a certain amount of lead, which depends on the speed; but even when this lead is given, we must give a still greater lead when the current is larger, this *further lead* having nothing to do with magnetic or electrical retardation, but being, as stated, due to displacement of the field. I am fully aware that with no current at all a certain amount of lead is necessary. What "E." says about the falling off in E.M.F., even with the brushes in the best position, I think is highly probable; it will be one of the problems in future machines to see whether it is possible to so arrange things that the field produced by the armature may assist, instead of weakening, the primary field. I cannot say, without more consideration than I have been able to give to this, whether such an arrangement is possible or not, on first principles. Another point I should like to mention is that, as a matter of fact, owing to residual magnetism, the characteristic curve does not begin at the point of intersection of ordinate and abscissa A, as in Fig. 1, but at a point a little way up, as Fig. 2 at B.

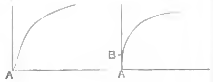


FIG. 1 FIG. 2

Ll.B.A.

LATHE-PLANERS.

[20741.]—The Rev. F. Carre, letter 20712, is welcome to adopt "F. W. G.'s" or any other planer if he thinks it better than the form suggested in my article, which seems to have given him such dire offence that he is almost unparliamentary in the expression of his views. For this reason alone I had determined to allow the letter to pass without further notice, and will now content myself with saying that my views are not altered, but that I do, as I expressed in that article and elsewhere, object to combination lathes or other machines; but that if a planer or shaper *must of necessity* be used on a lathe-bed, I think the rack and pinion may be so used satisfactorily where such rack and pinion has already a place on the lathe, as in the self-acting and screw-cutting ones. The form of planer-head is, of course, optional. "F. W. G.'s" may be better or worse than mine. I did not happen to notice it, and have sent the paper to my son, as I do weekly.

If "F. C." or "F. W. G.," or anyone else, sends a design of lathe apparatus, which appears to my humble mind a good one, I should most certainly recommend it, as I have no personal feeling in the matter. If I object to such designs, I always try to remember that a courteous letter alone should find a place in these columns. **O. J. L.**

SPHERICAL SLIDE-REST.

[20742.]—I am much obliged to "F. W. G." for noticing my proposal. I have received some good hints from him. I had, however, considered the backlash he objects to, but thought the two lower slides of the spherical were only used to place the centre of worm-wheel in position. If that is so, I think his objection would not hold, as only the upper slides would be used for the ornamental work, which upper slides should, of course, be made with the usual care. **F. A. M.**

NORTHCOTT'S APPARATUS FOR TURNING IRREGULAR FORMS.

[20743.]—In the English Mechanic for September 1st, 20404, p. [illegible], No. 910, I observe that "Gereb Admi" refers to a description of the above given in my book on lathes and turning, and inquires if the following passage is correct: "For every revolution of the back shaft the worm-wheel will make one-seventh of a revolution, and during one-tenth of a revolution of the screw *e* the slide D will traverse one-tenth of an inch." "Gereb Admi" goes on to say, he concludes the one-tenth to be a printer's error, and the movement of the slide to be one seven-hundredth of an inch, instead of one-seventieth, as given in "Lathes and Turning," for the movement corresponding to one revolution of the shaft A. "Gereb Admi" is quite right in assuming the *one-tenth* to be an error; but I expect it was my own error, and not the printer's. The shaft A, however, will revolve 70 times to move the slide D 1in., and "F. A. M.'s" reading of the sentence in question correctly expresses my meaning. If "Gereb Admi" will send me his address I will endeavour to give him a sectional drawing of the apparatus, as he requests, or any other information he may wish to have.

In regard to "F. A. M.'s" letter in September 8th (20471, p. 15, No. 911), I may state that he is quite correct in concluding that the slide must vibrate slowly, although not necessarily so slowly as one or two vibrations per revolution. The apparatus was mainly intended for use in conjunction with rotating cutters, although I produced some very pretty figures with it and a single point tool. Figure 198, for example ("Lathes and Turning," 2nd edition), was done in this way, and "F. A. M." will see that the vibrations were in that case many more than one or two per revolution. Figures 211 and 212, cut by single point tools, are not bad patterns. Figure 216, and the principal part of 217, were cut by an eccentric instrument used in conjunction with the apparatus. Figures 213 and 214 were very carelessly cut; but in these the vibrations per revolution were considerable, both in number and length. I have two or three very rough, but very curious, specimens of solid turning produced by this apparatus, and if "F. A. M." or "Gereb Admi" is in my neighbourhood at any time I shall be very pleased to show them.

W. H. Northcott.

Hatcham Iron Works, Pomeroy-street, S.E.

THE WIMSHURST INDUCTION ELECTRICAL MACHINE.

[20744.]—Unintentionally, I fear, though none the less effectually, does my friend "M.Ph.S." corroborate my remarks *re* the above machine. In the article to which I alluded in my last, the machine was spoken of as "a recent invention," and a "decided advance," and "certainly much in advance of anything previously known"; and I cannot but think that I was justified in thinking that the writer meant to say that the Wimshurst machine was new, and better than those now in the market.

Our shadowy "M.Ph.S." now says it is more than two years old. Just so, I say; even more than that—at least ten. We, therefore, so far, agree that it is not new. I presume the "Voss" was not known to him when Mr. Wimshurst built his machine; and the only mystery to me now is, why, at this time, when we have so much better, they should now be built at all. With reference to its merits, Mr. "M.Ph.S." kindly points out the cause of the weakness to which I referred. Just so, Sir. I am obliged to you for your explanation—the fault of the arrangement of the machine. Just as I said: and I congratulate and console myself for my neglect in not making the inquiry, in the fact I have so effectually called forth an explanation of its poor performance, and that, I believe, from the very gentleman who reports it a "recent invention" and a "decided advance." But, after all, I am to be excused, inasmuch as the object of my previous letter was not to explain the defects of the thing—the cause of which I knew very well—but to warn those who did not know better, lest they should build or buy such, and be doomed to after disappointment.

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* The figure in last number shows the connecting passage on the wrong side. It should connect E and F.

I was at a little loss to account for the extra-poor results reported; but the explanation of "M.Ph.S." shows that the machine performed more like what a respectable Holtz of magnificent size should, and I am quite willing to take the word of "M.Ph.S." himself in this matter, without the evidence of the ghosts he calls to witness—"the several members of the Physical Society"—nameless M.Ph.S.'s like himself; but, I submit, the fault was with himself, the writer of the original article; for why was length and number of spark given, if not to judge of power? If other data—the extra Leyden jar—was absent, that is his look-out. I mentioned the machine I showed at the Physical Laboratory merely to show that the connecting the similar armatures was simply a matter of "of course"; I claimed nothing, and, indeed, my very aim was to object to anyone claiming an arrangement so obviously necessary.

Since writing my first letter I have had numerous inquiries *re* the construction of multiplate Voss machines. To those who have already made a single plate, a few words will, I think, clear away all difficulty—to others I will ask them to wait a short time, as I am in communication with Messrs. Dale and Co., of Little Britain, with reference to a new model, which, when complete, I will describe. If the Editor can find room I will be pleased to explain the principle of "the Voss," which, when mastered, the amateur maker has not to stick so slavishly to the designs of others, but is free, and is thus more in a position to employ the material and tools at his command.

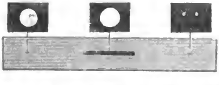
The few remarks to those who have constructed a single plate machine, are 1st: The brushes and buttons are necessary only on the first plate; if many plates are used they may be put on the last plate also. 2nd. The vertical combs are not needed anywhere. I do not care for the "slips of glass" arrangement, as they need a frame. If this frame is of conducting material it interferes with the action; if of non-conducting material (vulcanite) it is troublesome to make, and expensive. My stationary plates are round at the top and square at the bottom.

Swansea. **A. R. Molison.**

SPECTACLES.

[20745.]—Mr. Henry Stooke's letter (20673, No. 918) is of great importance. Three years ago, in a letter to Mr. Burnham, of Chicago, I mentioned an apparatus devised by me, and named a "parallaxoscope," which has for its principal objects some of the desiderata pointed out by Mr. Stooke. I have good sight; but for years I have observed that my left eye is weaker than my right one: still, I had never noticed any inconvenience from it. Some years ago I was studying optical phenomena, when, in winter time, I particularly observed the effects produced by frost on the glass of my windows. As freezing time is now very near, I advise all curious observers of natural, physical, and meteorological phenomena, to pay attention to the gradual freezing of their window-glasses, particularly those exposed to the sun-rays. It will afford them a gratuitous spectrum analysis of a peculiar and most interesting kind, and a source of great entertainment, concurrent with its marvellous effects. On these *flat* surfaces they will, perhaps, be surprised to observe a beautiful reproduction of most of the moon's surface—most interesting forms—mare, mountains, craters, craterlets, &c., which very likely will make them think, dream, and doubt. They will admire splendid landscapes, fields of grass, forests, trees, seas, &c., which all will be formed by successive deposits of vapour, the physical form of which will thereby be revealed to them, the cause alone remaining unexplained. They will have the physical explanation of the moon's yellow light, the colours, tints, shades, &c., observed on her surface, and of their changes. They will be able to observe the difference of temperature between moon and sunlight, and its cause; consequently, their different effects upon the earth and vegetation. They will be enabled to explain, according to physical laws, the production of halos, as they will be able to produce lunar ones, in simply looking to the moon through the frozen glass of their window, but on one face only, not on the other.

One day, on looking at my frozen window-glass exposed to the sun-rays, I observed a splendid, a glorious representation of the sky, with innumerable constellations of stars of all colours, which, owing to the earth's rotation, continually changed in colours and sizes, proportionally with the angular incidence of the sunlight. Not only did they change in colours, but some disappeared entirely, when new ones appeared suddenly. In closing one eye, I experienced beautiful phantasmagorical dissolving views, which vanished also, and changed on reopening it. It changed again on closing the opposite eye. These wonderful changes suggested to me very deep thoughts. Meanwhile, I was struck by the following discovery: *My two eyes have not the same focus;* that of the right one is higher than that of the left. When looking at very distant objects—stars, for example—I observe no sensible effect; but, at middling distances, it causes a faint want of neatness in the vision. This seems to come within the scope of Mr. S.'s query. No doubt, many persons, perhaps unknowingly, are affected in the same manner as myself, and even, perhaps, worse. I know of no instrument now existing for detecting this peculiar visional state. I therefore endeavoured to devise one. Convinced as I was that were such instruments existing, it would render possible not only to detect an abnormal state, but also its proportions, and, as a natural consequence, lead to a proper remedy. Such is the origin of my *parallaxoscope*, of which the following is a description.



I took three sheets of white cardboard: on two of them I traced a similar circumference; on the first, which will make the bottom of the instrument, I blackened the external part so as to obtain a round white disc in the centre of a black ground. Across the white disc I traced two thin perpendicular black lines, crossing each other at right angles in the centre, where I made a dot. On the second sheet, which will be the medium one, I cut off and removed the central disc, the sheet being blackened as above. Across the empty circumference I placed two thin black threads, crossing each other at right angles in the centre, where I placed a black pearl; the whole corresponding in form with the first sheet. The third, or front sheet, was entirely blackened; two pin-holes were pierced in it, at a proper distance from the two eyes, so as to permit to look through. The first, or bottom sheet was fastened at one end of a board; the second, supported by a stand, was placed in a groove, in which it could slide at will, backwards and forwards as required by the sight; and the third was fixed at the other end of the board. Such is the instrument.

It is obvious that in cases of normal lights, on looking through the pinholes of the front sheet, both the crossed thread and black pearl of the middle sheet will exactly cover the black lines and dot of the bottom sheet. But if there be any abnormality such will not be the case. In normal cases, on closing the right eye, for instance, the black pearl will be carried to the right, but on the black line. In closing the left eye it will be the reverse, but in abnormal cases all will change. If one eye's focus is higher, on closing it the black pearl and threads will no longer agree, and will be carried under the black lines and dot, of course, vice versâ. If the abnormality is in the vertical direction, on closing alternately the eyes, the difference of focus will be observed. In cases of normal sights, in closing the eyes alternately, the pearl is carried at an equal distance both ways, whereas, in abnormal cases the distance differs. As such it is easy to ascertain the degree of abnormality.

The direction and intensity of the aberration being known, it entirely depends on opticians to redress it by means of glasses. If one eye is weaker, they will increase the power of the glass; if differing in focus, they will place their glasses at an angle corresponding with that of the aberration, and the sights will be all right. I give above a rough sketch of the instrument. **Ch. Rabache.**

[20746.]—I quite agree with the querist (letter 20673, p. 184) that immense mischief has resulted from the ignorant and pretentious charlatanism rife in the spectacle-selling trade. Spectacles, like trusses, splints, and wooden legs, should be obtained under the advice of a medical practitioner. Specialists are now not uncommon who understand the anatomical structure of the eye and its needs—to assist nature is the honest aim of these gentlemen; and there are instruments which in the hands of these are almost infallible guides. I say, search out the nearest of the aforementioned, and get spectacles of the sort advised. A little trouble or money spent in this way is a profitable investment in the end. Above all things, avoid very cheap goods. Thousands of cheap spectacles have only one surface of the lenses optically worked; the other is just a common window-glass surface. Let any one look across the road through an ordinary window; note the distortion of all objects he sees, and ponder, then, at the possible results to his vision if he constantly has such a mass of distortion in front of his eyes. **Prismatique.**

DIE-CUTTING.

[20747.]—In letter 20720 "Robinson Crusoe" says the dies for large medals are generally cut by a machine and finished by hand. Can he oblige with any particulars, and a sketch of the machine? I have been partner in a large die-sinking business in the Midlands 11 years, and never heard of machines being used. In the last paragraph he says dies for coinage are produced in large numbers by punches. I presume he means what is technically known as "hubbing."

I stated, on page 72, Vol. XXXIV., and page 247, Vol. XXXV., much information on this subject cannot be conveyed by writing. **M.M.I.Se.S.**

LEGAL REPLIES.

[20748.]—Highway—Width (48511).—By the General Highway Act, 1835, which still stands good, no fence or other obstruction is to be put up within 15ft. of the centre of any carriageway. The querist must therefore measure his 15ft. from the centre, and not 30ft. from the opposite fence. But if the road in question is, and always has been, wider, he cannot reduce its width. The whole space between hedges or fences is highway, if it has been used as such, for carriages or cattle, and this whether it be hard road or not, and it cannot legally be encroached upon. But at least 15ft. from the centre must always be allowed.

The Agricultural Holdings Act, 1875 (48520).—This statute came into operation upon 15th February, 1876, and it applies only to leases entered into after that date. Any farm lease, therefore, which was granted prior would not be affected by its provisions. If, however, there be no lease, but only a yearly tenancy, then the Act applies to that tenancy, if current at the date of its coming into operation, unless it has been excluded by proper notice in writing, or by mutual agreement, or the custom of the country.

Detaining Goods—Repairs (48575).—The shortest way to proceed in this case will be for the querist to bring an action against the lathe-maker in the county-court for the return of the slide-rest, with such damages as he likes to claim for its detention. It would be as well to make one more demand for it in writing, of which he should keep a copy, and send by post himself, so as to be able to prove the posting. When the summons is served the lathe-maker will doubtless attend to the matter.

Nuisance—Smoke—Smith's Shop (48576).—Fuller particulars are certainly required to understand and answer this question. How long has the querist occupied the premises? How long has the smith's shop been there? What kind of a chimney is the smith's? How long has the nuisance been going on? What sort of a factory is it? Without knowing these things, at least, it is useless my trying to deal with a complex case of nuisance, damages, and injunction, which requires full and careful consideration.

Vehicle—License—Trade (48581).—A vehicle used *solely* in the way of any trade or business which has the owner's name and address lightly printed thereon, does not require a license; and such a vehicle may be legally used to convey the owner and his family to church. But any other user, even without letting on hire or carrying strangers, would make a license requisite; or where tradesmen drive out in their light carts on holidays, though the law in this respect is probably seldom enforced. But as the exception is solely for the good of trade, the professions are not included, and any professional man using a two-wheeled vehicle would have to pay 15s. for the license, or run the risk of being fined, so it would be safer to take out the license. It appears that a clergyman may keep a horse for his professional use without paying the duty, and there may be some exception in the same way in regard to vehicles, with which I am not acquainted.

Contract—Fraud—Infant (48589).—The law presumes a person to read an agreement before signing it, and to know and assent to its contents; and this is the usual course. The form signed was, of course, a contract. But still, if the party signing proves that he was induced to do so by a false representation as to discontinuing the book, that would amount to a fraud, and would avoid the contract. In the case put, few, if any, judges would enforce the agreement, as these canvassers and their modes of doing business are well known. But the querist being an infant, there is an end of the matter, as he could make no legal contract unless the book can be considered a "necessary," in which case other facts must be gone into. The publisher will probably let it alone; but if sued, the defendant should plead both fraud and infancy.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

THE LINK-MOTION

[20749.]—With reference to "M.I.C.E.'s" letter (20722), I beg to say that Rankine's "Applied Mechanics" does not, so far as I can find, contain an answer to my original query on this subject, which was in effect: What relation must subsist between *d*, *l*, and *r*, so that the curve in question may deviate least from a straight line?

I should, therefore, be much obliged if "Milverton" would favour me by giving the outline of the investigation by which he obtains the results $d^2 = l(l + r)$, and tan. DCO $= \sqrt{l + r / 3l - r}$, given by him in letter 20688. **A. J. Smith.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48030].—**Hardening Taps and Dies.**—Your correspondent "Essar," on p. 210, says there is only one way, namely, heating to cherry red and dipping in cold water, and then goes on to say practice makes perfect. Now a reply of that kind does not seem to me to properly answer the query. The great difficulty in hardening tools, is principally their liability to twist or get out of truth; secondly, cracking (especially if large) after hardening; thirdly, getting the right temper. In our factory we use a great number of small taps and rimers, some of the rimers are 9in. long and ¾in. diameter; these we harden very successfully, not more than one out of a dozen being out of truth. Our plan is as follows. First, carefully select your steel; let it be of the best cast, with a medium grain (a fine-grained steel will break when much less force is applied than a coarser-grained, and, although it will take a keener edge, it will not resist the strain required by a tap or rimer). Next centre it, and turn off the scale and soften. The object of softening after the scale is removed is to make the grain of the steel equal throughout; if it be softened with the scale on it will generally cast. To soften inclose the articles in a piece of gas-tube filling up with wrought-iron turnings and plugging the ends with clay, making the whole red-hot and allowing it to cool very slowly—i. e., leaving it in hot ashes all night.—This method makes the steel very soft, and equalises the grain. After softening turn up the work, taking care not to bend it or straighten it, should it have cast, as it probably will in the process of softening. The reason for this is that if the steel be bent or hammered, the grain will be closer in one place than another, and heat has a great tendency to bring it back to its original position. The next thing after finishing your tool is to harden it: first, slightly heat it over a gas or other flame, and rub it all over with a mixture of Castile soap and lampblack. This is to prevent the edges from being burnt. The next is to get a thick iron pipe (the size we use is 2in. diameter and ¾ bore). This is well filled up with taps or rimers and charcoal dust, the ends being closed with clay as before, this is placed in the furnace and occasionally turned, until it is one uniform heat of cherry red, or on the outside a trifle hotter. It is then carefully removed from the fire, one end of the clay knocked off, and the contents allowed to drop perpendicularly into a solution of water, chloride of sodium, and nitrate of iron; this solution is kept at a temperature of 60 degrees. The articles hardened should remain at least a quarter of an hour before being removed. This method of hardening may be summed up thus. Make the steel of one grain throughout, prevent it from oxidising whilst being heated, allow every part to heat at the same time, avoid bending while hot, and lastly restore if possible, by adding to the loss of carbon caused by heating. As I have taken up already too much of your valuable space, I will defer the method of tempering to some future time.—Arthur Clegg.

[48043.]—**Chemical Black.**—I have some sheet steel several square feet each, that I wish to treat so as to avoid rusting. Possibly "Auld Reekie's" process may answer. Will he please give clearer details of application? My steel is not bright; is this necessary? or will the application suffice without preparing the surface of steel, or with pickling in hydrochloric or sulphuric acid do.—Amateur.

[48132.]—**Bacteria in Beer.**—I must congratulate Mr. Thoms on his brilliant discoveries in biological science, as he is the first person who has ever seen the phenomenon of yeast-cells developing into bacteria, and vice versâ. This is altogether contrary to my experience, and is also contrary to the experience of every biologist of any note, either at home or abroad. I most emphatically deny that a yeast-cell, under any conditions whatever, is capable of developing into a bacterium, or that a bacterium is capable of developing into a yeast-cell. I maintain that a yeast-cell always remains a yeast-cell, that a bacterium always remains a bacterium, and after reading carefully Mr. Thoms' letter in No. 919, I can only conclude that had he been more conversant with the researches of the last few years on the lowest forms of life, he could not possibly have made such blunders—I beg his pardon, such mistakes.—John Heron.

[48149.]—**Dynamo for Electro-Plating.**—Several machines of the kind have been described in previous numbers with drawings; but the size of wire, &c., depend upon the work to be done and the general construction of the machine. The calculation is, in fact, complicated by so many considerations that, unless one took a given machine constructed to do certain work at a certain speed, no very definite instructions could be given.—T. P.

[48155.]—**Substitute for Hops.**—Consult some of the trade journals. What with substitutes for malt and for hops, brewers will soon set the popular taste against beer and ruin their own trade.—Essar.

[48156.]—**Geneva Watch.**—If you cannot discover the cause by the help of the numerous articles which have recently appeared, it will be advisable to take it to a professional. Examination is the only way to arrive at a correct opinion as to cause of stoppage, though it would be easy to guess at many things.—Orologo.

[48160].—**Hood for Camera.**—To Mr. Lancaster.—Many thanks for your offer on p. 187. If you will kindly send sketch referred to, I do not think I shall be the only person obliged.—Assoc. M.I.C.E.

[48161.]—**Secondary Batteries.**—No satisfactory reply can be given without examination of the cells. The danger depends entirely on the amount of E.M.F. If the current will not pass through the body, there is no danger.—T. S.

[48163.]—**Brake for Dog-Cart.**—Do not all brakes for two-wheeled vehicles throw the weight on the horse? Can it be otherwise, unless it is made to work on a drum on the axle, and is tied to the tail of the cart? The fact that a prize was offered shows that there is a difficulty.—T. P.

[48164.]—**Waterproof Dressing.**—Coat the sheets with double-boiled linseed oil, and leave them to dry well between the coats. If wanted coloured, use ochre, brown, or vegetable black. If tarpaulins are wanted, coat the cloth with Stockholm tar, thinned with whale-oil.—Essar.

[48193.]—**Medical Coil.**—Your query is rather incomprehensible. The wire is made up of one length of different sections, and the ends of the sections are carried out to pieces of brass, where connection with the handles can be made by plugs or switches. Mr. Lancaster explained that some time ago.—I. N. D.

[48291.]—**Softening Steel.**—One tablespoonful each spirits of salts and saltpetre to one gallon of water. Heat the steel and cool in it; then heat to soften by letting cool. Cast steel thus treated will weld with sand.—W. H.

[48316.]—**Dividing Double Stars with 3¼in.**—For several years I used a 3¼in. Cooke, and should have been pleased indeed to have separated such stars as those mentioned by "O. G."—both according to Webb, only 1 second apart, but distance varying. I found 2·5 seconds were nearly the limit of its performance, and this under the most favourable circumstances and with 150 power, the highest it would bear.—W. A. S.

[48355.]—**Silver Printing on Opal or China.**—Many thanks to W. Robinson, junr., for kindly answering my query *re* above. If it would not be too much trouble, will he oblige with giving full formula and detailed instructions for printing without development either by collodio or gelatino-chloride? Also full detailed instructions for toning the lantern slides after pyro-development with chloride of gold. Would it hurt the prints on china or opal plates if, after being dried and coloured with ordinary china paints or oil colours, they were to be burned in, as usually done in tile paintings.—Keramic.

[48386.]—**Iron Hoops.**—Allow 1in. for jumping, &c.; jump a little, set the end up a little narrower, lay flat on anvil, split up the middle 1½in.; then scarf one-half one way and the other half the other; hold it over the anvil, and knock the half you scarfed first down; turn over and knock the other half. Do the other end same way; then coil; give plenty of nip; pull them together; heat, and hammer together; then you can weld without any fear of slipping.—W. H.

[48399.]—**Telescope.**—Your correspondent, "Eleph," if he cares for experiment, might try to transform his instrument into a dialyte. He would require a crown and a flint lens to form the correctors, and these might be 3in. diameter. I cannot tell him what curves or foci would be suitable, but I happen to have a few data concerning an instrument described in these pages some years ago. It is 7½ aperture, and I should think if "Eleph" made his curves proportionately less for his 5½, he would not find any extraordinary difficulty in arranging the lenses so as to produce a decent effect.

Object-lens aperture, 7½.	Correctors, ap. 4.	
Focus 105.	Plano-convex crown	9
1st curve, 76·9	Double concave flint	9·97
2nd ,, 175·1		101·

Here is a more convenient formula given by Mr. Oldfield:—

Plano-convex objective, 5in. aperture, curved to 19in. radius.

Correctors, aperture 2½—plano-concave, dense flint, 5in. radius.

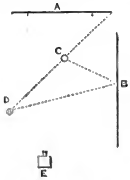
plano-convex, white crown, 5in. radius.

Probably, the latter arrangement is the easiest and most convenient, and I should think two planos, curved to say about 7in. radius, would give a fair result. But no definite prediction can be made; we can only judge what is likely to be suitable from the results which others have obtained.—O. V.

[48421.]—**Battery for Bell.**—Your battery might be simply charged with dilute sulphuric acid in the proportion of 1 of acid to, say, 10 of water, but most likely it will be a "bottle bichromate," in which case the solution would be a mixture of bichromate of potass and dilute sulphuric acid, in proportion, say, of 3 of bichromate to 4 of acid. The water and acid must be mixed in a separate vessel, and allowed first to cool, as the mixing evolves great heat. It is said that the addition of a little pure chloride of zinc solution increases the efficiency of the battery.—J. W. White.

[48434].—**Single-Needle Telegraph.**—You can prevent the needle from rebounding off the stops by folding a small piece of paper and gumming it to the bottom of the needle. It also gives a more distinct signal.—G.B.C.B.L.

[48444.]—**Lamplight Photography.**—It seems to me that your complaints all arise from the fact that your plates are under exposed. If you want full detail in the draperies and shadows, I should say you will require to burn about 8 or 10 times the quantity of magnesium ribbon you are in the habit of doing. I am not practically acquainted with the working of the magnesium lamp you use; but I would suggest that you might improve your results by interposing an oiled tissue-paper screen between the lamp and sitter; this would diffuse the light, and help in a great measure to reduce the harshness of the shadows. You should also have a white screen arranged at a right angle to the background on the side opposite the lamp, and this can be so placed as to produce almost any effect in light and shade. I have spent a considerable time in the study of portraiture by means of artificial light, the outcome of which has been the invention of the "Eclipse" light apparatus; and if "Fogged" would favour me with his address, I would be happy to send him some of my results for his inspection. My arrangement is shown in the following sketch. A, the background; B, the side reflector; C, the sitter; D, the lamp; and E, the camera. The dotted lines show the direction of the direct and reflected rays of light, from which it will be seen that the shadow will be projected into the corner and out of the range of the camera. I think, if you try a similar arrangement, and burn more magnesium, you may meet with better success.—John Y. M'Lellan, Craig-street, Glasgow.



[48452.]—**Book-edge Marbling.**—There are many causes why book-edge marbling does not always go right, and which can only be ascertained by noticing effects or defects as work is done. I should think the cause of the colours breaking up, is either that the gum is too thick, or too thin, or that the colours are not properly ground. The best gum is gum tragacanth, and this must be thoroughly dissolved, or if there are any lumps they will get into the teeth of the comb and drag the colours. The proper way to grind the colours is with prepared beeswax. The best red is carmine. But F. F. Cass had better get a copy of Woolnough's "Whole Art of Marbling," published by Bell and Sons. He will there find everything relating to paper marbling.—J. W. Z.

[48455.]—**Bath Boiler.**—I would advise you to put a high-pressed boiler at the back of your kitchen range, and lead a pipe from the boiler to your bath; you will get satisfaction this way; any other plan I think will fail to give satisfaction. Besides, the expense of gas and sheet-iron boiler would soon over-run the cost of high pressure, as the boiler at the back of your range would be placed so as the fire in the range would heat the boiler without any extra expense.—J. H. J.

[48457.]—**Electro-Plating.**—Your solution does not contain enough free cyanide. Add a little solution of the potassium cyanide, according to the quantity of your solution; as your solution now is, the deposit is adherent, but slow, and the solution loses more metal than it can gain from the anode. When in proper working order, the anode should be a light grey colour when the current is passing, and white when the circuit is broken.—Girdlestone Wright.

[48465.]—**Gas-Tar.**—Mix slaked lime with your tar for the roofs, or, better still, a thick coat of tar first, and plenty of lime shaken over this while wet; when hard, tar again. I have known this to be very effectual.—War.

[48465.]—**Gas-Tar.**—I have tarred a good many wooden roofs, and find by mixing cow-dung (fresh) with gas-tar, it makes a good cover of the nature of felt: the particles of herbage eaten by the cattle is of a fibrous nature, and binds the tar in one sheet. I boil the tar, adding a little pitch with quantity of cow-dung, say, one shovelful to 3 gal. tar, put on hot, only when roof is thoroughly dry.—J. H. A.

[48476.]—**Met. Ry. Engines.**—I am sorry to say that I can't give give dimensions of more than the cylinders and wheels, except as regards the L.N.W.R. The Metropolitan engines have leading Bissel-bogie, and have been before described in these columns, in the last volume but one. The Midland engines are of two kinds—Mr. Kirtley's and Mr. Johnson's. The former have outside bearings for driving, inside for bogie-wheels. The latter have side tanks with inside bearings, No. 8 class. The dimensions of the G.N.R. have already appeared. I may only say that they have vacuum ejector under footplate exhausting into tank. As regards the North Western, the cylinders are 17 × 20, and the driving-wheels 4ft. 7in. in diameter. Height from top of chimney to rail, 12ft. 7½in.; diameter of chimney at top, 1ft. 6in.; diameter at bottom, 1ft. 4in.; centre of boiler from rail, 6ft. 7½in.; from centre of leading-wheel to back of buffer beam, 5ft.; centre of leading to centre of driving-wheel; 0ft. 9in.; centre of driving to centre of trailing-wheel, 7ft. 9in.; centre of trailing to back of rear buffer beam, 1ft. 1in. The engines are numbered from 2,000 upwards. They are fitted with Webb's steam-brake, and also a hand-brake. The radial axle-boxes of the leading-wheel are peculiar; they are inclosed in a frame which is the segment of a circle struck from the centre of the forward pillar of the Ramsbottom safety-valve. The engines are fitted with a feed-pump worked off the trailing wheel-axle, and a Giffard's injector on the fire-box. The safety-valves are of the covered-in Ramsbottom pattern, and the regulator is in the smoke-box They are painted black, with red lining and grey between bands on tank. These engines work the L.N.W.R. Metropolitan traffic as far as Croydon. There is another rebuilt class, with Ramsbottom safety-valve and dome, with outside bearings for leading-wheels, and with cylinders 15 × 20. There is also another class, with leading Bissel-bogie, and with bright brass dome and Ramsbottom safety-valve, very like the Metropolitan engines themselves. I hope some other correspondent will furnish dimensions and sketches of the other railways' Metropolitan tank engines. In answer to "Carstairs," I have not dimensions of No. 303, etc., S.E.R.—E. W.

[48476.] — **Met. Ry. Locomotives.** — One of your correspondents wants the principal dimensions and particulars of the Metropolitan Railway locomotives, and tank locomotives of other lines. I send a few principal dimensions, together with a few particulars, of some of the tank engines on our principal railways. On the Metropolitan Railway, 205 and 209 are 5ft. 9in., 4-coupled outside cylinder passenger tank engines, with Bissel-bogies at leading end; weight about 43 tons, and designed by Mr. John Fowler. On the G.N.R., many of the tank-engines were built at Doncaster; some of the passenger wing tank-engines on this railway have driving-wheels 5ft. 6in. diameter, such as 274, 119, 250, etc. Some of the goods saddle-tanks have driving-wheels 4ft. 6in. diameter, such as 606, which was designed by Mr. Stirling. On the G.W. Railway, several of the passenger saddle-tanks and wing-tanks have driving-wheels 5ft. 3in. diameter, such as 566, 567, 202, 204, 1421, etc. "Salford" is a 4ft. six-coupled saddle goods tank-engine; 987 and 1224 are 4ft. 6in. six-coupled goods saddle-tanks stationed at Birmingham. Several of the fifteen hundreds, such as 1501, 1509, 1519, 1523, 1537, etc., are 5ft. six-coupled goods saddle-tanks: some of these engines are stationed at Wolverhampton, such as 1523, where it was built last year. On the L. and Y. Railway, some of the four-coupled passenger saddle-tank engines have their driving-wheels 5ft. in diameter, such as 623 Elk, 637 Sunbeam, 625 Venus, etc.; the last of these was in a collision at Burscough Junction in 1880, in which both driver and stoker were killed. No. 56 is a 5ft. 8in. four-coupled passenger wing-tank, and was built at the Glasgow Loco. Works by Dubbs and Co., in 1878. On the L.B. and S.C. Railway, the tank-engines of the "Terrier" class have driving six-coupled wheels, 3ft. 11½in. diameter, cylinders 13in. by 20in., have the Westinghouse brake, and were designed by Mr. Stroudley. On the M. Railway, 1265, 1266, 1268, 1271, 1272, etc., are 5ft. 6in. four-coupled passenger wing-tanks, cylinders 17in. by 24in., have bogie at trailing end, were designed by Mr. Johnson, weight 43 tons 9cwt., were built at Glasgow in 1875 by Neilson and Co., and run local trains between Birmingham and Wolverhampton; 789, 793, 794, etc., are 5ft. 2in. four-coupled passenger wing-tanks, run local trains on portions of the Metropolitan Railway, and were designed by Mr. Kirtley. On the North Staffordshire Railway, 25 is a four-coupled passenger wing tank-engine, and was built at Stoke Locomotive Works, 1882.—Prometheus.

[48481.]—**Rigging Boat Yawl.** — I should recommend a lug-sail, as shown in Fig. 1, it being easily managed, and if arranged as shown in the figure, with about the same proportion, it will give a good result, according to the lines of the boat. The sketch shows the vessel close-hauled. Fig. 2 represents an adjusting shackle for the purpose of tightening the stays. It consists of a right and left-handed gun-metal screw, with a swell and holes for towing. Two shackles, having corresponding female threads to the ends of the screw, enable one motion to draw the two together, the reverse motion separating them. Respecting water ballast, I don't know where you can get bags cheap. I have seen pillows for water-beds in good condition cheap; but I think stones quite as good for the kind of boat.—Fred. Walker.

FIG. 1

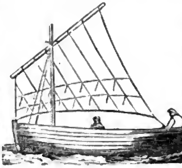
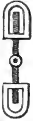


FIG. 2



[48481.]—**Rigging Boat Yawl.**—I do not see how "S. S." is to rig his boat as a yawl with only one mast—he will require main and mizen mast, with gaff, mainsail, and jib brought down to a short stout bowsprit; the mizen may be either a working lug with the tack brought down to the mast a little above the level of the gunwale, and the sheet rove through a block at the end of an outrigger or fixed boom projecting from the stern, or a Bermudian mizen, which is triangular, and does not require a yard. The jib and mizen should balance each other, so that the boat may be sailed under them, or the mainsail alone if necessary. "S S." can set up his stays by substituting a right-and-left-hand screw tapped into the ends of a piece of tube for the dead eyes and lanyards usually employed. The tube should have a hole about the middle, in which to insert a pin to heave it round by, and the stays should be made of wire rope. A steering-wheel in so small a boat would be only a nuisance. Nothing is so handy as an ordinary tiller, especially for sailing. I do not know where you can get water-bags cheaply; but why use them at all?—War.

[48484.]—**Wool Skins.**—If "Waste Not" will contrive a box or old barrel with a hole in one end of about three or four inches in diameter, so that steam can be introduced beneath from a small boiler, he will find that on passing the skins over the hole, the wool will be so loosened that he can tear it off rapidly, and with great ease. Care must be taken to preserve the temperature of the steam, so that as little condensation as possible takes place within the barrel.—A. A. C.

[48493.] — **Gas-Stoves.** — "Hayling Island" cannot do better than try Ritchie's "Lux Calor" gas-stoves for his conservatory. Acting upon the strong recommendation of Mr. Veitch, of King's-road, Chelsea, I used a couple of the heat-giving Ritchie's stoves in my greenhouse last winter, and they effectually kept the temperature up to the point required—not a high one certainly, but quite high enough for tender ferns, bedding-out plants, &c. The stoves, as "Hayling Island" surmises, require no flue, emit no unpleasant smell, and generate no blacks; and my plants throve as well as if my house had been heated with hot-water pipes—no trouble of keeping up fires or raking out cinders. The gas is simply lighted and turned up to the necessary height, and turned off if not required in the day-time. I must say that, in spite of Mr. Veitch's recommendation, I had some misgivings about these stoves before actually using them. All these were, however, dispelled when, after a fortnight's constant use, I found my plants healthy and vigorous, which they continued up to the time when artificial heat was no longer necessary.—Highlander.

[48494.] — **Microphotography.** — I think "Shutter" will easily find the actinic focus of any objective, if, after having made the necessary corrections for cover-glass, and removed the eyepiece (never use eyepiece or anything else between objective and sensitive plate), the best visual focus is obtained, he will turn the fine adjustment until the object appears surrounded by a red areola. If it cannot be surrounded by a red areola, the objective is perfect, and does not require this correction. A blue glass stand is then placed between the source of light and substage condenser: this monochromatises the illumination. Some German opticians manufacture photographic objectives; but their employment is unnecessary, especially when using high powers: then the visual and chemical foci are so close as to be practically coincident. Direct light and an achromatic condenser of lesser aperture (numerical and actual) than the objective, gives the best illumination for all pathological and histological preparations. Oblique light, without an open substage, is necessary for the resolution of minute surface markings. Should "Shutter" desire further information, I will be most happy to supply it, if he will communicate with me. I append address for this purpose.—A. Cowley Malley, B.A., M.B., Craven Arms, Munslow, Salop.

[48497.]—**Plating Brass.**—Use a strong solution of cream of tartar hot; add first some grain tin. Then put in your discs (which must be thoroughly clean), and boil for a few minutes, when they will be thoroughly cleaned; or you might silver them this way: chloride of silver 1 part, common washing-soda 2 parts, common salt 1½ parts; mix with a little warm water until as thin as cream; as it gets exhausted of metal it may be replenished by the addition of a little silver chloride. The best way to apply it is to a piece of rag on the end of a stick, dab in the mixture, and rub on the articles.—Girdlestone Wright.

[48504.]—**Roman-Candle Stars.**—Mix your stars with shellac varnish—about 2oz. shellac dissolved in 10oz. methylated spirit. They will then be quite hard. You seem to have got hold of peculiar compositions; let me warn you that most books professing to deal with firework-making contain useless rubbish. The best I know were articles by "Practicus" in the "Boys' Magazine," several years ago. Your rocket composition would blow them all to pieces, if properly made. Use nitre 13, sulphur 3, charcoal 6, mealpowder 2. Choke all your cases, small and large, and make the rockets hollow on a gun-metal spike. Dry the water of crystallisation out of all the salts.—John S. B. Bell, C.E., Newcastle.

[48506.]—**G. E. R. Engines.**—The only new engines that I am aware of which are running on the Joint Line are the 7ft. 6in. single express (245 and 600 class), which have been so recently described as to need no further dimensions being given. The engines mostly used are the old 280 class (1862-1866) for express, and the No. 1 class (1868-1870) for local traffic. I may, however, add that there *will* be a class of new engines running shortly, which are at present being built at Stratford from Mr. Worsdell's design, and the first of which is to be out by Dec. 6th. This class will have 7ft. coupled-wheels, and about 3ft. 6in. leading-wheel, which will be fitted with the radial axle-box. Cylinders (outside), 18 by 24. They will also have the Joy's patent valve gear; boilers and frames of steel. The cab and splashers will be in one continuous plate, without break; the donkey-pump of the Westinghouse brake, coming between the splashers, will not be seen, access being gained to it for oiling, &c., through the number-plate, which will be hinged for the purpose. I shall be most happy to send a sketch with dimensions on some future occasion, should our readers think it will be of any interest to them.—Busybody.

[48507.]—**Sky-Rockets.**—"Grapho" must have made a mistake in saying "that the cavity left by the piercer is 'filled up' with meal-powder." The cavity must be left hollow and open. The mouth of the case is primed by smearing with meal-powder and water as a soft paste. I will give my own recipe for red stars:—Chlorate of potash, 6; nitrate of strontia, 10; sulphur, 3; fine charcoal, 1¼; shellac, 1; antimony, 1. This is a brilliant red. I should not advise the use of clay-stopped mouths for rockets. It answers very well for large gerbs. Rocket stars should not be too small, about ½in. square, except for small rockets. About ⅛in. to ¼in. bore when ¾in. square will be about the size.—John S. B. Bell.

[48507.]—**Sky-Rockets.**—"Grapho's" extract from Spon's "Workshop Recipes" may mislead. Brass cases for inclosing rocket-cases while ramming are quite useless. The book I recommend is much more modern, and well worth having. Coloured-fire compositions will not make stars, nor will spirits of wine make them stick together.—J. F. E.

[48510.]—**Electro-Motor.**—You had best not attempt to use an electro-motor, as the cost of working the battery to drive a 10in. fan at the speed you mention would be excessive. It would require from 25 to 100 such cells as you describe, and the cost would be too great to run 10 hours per day.—J. Sutcliffe.

[48515.]—**Resistance of Wire.**—In Mr. Sprague's book there is a valuable table which gives all such particulars. I quote from it the resistance in ohms per pound of the Nos. you specify: No. 12, ·02331; 14, ·06698; 16, ·19141; 20, 1·3347. Pure copper at 60° Fahr. assumed.—Nun. Dor.

[48527.]—**Electric Clock.**—I am glad to find my guess at your arrangement was correct, and that I have been of use to you. The sketch on p. 118 is not quite correct, inasmuch as the magnet should be immediately beneath armature when pendulum is at rest. My reason for telling you to put pendant on one side of the vertical is that it is difficult to break contact at the right moment when placed in the middle. Make spring as weak as is consistent with freedom from chattering at contacts. Make under side of armature slightly rounded; fix magnet so that armature passes as close as possible without fouling; adjust pendant, or bend spring, &c., until, even when pendant catches in the notch furthest to the left (p. 118), contact is broken just as armature is on the point of reaching centre of magnet-core, and set your clock going again. These are the best instructions I can think of; by experiment, you may possibly find better adjustments. If you make B, on my sketch, a screw, with platinum point, I think you could adjust number of beats to some extent. I am sorry I cannot tell you where to get dial enamelled. Perhaps some of our watchmaking correspondents can give you the required address.—Glatton.

[48528.]—**Bee Skeps.**—Even if you get your elm boards straight and prevent them warping, they will not last, for although elm is an excellent wood for articles of furniture, or for keels, garboard strakes of boats and ships, sunk piles, &c., it quickly perishes when exposed to the atmosphere, so that it is alternately sopping wet and then dry. If anyone advises you to use elm posts for fencing, you will know what to think of him; he is a "friend" whose advice is to be made a note of, but not followed.—Essar.

[48528.]—**Bee Skeps.**—If you can keep elm-board from warping you will be more clever than most men. If you cannot afford to abandon the boards fill up the openings caused by the warping with mortar or plaster of Paris.—E. B.

[48531.]—**To Engineers.**—Without further data it is impossible to say what plan would suit your particular case best. A ratchet-wheel and pawl, a cam, &c., &c., in combination with a rack and pinion under the table, would give the required motion. If you have a chance, visit an engineer's shop, and observe how a slotting-machine table is traversed.—Labor Omnia Vincit.

[48532.]—**Nitrate of Lead.**—Nitrate of lead is made by boiling with steam in a stone cistern nitric acid and the oxide of lead to the point of saturation, when it is run into other stone cisterns to crystallise; crystals collected and dried on a stove in earthenware mugs.—E. Brearey.

[48533.]—**Angles of Pyramid.**—The angles contained between the sides of a pyramid may be found as follows:—I presume you know how to calculate the angles at the bases of the triangular sides; let us call one of these angles A (they are, of course, all equal). Now, if from one of the corners at the base we measure a distance unity (1ft., or 1 yard, or whatever the unit may be) along the base, and from the same corner measure the same distance along the adjoining base, and from the points so found draw lines at right angles to the edge of the pyramid sloping up from the corner; these lines will meet in a point somewhere on this edge, and will inclose the angle we require to find. The length of each of these lines will be sin. A, and the line joining their lower ends will be $= \sqrt{2}$; we have, therefore, a triangle, two of whose sides are each equal to sin. A, and the third side $= \sqrt{2}$, required to find the angle contained between the two equal sides, which angle we will call θ. The ordinary formula for cosine in terms of the sides may be used, and from this it will be found that—$\cos.\ \theta = 1 - (1/\sin.^2 A) = -\operatorname{cotan.}^2 A$. The minus sign shows that θ will be greater than a right angle, so $\cos.\ (180 - \theta) = \operatorname{cotan.}^2 A$, from which $180 - \theta$, and, therefore, θ may be found. Another result may be given: if we call the length of the base l, and the height of pyramid h; it is $\cos.\ (180 - \theta) = (l^2 / 4h^2 + l^2)$. When the pyramid is oblong the angles at the base of the long sides must be separately calculated from those of the short sides; calling these A and B, the equation will be $\cos.\ (180 - \theta) = \operatorname{cotan.} A \,.\, \operatorname{cotan.} B$.—M.I.C.E.

[48536].—**Indicator Diagrams.**—Are the indicator taps near the ends of the cylinders? as from the loops in the diagrams it would appear that the taps are $\frac{1}{24}$ the length of the cylinder from the ends of the cylinder, the loop being caused by the piston cutting off all communication between the cylinder and indicator, causing the indicator piston to fall and again rise (late in action) when piston had uncovered the opening to indicator.—Boswell.

[48536.]—**Indicator Diagrams.**—The loop is caused through the steam-valve being too late; that is, the piston has commenced its stroke, and moved some distance before steam is admitted to the cylinder. The remedy is to give the valve "lead"; but as you give no particulars of the engine, I cannot say how much exactly. But, for a start, put the crank on dead centre, and let the steam valve be open $\frac{1}{16}$in. at each end, when the cylinder is hot. You will find a material improvement in the working of the engine. I shall have pleasure in giving you any further advice.—Labor Omnia Vincit.

[48536.]—**Indicator Diagrams.**—The loop is evidently caused either by a bad attachment of the indicator, or a slackness, either in bearings or piston-rod, between the piston and crank. I once knew a similar loop, though not so distinct, caused by a groove worn upon the slide-valve face. Your diagram shows a contraction of the steam-passages, which I have mentioned in my reply to query 48537. I think you will find that an unusual vibration, either of indicator or rods, from either cause I mention, will account for the loop, but I cannot see that it is detrimental to the effective working of the engine, nor so serious as the fall in the horizontal line at the top of the diagram.—Fred. Walker.

[48536.]—**Indicator Diagrams.**—The loops in your diagram at both strokes of the piston are probably caused by the looseness of the bearings between the piston-rod and the crank, and will, if this is the case, be remedied by tightening them.—H. B. G.

[48537.]—**Indicator Diagrams.**—The chief fault in your diagram is that it shows your steam cut off at the beginning of the stroke—in fact, directly the piston has commenced to move. To cut off steam at half-stroke you will have to reset your valve. I should like to know the form of diagram from the reverse side of the piston. The one you send is otherwise a good shape.—H. B. G.

[48537].—**Indicator Diagrams.**—The valve appears to be suddenly opened full at commencement of stroke, and afterwards gradually closed, causing the steam to be wire-drawn, which can scarcely be called a cut-off.—Boswell.

[48537.]—**Indicator Diagrams.**—It is evident that there exists the great fault of contracted steam-passage, either in port or pipes, from the diagram you sent. The top line should be horizontal, and parallel with the atmospheric line up to the point of cut-off, where expansion takes place, and from which the fall should be gradual to the exhaust point. The fall of your line from its commencement, shows that the volume of steam entering the cylinder is not sufficient in relation to the velocity of the piston, to maintain the initial pressure, therefore you should see to your pipes, ports, and throttle-valve. The area of steam-ports is often considered as a proportional to the area of the cylinder, which certainly is the case, but the piston velocity must be taken into consideration as a proportional too. The piston velocity in your case is 440ft., therefore, dividing by 60 you obtain the velocity per second, and

$$\frac{\text{Area of ports}}{\text{Area of cylinder}} = \frac{\text{Piston velocity in feet per sec.,}}{100}$$

from which formula you can easily ascertain where the fault lies. The area of steam-pipe should be area of ports × 1·1. The rest of the diagram is fairly good.—Fred. Walker.

[48537.]—**Indicator Diagrams.**—A case of "wire-drawing" the steam. Either the engine had not full load on her when the diagram was taken, or else you have a much higher pressure in boiler than is required. If you cannot alter boiler-pressure, put lap on the valve to cut off earlier. But, like preceding querist, you don't give sufficient data. All queries on diagrams should give scale, boiler pressure, diameter of cylinder and stroke, revolutions per minute, and any peculiarities of valve-gear, or work to be done. If you will let me have the necessary information, I shall be pleased to help you to put the engine right.—Labor Omnia Vincit.

[48538.]—**Plumbing.**—You cannot do better than read the "E. M." for July, 1881; you will get the information you require. The articles on joint wiping are very complete.—A Plumber.

[48546.]—**Induction Coil.**—If the coil can have the ends taken off and be kept in a warm oven for a day or two, it perhaps may recover itself; however, this is a dangerous remedy, and you had better re-wind the coil. The iron wire core should be wound with silk ribbon as firm as possible, the ends of the core being also bound with cord for ½in., then put on the three layers primary: cotton-covered wire will do. When the primary coil is fastened by thread, wrap it with guttapercha tissue cut into slips about ⅜in. wide and 2ft. long, so as to make four thicknesses of guttapercha tissue on the primary; next drive a wire into one end and a wire handle into the other end of the coil to turn it by on two wooden supports; run the cotton secondary wire through melted paraffin, or you will not get it close, and insulate the layers of wire with guttapercha tissue overlapping, to make three thicknesses; when the winding is done put on the ends of the coil. If you use your cotton-covered wire for another purpose, and replace it with 4oz. of silk-covered wire, you will be better satisfied. It is no advantage to wind a small coil in sections.—J. Sutcliffe.

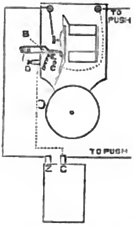
[48548.]—**Steam-Engine.**—An 8-h.p. (nominal) engine will cut up 11in. planks with saw, &c., in fair condition: but I would strongly recommend a 10-h.p., with cylinder 10¼in. diam., and a Cornish boiler, with grate arranged to burn sawdust, &c. An inverted cylinder engine would not require quite so much room or foundation as a horizontal; but there is not much difference in the wearing qualities supposing both to be equally well made. Don't have a welded boiler; have a Cornish boiler, 16ft. long, 5ft. diam., with 30in. flue and two Galloway conical tubes. It should be tested to double the working pressure; say, you work at 60lb., test to 120lb. The room over boiler can be arranged as drying stove, whilst you will have engine and boiler power for other purposes whenever required. Having had some experience in this line, I shall be pleased to afford you any information.—Labor Omnia Vincit.

[48548].—**Steam-Engine.**—The engine portion of this query I leave to someone with special experience in wood-working machinery. As regards the boiler, I may say, do not get a welded boiler; get one riveted; the pressure will all depend on the size of engine; a boiler double-riveted at longitudinal seams is 24 per cent. stronger than one single-riveted. I should think a good vertical boiler with cross tubes in fire-box would be as useful as any, and perhaps as cheap. When you get a boiler send particulars, and I will give the highest possible pressure. Do not get engine and boiler barely strong enough; get one that will give a little margin. The most reliable information would be sent on application to makers of wood-working machinery.—Boswell.

[48549].—**Steam-Boiler.**—A boiler 18in. diameter, ¼in. plates, would burst at about 600lb., if single-riveted, and at about 740lb. if double-riveted. This would give a safe working pressure of 100lb. under Lloyds' rules, as the Board of Trade allow a margin of ⅙th, Lloyds ⅕th, and insurance companies about ⅛. But what about the ends? If they are flat or welded into shell, the above does not apply to them, but if suitably dished or cambered and flanged and securely riveted to shell, then they will be nearly as strong as shell, and quite so if a longitudinal bolt be applied from end to end. Rain-water is very good, and if I had a sufficiently large quantity I should not use any other. The times of cleaning must be ruled by quantity of water used. Open out monthly until you find what incrust is made.—Boswell.

[48552.]—**Electric Bells.**—You can easily make single-stroke electric bells by not using a contact breaker, and simply joining the two ends of the coils on the electro-magnet to the two binding screws. On the circuit being completed the magnet draws the hammer on to the bell each time that the circuit is completed. The continuous action bell is, however, rather more complicated, and will be better understood by reference to the diagram. A small piece of brass or iron is fixed in a suitable way (riveting is best) on to the armature of your bell, upon which rests edgeways a piece of flat brass

A, shaped as in the diagram; it is supported by a piece of brass tube, through which a screw B passes securing it to the board—not too tightly, however, so as not to allow of its swinging easily; a piece of brass rod or stout wire, C, is driven into the baseboard in such a way that when A is drawn down by the spring E a good contact is formed between A and C. A wire is taken from C to one binding-screw of the bell, and a wire is taken from the brass tube which supports A to another separate binding-screw D. The dotted lines represent wires as well as the other lines; the dotted lines also represent the direction of the current for the continuous action using the same wire to the zinc element. The current passes from the zinc to the contact-screw through the coils to C, across A, down B, and out through the binding-screw D to the carbon element. The bell is stopped by pulling a cord attached to A, which breaks the contact, and which, if pulled hard enough, forces the armature towards the magnet by rubbing against the piece in the armature (which must be made in the shape of the diagram). When it gets above the piece in the armature, the armature springs back and A rests on the piece of brass again, ready for another time. I know of no way of testing paraffin wax.—ATELIER.



[48554.]—**Determination of Carbon in Cast Iron.**—Take 1 gramme of the iron in a fine state of division, place in a small beaker and add about 10cc. of strong solution of cuprous chloride, keep at about 90°C. for one hour, then add about 1cc. of strong hydrochloric acid, and heat until all pptd. copper is dissolved. The residue will consist of the whole of the carbon and some of the silica in the iron; filter through asbestos (the asbestos may be put in a filter paper), dry at 100°C., weigh the asbestos and carbon, then place in muffle until all the carbon is burnt off, and weigh the asbestos; difference gives the total carbon in the iron. To find the graphitic carbon: Take 1 gramme of iron, dissolve in HCl, filter through paper, dry at 100, scrape off the silica and graphite, weigh, ignite, and weigh residue: difference gives graphite. Total carbon — graphitic = combined carbon. The above are far superior in accuracy and ease to any combustion methods.—A.R.S.M.

[48557.]—**Boat.**—No manual power could propel a boat of the beam and draught specified against a four-knot current so advantageously as ordinary rowing, which is the form in which the best percentage of effect can be got out of manual force; but rowing a large boat against a strong current is most exhausting labour, and would require frequent relays of rowers, and a good many of them. If towing by men or animals is not available, nothing remains but steam-power, with all its drawbacks.—ROBINSON CRUSOE.

[48560.]—**Obtaining Heat by Chemicals.**—I don't think that "I. O. U." would obtain any satisfactory result from the plan he suggests. I believe that Ritchie and Co. have an adaptation of their "Lux Calor" stoves for use with mineral oils; and if their adaptation is anything like as successful as their gas-stoves, which require no flue, it would be the very thing to suit "I. O. U.'s" purpose to heat a small room.—J. G. S.

[48565.]—**Etching.**—I gave some hints respecting etching a couple of months or so ago; I don't know how to produce a line like an engraving. A cross section of a line etched by the "Dutch mordant," shows a ring with the upper segment removed. The acid bites into the copper, and as it penetrates widens the line laterally; this probably accounts for the difference between the etched line and the line which is simply engraved on the surface of the plate. I shall be glad to give you any further hints that I can.—R. B.

[48573.]—**Spindles in Woollen Mills.**—I cannot say with certainty of what these are made, but believe it is shear steel, and some new of Bessemer. I *do* know from sad experience that they are not the slightest use for conversion into cutting tools, and least of all for taps, for which purpose the very best cast steel is none too good, and the few pence "R." will save in material will be lost over and over if he uses the spindles for anything else but makeshift screwdrivers. If they had any workable value, there would not be so many old ones for sale.—SOUTH EASTERN.

[48579.]—**Loss of Sight.**—I sometimes partially lose the sight of my left eye for about a minute or so; if I look at a book I find that I cannot see some lines at the top of the page, it is simply blotted out as if by a dark curtain; sometimes the darkness gradually increases until I can only see half the page. After a short time the curtain seems to roll slowly up the page, and my sight is all right again. I consulted an oculist, who said there was nothing whatever wrong with the eye. I fancy it has something to do with the state of one's stomach, which may be considerably out of order without one feeling actually dyspeptic.—B.

[48591]—**Screw Taps.**—"South Eastern" cannot cut his dies from a tap; he must cut them off a hub. To make a hub he should get a piece of steel, cut and groove it in about a dozen places with a small file, his hub should be a ⅛ of an inch larger than he wants to cut.—YOUNG TURNER.

[48593.]—**Midland Engines.**—The change in working, about which "A. S. H." asks, came into operation upon the 1st November, and consists in the Leicester engines for the Scotch traffic being transferred to London to work as follows:—

	Day expresses.	Night expresses.
St. Pancras............ dep.	10.35	9.15
Leicester.............. arr.	12.42	11.32
	p.m.	a.m.
Leicester.............. dep.	6.32	5.32
St. Pancras............ arr.	8.40	7.45

The distance from London to Leicester is 99 miles, 9 chains, and the up and down day expresses perform the journey without stopping; the engines at present working these trains are Nos. 804, 807, 829. These Scotch trains are fitted with the Westinghouse automatic brake. No. 66 has been rebuilt; less than a year ago this engine was fitted with steam brake and vacuum apparatus; but these have now been taken off and will be replaced by the Westinghouse brake.—CLEMENT E. STRETTON.

[48594.]—**Half-Round Boring Bits.**—If F. Search makes these $\frac{1}{100}$in. smaller at the back than the front edge, it will be quite sufficient relief to prevent them from binding when in use, and if he sets his slide-rest over half a degree, or to taper ⅛in. to the foot, he will be right. There is no need to make the semi-cylindrical part too long, as it only increases the risk of warping when being hardened; and here I may remark that when hardening the bit should be dipped with the half-round side leaning 20° towards the water. If plunged perpendicularly, it will come out crooked.—SOUTH EASTERN.

[48595.] — **Spoilt Miniature.** — Miniature painters usually (not always) mix their colours with a weak solution of gum-arabic and sugar-candy, with a view of producing a glossy surface. The rain-drop has dissolved this out of the colour upon which it has fallen, and on evaporation has deposited the gum and sugar on the outer circumference of the drop, just as drops of wine or beer spilt on a mahogany-table leave sticky rings as they dry up. Only a miniature painter can repair the damage by repainting the injured part.—ROBINSON CRUSOE.

Crystallising Tinplate.—An improved method of crystallising tinplate has been recently patented by Mr. C. S. Gardner, of Neath, by which the effects are produced more expeditiously and cheaply than hitherto. In the usual method of tinning iron sheets, they are first plunged into hot grease, then into molten tin, then passed through rollers working in molten tin, and lastly allowed to cool, the tin plate being then finished. When it is desired to produce a crystallised tinplate, the patentee directs, by means of a large syringe with a fine rose, a spray of water upon the plate immediately after it issues from the rollers working in the molten tin (the tin upon the plate being still in a melted state); having chilled the plate by this shower bath, he then dips it into an acid solution, the crystallisation being thus produced in the ordinary course of manufacture.

Largest Coil Spring.—The largest steel spring ever made has been successfully rolled at Kloman's steel works, Pittsburgh, Pa., for the United States Car Motor Company, of Philadelphia. The spring is 310ft. long, 6in. wide, and one-quarter of an inch thick. It was tempered and coiled by the motor company at their works in Philadelphia.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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47890. Lathe Flywheel, 22.
47894. Steinheil's Eyepieces, 22.
47898. To Art Students, 22.
47901. Bath Pipes, 22.
47903. Submarine Telegraphy, 22.
47906. Notes on Dynamos, 22.
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47926. Street Medical Coils, 23.

48151. Flax, Hemp, and Jute Spinning, p. 122.
48152. Violin, 122.
48154. Bacchante, 122.
48165. Valve Trumpet, 122.
48170. Electrical, 123.
48178. Best Form of Forge, 123.
48179. Handy Punch, 123.
48180. Wood-Splitting Machine, 123.
48186. Magneto-Electric Light Machine, 123.
48188. Organ Blower, 123.
48189. Commutator. To Mr. G. Tolman, 123.
48192. Civil Service Exam., 123.
48195. Cambridge University, 123.
48199. Copper Boiler, 123.

QUERIES.

[48596.]—**Harmonium Reeds.**—I want to put a new set of reeds in my harmonium. It is five Octaves, only one set of vibrators. Will "Saul Rymea," or any kind writer who is able, inform me where I can obtain a new set of bent reeds, like those recommended by "Elève" in some of the back numbers of the "E. M."? I have recently experimented on the old set by making them bend a little to their work, and was surprised at the clear flute-like quality of the tone produced, which, before the operation, was quite "reedy." I should be quite satisfied with the old set now in the instrument if I could get them to stand in tune; but with a high pressure of wind most of the notes flatten in pitch; so I thought it would be best to put in a new set. Would it be possible to put American-organ reeds into the instrument? I would add that after bending the reeds at the point, I found they did not speak so readily as before?—T. B.

[48597.] — **Boot-Heel.** — Would "Jack of All Trades" have the goodness to say how I could have heel of boot made so that it would yield a little on contact with the ground? Could a layer or "lift" of india-rubber be inserted when the heel is being made, or could a piece in the form of a cushion be fitted on? My reason for requiring this information is, that having hurt my knee-joint some time ago, the synovial membrane where the bones meet has been left somewhat tender, and there is a sensitiveness in the joint to the sharp contact of the heel on flags or other hard substance. If the heel yielded somewhat in the manner I have described, I could walk better and with less discomfort.—O. R.

[48598.]—**Tinned Meats.**—I don't understand why so many fancy tinned meat has not the nourishment in it that common meat has? Is this mere fancy, as I think, or is it real? Now see; you take a piece of mutton and boil it. The liquor is often thrown away, with what nourishment may be in it. The meat, on the other hand, is cooked in the tin. The juice remains with it, and, of course, that part of the nourishment remains. Why should not the tinned meat have quite as much nourishment in it as the fresh?—EDWD. THOS. SCOTT.

[48599.]—**Copper Scale.**—Will Mr. Belcher, or others, please describe the best means for reducing the red and black oxides of copper to an impalpable powder, say, from 2 to 5cwt. daily? Also, whether these oxides as found in nature contain the same percentage of copper as the scales derived from heating and rolling metallic copper?—W.

[48600.]—**Speeding.**—Will some kind reader inform me the simplest way to find the speed of pulleys, also of gearing-wheels?—SCOTIA.

[48601.]—**Transparent Photographic Views.**—Will some kind reader inform me of the process necessary to obtain transparent pictures of buildings, scenery, &c., and whether it is necessary to take them direct on to the plate for as many copies as may be required, or can they be printed from an original plate, like ordinary photographs? I should likewise like to ask if it be possible to obtain a transparent picture from a photographic print, and how? I should like also to know if an ordinary negative can be taken from a photographic print to enable more copies to be obtained as good and as clear as from the original negative?—'XMAS.

[48602.]—**Cleaning Plate.**—How can I clean insides of plated teapots, milk-jugs, &c., where the mop or brush can't reach, so as to take the black stains out of the plate? PLATEMAN.

[48603.]—**Putting Watch on Beat.**—Many thanks to Mr James Taylor for instructions on altering hair-spring. I should be obliged by his informing me how to put watch on beat. Is it necessary, when replacing balance, to add drop of oil? I may mention this is only the second occasion of my attempting to do anything to a watch.—AMATEUR.

[48604.]—**Brick-Making.**—Would any brick manufacturer or burner, or any reader of the "E. M.," have the kindness to indicate the best principle to be used (1), for preparing the earth or mortar, according as dry compressed or wet-moulded bricks are to be produced, and means of preparing and moulding the same? (2) For drying the bricks before burning? (3) The best mode of burning, either in open air or in kiln, and in case of kiln the best mode of burning either by up or down-draught, so as to use the least possible quantity of coal, and obtaining the best and most equal burning—that is to say, no over or under-burnt bricks? (4) Which is the best mode of burning bricks, either by means of coals introduced between the layers, or simply by means of air currents properly treated and regulated at will? (5) The best process to use for continuous burning, so as to lose no time and none of the heat developed in the kiln, if a kiln be used? (6) The best kiln to be adapted for continuous burning, economy, and easiness of work?—AN IGNORANT.

[48605.]—**Photographic Enlarging.**—Can any reader kindly describe how an apparatus for enlarging by artificial light (lamp or other light) can best be made, giving dimensions and, if possible, some kind of sketch to work by? Various kinds of apparatus for this purpose are, I know, sold; but the prices are high. I therefore feel sure that any information on the above subject would be most welcome to photographic readers who are not too well provided with this world's goods, and among them to—NEGATIVE.

[48606.]—**Pressure of Pedals in Bicycle and Tricycle.**—In Vol. XXI., p. 499, the pressure on pedals of bicycle is approximately worked out. Will some one of your correspondents kindly work out the same for tricycles?—T. W.

[48607.]—**Combination of Levers.**—Is there any work on mechanics which, for a combination of levers, gives an algebraic formula for the space travelled through by P, the power, and W, the weight?—T. W.

[48608.]—**Carbonates.**—Will Mr. Allen, or other of our chemical readers, kindly give the solubility of carbonate of soda and carbonate of potash in ordinary methylated spirit? Also, is the sp. gr. a good guide to the purity of methylated spirit?—INQUISITIVE.

[48609.]—**Electro-Plating.**—Will some of "ours" kindly say what per cent. of cyanide and what per cent. of silver ought to be in a silver-plating bath to get the best results, as my solution has gone wrong; and, by analysis, if I knew what per cent. of each ought to be present, could I make the solution right again?—AN AMATEUR.

[48610.]—**Watchwork.**—I shall feel grateful if any of our watchmaking readers will assist me in the following:—The teeth of escape-wheel of Geneva, instead of passing freely out of cylinder, catch on right side of same, and get so firmly locked as to stop watch. Sometimes for a few minutes it will go, and the beat will sound very even; but there is a grating noise instead of being clear. How is balance taken off without injury to cylinder?—PIVOT.

[48611.]—**Organic Analysis Table.**—Will any of the readers of the "E. M." kindly give me a good table for the separation of organic acids? I have tried several methods, but find every one unsatisfactory.—ALTAIR.

[48612.]—**Silvering Process.**—I was much pleased to see a communication in a recent number from Mr. Brashear, whose process for silvering mirrors I have understood from the columns of the "E. M." to be the very best known; but I have so far failed to learn what that process is. Would Mr. Holmes, or some of "ours," kindly supply particulars of the process, and should Mr. Brashear see this query, perhaps he would oblige by stating if he has made any improvement in his published formula? What does Mr. Holmes mean by the commercial process of silvering?—ALTAIR.

[48613.]—**Strain on Chain or Wire.**—A chain weighing 12oz. per ft. is suspended from two points 100ft. distant, centre of the festoon falling 10ft. from the level of the points of suspension. What is the tension upon the two end links, and how is it calculated for any other weight of chain or angle of deflection? If a wire of inappreciable weight were substituted for the chain, and 100lb. suspended from the centre, what is the strain on the wires?—R. N.

[48614.]—**Warping of Small Lathe-Beds.**—Your correspondent in his very useful article on lathe-planing attachments (last issue) advocates their application to small lathe-beds (3in. centre). Has he, or any other correspondent, experienced the above defect in any of these? I have a small bench lathe (3in. centre, 30in. bed, planed) which is now considerably out of truth, being quite $^1/_{16}$in. higher in the middle than at the ends. I have also seen a small screw-cutting lathe, quite new, the bed of which (and consequently the leading screw) were so arched as to be perfectly useless. It would be interesting to many of your practical readers if any correspondents could kindly explain the cause of this—whether they are made of some inferior alloy, or whether the depth given to them is insufficient in proportion to their length?—W. E. H.

[48615.]—**Electrical.**—Will "Sigma," or other electrician, please state the sizes of copper wire (B.W.G.) necessary to convey the following currents?—5 and 10 ampères, both continuous and alternating, without overheating, through a distance of about 30 or 40 yards.—W. E. H.

[48616.]—**Steel Castings.**—Will some brother-reader tell me what is the best kind of sand or other composition to make steel castings in? Also, what is the best thing to wash them over with? Also, best thing to wash the moulds over with?—ONE IN A FIX.

[48617.]—**Horse-Power and Screw-Propeller.**—I want to know approximately the h.p. of a compound engine. Dimensions as follows:—High-pressure cyl., 12in. dia., cutting off steam at one-tenth of the stroke; low pressure, 24in. dia., stroke 16in.; pressure in boiler, 70lb.; revols. 135; vacuum 35·5in. Also, what pitch of screw would they recommend for the above engines that are in a yacht 100ft. long, 14ft. 6in. beam, drawing 7ft. of water aft, 4ft. 6in. forward, with fine lines, and a clean run aft? The propeller we have been working with this summer is a four-bladed one, 6ft. dia., pitch unknown (it having been cast from a part of the only remaining blade of the old one (the others were lost at sea), and weighs 7½ cwt. This propeller drives the vessel 8½ knots; but I think with a properly-pitched propeller we could get 10 or 11 knots, as when we are running full speed the draught-plates are closed half the time. Any information on the above subject will greatly oblige—BIJAH.

[48618.]—**Legal.**—TO MR. FRED. WETHERFIELD.—I implore your kind advice upon the following:—I am an unfortunate member of a coal-club held at an inn in this town. It is not registered. When 13 weeks' subscriptions are paid in, our indoor members (who act as a sort of committee) buy the desired quantity. Every confidence has been placed in our treasurer, especially as it required one of the indoor members to sign with him the cheque for payment of coals; but it never dawned upon us, "Did he bank it all-right?" Alas! he has committed suicide, leaving only £48 behind him in the bank, instead of over £100, as there should be. With this our acting members have paid the coal merchant, being a little over half of his bill for the last delivery, and which he has accepted as payment in full, he reserving to himself the right to proceed for payment of 14 tons he had commenced to supply members with on a new delivery. As I have received half a ton, can this coal merchant make me pay again, as I have paid for them by weekly subscriptions to the treasurer before they were delivered? The coal merchant argues that the treasurer was of our selection, and not his.—A POOR MECHANIC.

[48619.]—**Polishing Stag-Horn.**—I have a stag-horn which I am desirous to make into a walking-stick handle. Would any of your contributors kindly tell me how to clean and polish?—F. S. JONES.

[48620.]—**Portrait Lens.**—I am much obliged to Mr. Robinson and Mr. Lancaster for their replies to my query about portrait lens. I find, however, that putting the front combination into the back does not give a distinct image. I should like to know whether it would be possible to convert this portrait lens into a "symmetrical" lens by removing the lenses from the front and back combinations altogether; but taking the concavo-convex lens from the back combination, and purchasing another exactly like it, and then placing the two in their cells—concave surfaces to each other, would such a combination work well? If so, what distance should the lenses be apart, and what length of exposure would ordinary dry-plates require with such a lens?—C. R. H.

[48621.]—**To Mr. Lancaster.**—Is there any developer by means of which a transparency may be produced on your dry plates as they come from the camera? Or, must they be printed in the ordinary way like paper positives? I use "Le Merveilleux."—GLATTON.

[48622.]—**Making Ports in Cylinders.**—Will any reader oblige by describing the operation of making ports in cast-iron cylinders about 1½in. or 2in. bore? What size ports should such cylinders have? I cannot understand the process of drilling them in.—A. R.

[48623.]—**Moleskins.**—Will some kind reader inform me the best and most effectual way to preserve moleskins?—A. C. W.

[48624.]—**Electricity and the Organ.**—Will someone be kind enough to tell me whether the recent developments in the science of electricity have affected the method of applying it to organ-playing? Whether, for instance, any improvement has been suggested upon Bryceson's patent.—GEORGE GROVE.

[48625.]—**Fingering.**—Will anyone be kind enough to say what sorts of wool are used; if carded and combed, what kind of machines it passes through; if "tops" are used, what counts for medium qualities?—GILL.

[48626.]—**Toning Solution.**—TO MR. LANCASTER.—Please give formula for toning solution as supplied for "Le Merveilleux."—ASSOC.M.I.C.E.

[48627.]—**Chemical.**—Could any correspondent kindly say how the moisture can be estimated in a salt whose water of crystallisation comes off below 212° F.? Also, how can you estimate the water of constitution in a body containing organic matter?—D. CROTTACH.

[48628.]—**Legal.**—Will Mr. Wetherfield kindly enlighten me on the following few questions, through the columns of this most useful journal of enlightenment? A. and B. were respectively niece and nephew to D. who died, leaving all he possessed to B., subject to some annuities, among whom was A., who married soon after. Firstly, did not the annuity, in the absence of a settlement, become the sole property of A.'s husband? Secondly, he having died leaving a will in which he bequeathed all he died possessed of to his sister, does not the annuity legally belong to the sister now, and not to A.? Thirdly, A. having kept in possession and given up nothing to the sister-in-law, have I done right in paying A. the annuity for the past few years, neither party having ever taken out administration? And, if not, can I recover some from her again?—D. J. H.

[48629.]—**Thermostatic Bar.**—Can any of your numerous correspondents inform me what are the best materials for making thermostatic bars for regulating the heat of any apartment, &c., which is required to be kept at a regular temperature? What are the materials to make the most sensitive article, and which is the best way to make it?—THERMOSTATH.

[48630.]—**Married Woman's Property Act.**—TO MR. WETHERFIELD.—Will you kindly advise under the following circumstances?—A married woman had left to her by her mother about 10 years ago a sum of money which now stands in the Three Per Cents. in the names of herself and husband, and of her brother as trustee; the brother drawing the interest and forwarding it to her, on account of residing a long distance from London. The wife now wishes the money to be settled solely on herself, as the husband is about to start in business on his own account, and the husband is quite willing that it should be so. Under these circumstances, what would be the best way to proceed? Could any simple deed be drawn up and signed by the husband, which would give the wife absolute control of the money, and insure it to her in the event of his failing in business? Or, would it be necessary to employ a solicitor? The wife at the same time wishes to sell out of the Three's and invest in some more remunerative stock. Could the brother in any way oppose or prevent this arrangement being carried out?—YORKSHIRE.

[48631.]—**Rusty Pressure Boiler.**—I have a high-pressure boiler attached to Flavel's kitchener. Boiler is of wrought-iron riveted boiler-plate, and is boot-shape, supplied from tank of rain-water at suitable elevation, has been running for two years, and the water is still always rusty. Will some reader kindly suggest remedy?—NEW ZEALAND.

[48632.]—**Braiding Machine.**—Can anyone give me a description of a braiding machine for covering wire with? Any hints will greatly oblige—G. B. C.

[48633.]—**Bichromate Cells and New Dynamo.**—To "SIGMA."—1. A mixture of pot. bichro. nitric and sulphuric acids works well in the porous cell of a Bunsen. Can I substitute calcium chromate for the pot. bichro.? 2. Can you spare time for a short outline description (very brief will do) of the new Thomson-Ferranti dynamo?—J. L. M.

[48634.]—**Wood Screw-Cutting.**—Will some practical reader kindly inform me how to accomplish wood screw-cutting in the lathe?—H. H.

[48635.]—**Concrete.**—A fortnight ago "Grapho" gave me valuable information as to concreting upper floors, for which I thank him. The person about to build finds the expense of concreting four floors with rolled iron joists too expensive. May I trouble "Grapho" to inform me if there is any danger of the timbers rotting sooner than ordinarily if two feet of concrete is put down on either side of the inner walls on the upper stories?—CLERK WORKS.

[48636.]—**Agreement.**—Is it necessary to stamp an agreement under hand under the value of £5?—GERALD HARLEY.

[48637.]—**Insurance Companies.**—How is the "office value" of a life insurance calculated?—GERALD HARLEY.

[48638.]—**Gauge-Glasses.**—Wishing to attach one of these to some apparatus to register the height of its contents to a great nicety, I have been looking through many works on hydrostatics, and find authorities differ, some saying the level of the water in the small gauge tube is higher than that in the cistern, and others it is lower because of the friction against the sides of the small tube. Can someone say from experience which is correct?—M.M.I.Sc.S.

[48639.]—**To "M.I.C.E." or Fred Walker.**—I see, by the law of Marriott, that if a given volume of steam at 60lb. be made to expand four-fold the pressure is reduced four-fold, or to 15lb. Does the same law apply to compression of steam as in the following case? The exhaust-valve of a high-pressure engine closes when the piston is 3in. from the end of its stroke the clearance, &c., is 1in., giving a volume of steam of 4in. (say) at 15lb. When the piston moves 2in. the volume will be compressed into half the space. Will the pressure be 30lb. And when the piston is at the end of its stroke, and the volume will only be ¼ its former size, will the pressure be 60lb., if there were no loss from condensation, &c.? If above is not the right law, what is?—MEDO.

[48640.]—**Stains in Marble.**—Could any reader kindly inform me as to the best means of removing a stain from a white marble mantelpiece made of pure white statuary marble? The stain is of a yellow colour. I suppose some acid would remove it, but should like to know of a method that would insure safety to the marble.—OULTON.

[48641.]—**Cleaning Medallions.**—I have two composition medallions which have got very much discoloured by smoke, &c.—I should like to know a way to clean them. They seem to be made of a chalky substance, and will not wash. The front surface of them is quite smooth, and an ordinary coat of whitewash would make a rough surface. Query: How to clean them?—OULTON.

[48642.]—**Analytical Chemist.**—I wish to qualify for the post of analytical chemist to a chemical manufactory. Is the Associateship of Mines any use towards this? And, if so, should I have to be also articled for a period?—KHEYM.

[48643.]—**Photography.**—Will J. Robinson, junr., tell me what is the reason the image on a ferrotype plate will not come out sufficiently distinct to see what it is after being developed? Is the developer weak, or is it through having thin collodion? A few wrinkles will be esteemed by—LEARNER.

[48644.]—**The Diurnal Inequality of the Tides.**—On reading the letter of Mr. Jas. Pearson, M.A., &c., on "The Diurnal Inequality of the Tides," I find that by the attraction of the moon upon the waters of the surface of the earth, they are heaped up under the moon. This is easy to understand, but it is not so easy to understand how, with the moon's attraction heaping up the water on the one side of the earth, it heaps up the water on the opposite side in a direction away from it.—JULIAN HARTSHORN.

[48645.]—**Pump.**—To "LABOR OMNIA VINCIT."—Thanks for your kind reply. The average pressure I work my boiler at is 30lb. I am not obliged to lift any specified quantity of water, but merely want a description of the pump that would lift most with engine at the above pressure. I would like to construct the pump myself, as I have every means at hand; but do not know the pattern or size that would succeed.—J. H. A.

[48646.]—**Legal.**—TO MR. F. WETHERFIELD.—I wish you would kindly advise me in the following case:—A. built property some 30 years ago in a rural part, and ran his sewerage through the adjoining property. 25 years since B. bought the said adjoining property, and 20 years since built upon it, still allowing A.'s sewerage to pass through uninterruptedly, as the district wasn't then publicly sewered. 17 years ago the town sewered the district. B. died 12 years ago, and left his property to C., who disputed A.'s right of way, when A. promised to make a way for himself, but didn't. A. died four years since, and his executors sold the property to D. C. good-naturedly allowed matters to remain; but three months ago wrote to D. requesting him to divert the sewerage. D. doesn't reply, and to a neighbour claims a right of way. Can C. stop the sewerage by taking up the pipes and thus break the connection? Or has D. really a right of way? It is about five years since A. last promised C. to make a way for himself.—Juvenis.

[48647.]—**Medical.**—Dr. Edmunds, in his article on gout in your paper for 3rd of Nov. last, says that half a pint of hot water before breakfast is good for a person of gouty diathesis to take who has been living according to rule, but by some indiscretion (such as a good dinner) has run over the lines. For how many mornings should he take this hot water? Also, on a person of gouty diathesis, but living according to rule, what would be the effect of taking half a pint of hot water every morning—beneficial or otherwise? Would it work the kidneys too much or weaken the coats of the stomach?—H. F.

[48648.]—**To Dr. Edmunds.**—A lady who is now staying with me suffers very much from general weakness and aching of the limbs, great drowsiness, and want of energy, no great desire for food, but will eat occasionally because she feels she must. She is unmarried, and is about 62. Has been in business for many years, and the same seems to have been too much for her lately. She also complains of a great itching of the head, and her medical adviser has recommended frequent cleansing with paraffin. When out walking, she is often seized with a violent pain in the back. If Dr. Edmunds will kindly give us his advice, he will no doubt confer a great boon on the poor sufferer.—R. M.

[48649.]—**Bean-Mill.**—As I have some rollers of bean mills to recut, and find them so hard that neither chisel nor file will touch them, will some kind reader of the "E. M." inform me how to soften them, afterwards recut them, then reharden as hard as now?—Cambridgeshire Boy.

[48650.]—**Electric Gas Lighter.**—Could any reader give me simple directions how to make the above? I saw one the other day; it was something like a small canister (which, I suppose, contained the battery) with a long hollow brass tube running from it. It also was supplied with a push. When contact was made, it raised a small piece of wire incandescent, which lit the gas when turned on. It was carried in the hand, and seemed fairly portable. What I want to know is, how to make the battery, and how to confine the acids so as to prevent spilling? Also, what wire is used for the part which lights the gas—is it platinum? Also, how is the push made—is it the same as a bell push, and how are the conducting wires carried along? Please give the simplest method of making. Sketches would greatly oblige.—One Seeking for Knowledge.

[48651.]—**Street Medical Coil.**—I have been waiting for over twelve months for instructions how to make a street medical coil complete. Mr. Lancaster has promised to give me full instructions three or four times. I think if Mr. Lancaster can't do it, I do hope some one will help me soon, as I think I have been waiting long enough.—F. Rows.

[48652.]—**Post Office Savings' Bank.**—To Mr. Wetherfield.—Would you kindly give me some advice?—My case is this: An uncle died two months ago (my mother's brother), and I and a friend buried him. He left a small amount (under £30) in the Post Office Savings Bank. We have made application, answered numerous questions, filled up forms, and forwarded the book. They continue to repeat the same questions, and give us no satisfaction. All other relatives are abroad, and were not in communication with the deceased. I am the eldest nephew, and wish to know whether I am entitled to any part of the money. He left no other property. I and my friend paid funeral expenses—£6.—Workman.

[48653.]—**Stippled Lobby Walls.**—If this should meet the eye of a practised painter, I would be much obliged if he would give me advice upon the following matter:—I had a large hall wall about 30ft. high, painted a pinkish drab, the oil mixture used being 3½ gallons boiled linseed oil, and 4½ gallons of turpentine and paint colour added to make of proper consistency. As the wall was painted the second time, it was gone over with a stippling brush, and not being satisfactory, was again painted and stippled over. It looks streaky still when the light shines upon it, and not an even flat. Will the wall have to be painted again, and if so, how can the wall be evenly flatted, so as not to show the light and dark shades it does now? How should such a high wall be painted, so as not to show any joining in the painting? I think of going over the wall with the stippling brush moistened with turpentine. Would some one kindly say if this would remedy the defects in painting it without painting it over afresh?—M. E.

Marking Trigonometrical Stations.—For marking trigonometrical stations in the State Survey of New York, a glazed earthenware pot, of the shape and size of an average flower-pot, is buried in an inverted position to a depth of some 4ft., and is so placed that a small hole in the centre of the base marks exactly the centre of the station. Immediately over this is set vertically a granite stone 4ft. long and 6in. square. This is buried to a depth of 3ft. 6in., so that the upper end projects 6in. above the surface of the ground. The sides of the projecting part, and the top, are dressed smooth, and on the top are engraved diagonal lines from angle to angle, the intersection being immediately above the central hole of the inverted pot. The number of the station and the letters N. Y. S. S. (New York State Survey) are cut into the sides of the stone. The height of the station is measured to the upper surface of the stone. As an additional precaution in the event of the stone being displaced, two other pots are sunk inverted in the ground to a depth of above 18in., and at a distance of about 3ft. from the centre of the station. Referring to this latter, the pots are set to an angle of 90°, and arrows are strongly marked upon the base of the pots, which are so set that the arrow heads point exactly to the centre of the station. The magnetic bearing of each pot is taken, so that if one is lost there shall be no difficulty in testing the position.

CHESS.

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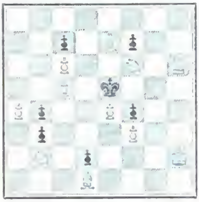
All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXCIX.—By J. [illegible]

Black.



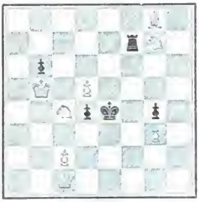
White.

White to play and mate in three moves.

PROBLEM DCCC.—By D. Mackay.

(From *Youth*.)

Black.



White.

White to play and mate in two moves.

Solution to 795.

White.	*Black.*
1. Kt to K 4	1. Anything
2. Mates	

Solution to 796.

White.	*Black.*
1. R to Q Kt sq	1. Q takes R (best)
2. Kt to K 4	2. Anything
3. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 793 and 794 by A. Watson, Dicky Sam, W. A. Bowen; to 794 by W. Stevens; to 793, 794, 795, and 796 by Celsus.

D. Mackay.—Cannot your problem be done by 1. Kt takes Kt?

Problems received with thanks from E. C. Rimington, Jas. Rayner, and T. Byng.

Coal Mining 3,000ft. above the Sea.—Among the coal mines rapidly being developed in New Zealand is one situated near the town of Westport, on the west coast of the Middle Island, which is distinguished by two remarkable, if not unique, features—viz., the thickness of its coal seams, which range from 6ft. to 53ft. 6in. in thickness, and the fact that these enormous deposits are placed, and can be easily worked at an altitude of from 800ft. to 3,000ft. above sea level. Some of these seams are exposed on the face of the cliffs and can be got at with the greatest ease by tunnelling. Besides the comparative immunity from ordinary accidents which this remarkable disposition of the coal deposits affords, there is the further advantage that the mines are absolutely safe from floods, and almost, if not quite, secure from the risk of explosion from fire-damp. There is the further advantage that the coal can be loaded on board ship by gravitation, the danger and expense of hauling the coal up a deep perpendicular shaft being entirely avoided.

ANSWERS TO CORRESPONDENTS.

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, *All communications should be addressed to the* Editor *of the* English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

, Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 15, and unacknowledged elsewhere:—

J. and H. Grace.—P. Argall.—Ellis' Patent Boot Stud Co.—Britannia Co.—W. H. Park.—Beginner.—J. T. Bochard.—Set Square.—Electra.—Progress.—A. Bartlett.—Tank.—A. C. B.—M.I.C.E.—W. Robinson, jun.—S. W. J.—J. G. H. B.—W. A. S.—Mack.—Gamma.—C. J. Little.—L. R. B.

A. H. Newman. (You should protect them by soaking the upper parts of the carbons in paraffin wax. The process has been described many times, but one method is given on p. 231, last week. 2. The new edition of Mr. Sprague's book, when it comes out.)—[illegible]. (Dr. Percy's "Metallurgy of Iron and Steel," published by John Murray, is the best.)—Amateur. (Daniell's or Smee's. See full instructions for such work in Vol. XXXIV., pp. 237, 261, and recent volumes.)—J. K. (Don't waste time over it. A galvanic belt may be of use. Watch for replies to query 48451, p. 215.)—Mackintosh. (The only way, we believe, is to coat the parts with a solution of rubber, either in bisulphide of carbon or mineral naphtha.)—Negative. (See list of "Back Numbers," in this column last week.)—Diana. (You should get the best plaster. That sold at the oil-shops is as a rule, useless for the purpose. If necessary, you must drill holes and fill them with plugs of wood, into which screws can be put.)—S. R. (Keep a hungry cat.)—Scrutator. (A number of remedies will be found in Vol. XXVI., pp. 198, 221, 243.)—Taxidermist. (Full instructions in Vol. XXX., p. 341.)—H. B. (The positive pole of a Daniell is the wire attached to the copper.)—H. A. (Dissolve a pound of pale glue in a pint of rain-water. When cool, add by degrees 3oz. of nitric acid, sp. g. 1·3. Many of the liquid glues sold are solutions of shellac in wood naphtha or in borax water.)—Maori, New Zealand. (Gosse's "Evenings at the Microscope," published by the Society for Promoting Christian Knowledge. See also many hints in back numbers.)—Petro. (No, certainly not; plenty for the so-called paraffin oil. Most ironmongers keep them in stock. Davidson's "House Painting," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., 6d.)—Davies. (They are cut out and filed up to pitch. There is no other way.)—An Old Fellow, Melbourne. (Before this can come before you you will have seen answers to the first question on pp. 214, 233. 2. They take the aniline dyes readily, and the process is as simple as possible. See that they are clean, not greasy, and dip in the solution.)—W. H., B'ham. (There is nothing better than the ordinary tuft of cotton immersed in tallow. For spirit-lamps, see p. 41, No. 910.)—W. Davies. (Soap-making by cold process in No. 840, p. 198, Vol. XXXIII.; or more fully in No. 822, p. 350, Vol. XXXII.)—O. W. (Commonly known as the vinegar plant—Penicilium glaucum. Not injurious.)—J. H. M. (What are the "results" of which you speak? There is nothing novel in your experiments, but there may be in your "results," if you would say what they are. How much copper can you deposit in an hour with the current derived from the earth?)—Gerald Harley. (The best thing to use would be a solution of guttapercha, but the surfaces must be very clean.)—Nova Scotia. (Such a case must be examined—perhaps by a specialist.)—Inquirer. (It would be advisable to consult a medical man. If only dyspepsia, see Dr. Edmund's papers in the last two volumes.)—Halifaxonian. (The only satisfactory plan is to have the glass resilvered; but as a temporary remedy, secure a piece of bright tinfoil over the hole at the back.)—F. W. (Not even a physician can advise without examining you.)—E. R. (For all kinds of telephones, see the last six volumes. See the index to Vol. XXXV., for instance.)—A Sixth Standard Boy. (See p. 39, No. 906, and the index of the last volume.)—Vera. (Blue process in No. 913, p. 64. 2. Illustrations of artificial legs that will suit in Nos. 351, 353, and 357.)—Vesta. (Given on p. 108, last volume. 2. It is usually made by the railway companies themselves, and the weight varies with the size.)—D. H. (On p. 457, last volume, warm methylated spirit applied by means of a tuft of cotton wool was recommended. Size with isinglass, and give two coats of paper varnish. 2. We do not think so, but you could try at Wyld's or Stanford's, both at Charing-cross.)—Amateur Electrician. (Electric engine, p. 39, last volume, and p. 89, Vol. XXXIV.)—W. Cliffe. (Pernitrate of iron applied with a camel-hair brush twice a day.)—Frank J. Brown. (All the processes for silvering glass have been described in our volumes. See the index to Vol. XXXIV., for instance. Any dealer in chemicals supplies them. See our advertisement columns. Enamel implies the use of heat as the substance is melted on. Black Japan varnish will probably suit your purpose.)—F. A. B. (A couple of years, for it takes some time to get the fingers hardened. Unless you are prepared to give up piano, better leave it alone. Prices to be obtained of the sellers.)—A Mother. (There is, undoubtedly, a great future in store for it, and those who, in addition to mechanical skill, possess a theoretical knowledge of it, will not lack work, if willing.)—W. Y. K. (If you cannot read a book without thinking about something else, you had better put it down and concentrate your thinking powers on the subject which is so attractive.—Oracity. (You will find much on the subject stated in general terms in back numbers; but no useful advice can be given without a personal examination in order to ascertain what is really the matter. There is an excellent eye-hospital in your city.)—Juvenis. (We have no idea, except by applying personally or by advertising for such a situation.)—J. J. (All you can do, we believe, is to paint the patches with rubber solution.)—Manufacturer. (See pp. 476, 632, Vol. XXIX.)—Stanley. (Messrs. E. and F. N. Spon, Charing-cross. The new edition is not yet ready. 2. We do not know. 3. They are not joined at all, but are moulded into rings before the rubber is cured or vulcanised. There is no cement that will make a trustworthy joint.)—D. W. B. (Against the rules. Such queries, and the replies to which they would lead, would involve a large amount of gratuitous advertising. An answer to your query would be unmistakably an advertisement.)—Bandsman. (If it cannot be reached so as to hammer into shape on a mandrel, the method is to solder a loop to the part and pull it up, planishing off level as much as possible afterwards.)—Vava. (The "sole" is still the end relatively to the magnet, and has same polarity. 2. We believe such details have been given, but not for all all sorts of purposes. A machine to light one arc well would be powerful enough for two on a pinch.)—Salford. (It is usually given in such works as the "Brassfounder's Manual," Lockwood and Co., Stationers' Hall-court, E.C. The general rule is to have the copper just above fusion, and add the zinc heated nearly to fusion in several portions instead of all at once. Guettier's "Manufacture of Alloys," Sampson Low and Co., may help you.)—F. C. (We believe not. The Customs gaugers have tables, which we presume are what you mean; but calculations are still required.)—A. H. Smith. (See p. 300, No. 896. There is more or less about it in nearly every volume from the commencement to present time—especially in Vols. IX., X., XI.)—Gamma. (Please send.)

USEFUL AND SCIENTIFIC NOTES.

◆

A Poison for Tubercular Bacteria.—A paper was recently communicated to the Paris Académie des Sciences, by M. de Korab, on the action of helenine on the bacteria of tuberculosis. The facts mentioned deserve notice, although we fear that the hopes suggested are too bright to be realised. The bacilli were cultivated in bovine blood serum, which was daily heated for a week to effectually sterilise it, and was then coagulated by a temperature of 65° C. A guinea-pig having been rendered tubercular by inoculation and inhalation, small tubercular masses were taken from it, introduced into ten tubes containing the tubercular serum, and the tubes plugged after some helenine had been poured into three of the tubes. All were kept at a temperature of 37° C. for a week, and at the end of that time inoculation experiments showed that the organism in the tubes to which the helenine had been added no longer caused tuberculosis, which was readily produced by the contents of the other tubes.

Electric-Lighting on Board Ships.—After an extended trial of the electric light on board the *Alaska*, Messrs. Guion and Co. have given Messrs. Siemens Brothers and Co. an order for a complete installation on board the *Arizona*. There are 300 Swan lamps in the ship, every part of the passengers' and officers' quarters being lighted by them, to the complete exclusion of oil and candles. Very special attention is being paid to the illumination of the engine-room. There are three lamps in the screw-shaft alley, and thirteen beside the gauge-glasses of the boilers. Lamp-sockets are fitted near various parts of the engines that require occasional attention, such as the glands; and the men are provided with loose lamps in very strong globes, and of such a size that they can be carried in a jacket pocket and slipped into the sockets when required. Lamps with flexible leads are also supplied and can be coupled to the same sockets. The current is generated by two dynamo machines of the size marked by the makers S D o o, each driven by a separate engine. Either machine will supply all the lights of the ship, so that there is no probability of a breakdown, although usually both will be in operation together.

The *American Miller* gives the following rule for computing the contents of a hopper, the rule apparently relating to the lower square or rectangular conical portion only:—Multiply the length by the breadth in inches, and this product of one-third of the depth measuring to the point. Divide the last product by 2150—the number of cubic inches in a bushel—and the quotient thus obtained will be the contents of the hopper in bushels.

The new scale of fares on the South Australian Government lines is fixed at first-class 2d. per mile, and second-class 1¼d. There are to be no return-tickets, and third-class fares have been abolished.

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*** Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the Post Office prevent their transmission through the Post.

Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctors' bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in Packets, labelled "James Epps and Co., Homœopathic Chemists, London."—Also makers of Epps's Chocolate Essence.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.s.

The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 3 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Ointment and Pills.—Diseases of the skin.—Scurvy, eruptions, and glandular swellings, which had resisted all other modes of treatment, have been completely cured by Holloway's cooling Ointment and purifying Pills, which root out the disease from the blood itself, and leave the constitution free from every morbid taint.

OUR EXCHANGE COLUMN.

◆

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◆

Rubber Stamps, best quality. What offers in exchange? Wanted, Violin, Medical, and recent Scientific Books, Photo. Apparatus, &c.—Wrayn, Litcham, Swaffham.

Dulcimer. Rare opportunity. Excellent tone. Value £3. What offers?—J. Brown, Main-street, Kilwinning.

First 14 Vols. "**English Mechanic**," bound. What offers?—W. Smith, 78, Ford-street, Coventry.

A Cabinet, 9 drawers, shells, minerals, fossils. Offers.—W. Smith, Ford street, Coventry.

Barrel Organ, plays 50 tunes, 5 barrels, 4 stops, wood and metal pipes in fair condition. Exchange lathe, will give part cash for one.—H. Coldwell, Great Harwood, Lancashire.

Wanted, good **Music Box**, with Bells or Drums, or both, in exchange for Music Box, in good condition, six tunes, and money; or good Magic Lantern and Slides.—W. Watson, White Hart, High-street, Gravesend, Kent.

Fret Saw to fix on Lathe, value 12s. 6d. Last 20 Volumes English Mechanic, unbound. Offers requested.—H., Verona Cottage, East road, Kingston-on-Thames.

"**English Mechanic**," XXIV. to XXIX., and part XXX., with Index, clean, for sewing machine, book-case, or offers.—T. W., 62, Alvey-street, Old Kent-road, S.E.

Dallmeyer's Mahogany Sliding Body **Camera** for plates up to 8in. by 10in., good condition; cost £8., invaluable for enlargements, what offers?—Pennefeather, Pallasgreen, Limerick.

Splendid double-barrel **Air Pump**, by first-class maker, good as new, cost £14, what offers in exchange?—S., Spring Hill, Bristol.

Whole and quarter-plate **Cameras**. Ten-cell Smee Battery, capital Sextant, Magneto Electric Machine, 54in. Bicycle. Offers wanted: "Saunier's Modern Horology," good small slide-rest, or Screw-cutting Lathe.—A. Gardner, Towcester.

Wanted, 6in. or 7in. self-acting **Lathe** in exchange for set of Hand Bells, worth £20. Set of Castings for 6in. by 4in. Launch Engine Cylinder, bored and faced, and 1 horse Horizontal Engine and Boiler.—G. Williams, "Jolly Farmer," Egham, Hythe, Staines.

Good **Revolver** in case, and box of cartridges, for back vols. English Mechanic, or Magic-Lantern.—W. J. C., Aldwick cottage, Springbourne, Bournemouth, Hants.

Magic Lantern Slides. My school children are tired of what I have. Would any amateurs similarly circumstanced exchange?—Send list to the Rev. J. Armstrong, The Vicarage, Castlerock, Ireland.

Quarter-plate Vignette **Achromatic Lens**, in leather case, good as new; exchange microscope or offers?—G., 5, Kirkwood road, Crogsland road, N.W.

6in. spark **Induction Coil**, all ebonite, 120 divisions, worth £15, for first-class Microscope, or Microscope and smaller Coil; will adjust value.—J. Richardson, Jardington, Dumfries.

A Lamb's **Knitting Machine**. Exchange for a Joiner's Foot Lathe.—Brearley Lee, Upper Mill, Holmfirth, near Huddersfield.

Davis and Kidder Patent **Magneto-Electric** Machine; exchange for Model Engine, in working order.—E. Fussell, Calne, Wilts.

Wanted, good 50in. **Mackintosh**. Exchange good Silver Lever Watch, splendid timekeeper.—E. Fussell, Calne, Wilts.

Wanted, offers for a good brass **Cheese Tub**, with rotary knives, tap, complete; wanting room.—E. Fussell, Calne, Wilts.

Superior 4½in. back-geared **Lathe** and appliances, value £12; want gas fitter's 1in. to 2in. Stocks and Dies, Pipe Vice, Wrenches, Cutters, &c.—F. Underwood, Beverley.

Lathe Standards, 4-speed turned wheel, and crank treadle, complete; 6 Steel Chasing Tools; exchange Lever Watch.—Letters, W. Smith, Bilston-road, Wolverhampton.

Quantity of No. 40 good silk **Secondary Wire** for Coils; also a real Siemens Armature, two brass flywheels; exchange offers requested.—Alfred Crofts, Dover.

Real Siemens **Armature**, beautifully made, suitable for small Dynamo or Motor; has brass bushings; what offers? Pair of Plummer Blocks preferred.—Alfred Crofts, Dover.

What offers for good 50in. **Bicycle** and books, "Indian Mutiny," 3 vols.; "All Round the World," 2 vols.; as new, bound in calf.—F. Underwood, Beverley.

Quantity of **Copper Tokens** and some Foreign Coins; offers; tools preferred.—A. L., 33, Curtain-road, E.C.; or call after 6 o'clock.

A good Geneva Hunter **Watch** in exchange for Carpenter's Tools, Jack Plane, Smoothing Plane, Iron square, Stock and Bits, Screwdriver, Chisels, and Tenon Saw wanted; no cards.—W. Woolley, Beedon, Newbury, Berks.

50in. **Bicycle**, ball bearings, nearly new, value £5, for good Musical Box; must be perfect.—Box, Tutbury, Staffordshire.

Wanted, superior mahogany framed **Dissolving** View Apparatus, with all accessories; 4-inch condensers; exchange splendid 48-inch Cheylesmore Tricycle, new last year; give full description.—Rev. J. H. Kimball, Gomm road, Rotherhithe.

Wanted, offers for Vols. XXXI., XXXII., XXXV. English Mechanic, 2 vols. "Design and Work," and "Mechanical World," except three numbers.—J. Hanson, Wheatholme, Clough Fold, Manchester.

Wanted, a good **Monocular Microscope**, in exchange for a Central fire 12 bore Double Gun, a first-class killer.—J. H., Elysium, Bovey Tracey, Devon.

Spare **Engineer's Tools** for any others likely to be useful; see next advertisement.—Mr. S. Hawley, South Norwood, London.

Blast Furnace or Smith's Fires Fan, Patent Bellows, Grinding Machine, Taps, Hobbs, &c., Engine, Boiler, &c. See above advt.—S. Hawley, South Norwood, London.

THE SIXPENNY SALE COLUMN.

◆

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

◆

For Sale.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. (List Twopence.)

Electrical Depot and Manufactory.—Millar's, 138, Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Bells, 5s.; Batteries, 2s. Telescopes, Microscopes, Field Glasses, Spectacles. None better or cheaper.—Millar, as above.

Thirty Per Cent. Discount off Standard List of **American** Twist Drills. Sample 3-16 sent for 8 penny stamps. They are made of the very finest steel, by Bantall Bros., Maldon, Essex.

Pyrotechnic and Trade Chemicals. Lowest price at Gardner and Kelly's (late Page), 47, Blackfriars road.

Photographs for Collectors and Amateur Artists. Popular Celebrities, Statuary, Mythological, Female Figures, Sacred and Secular Photographs, British Views, Cathedrals, Abbeys. Packets are sent for selection post free. Catalogue and samples, post free, 4d.—M. Mottershaw and Co., Photographic Publishers and Mounters, 30, Brunswick-street, Sheffield.

Microscopic Objects for Mounting. Sample 20 preparations and price list, 1s. 2d.—R. Philip, Grove street, Stepney, Hull.

Lathes! Lathes!! Lathes!!! Cheap. Good Screw cutting, £10. Satisfaction guaranteed.—Mason, Cupola, Sheffield. As supplied Government Dockyards.

"**Watch and Clockmaker's Handbook.**" Latest edition, post free 3s. 3d.—Barrows, 35, Northampton-square, Clerkenwell.

Lot of **Electric Bells** and other first-class Apparatus, cheap. List post free.—Burrows, Didsbury, Manchester.

French Polishing, Staining, Varnishing, &c. 40 Recipes with Instructions, post free, 1s.—J. Tomlin, 13, Cavendish terrace, Barnsley.

Minerals.—Hundred separately named varieties, including emerald, opal, sapphire, ruby, 10s. Apply for list. Blowpipe specimens separately named, post free, 250, 6s.; 100, 2s.—Collector, 42, Tachbrook street, Pimlico, London.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 24, 1882.

LATHE-PLANERS.

THE tool-holders of some slide-rests are fixed by riveting under the top-plate so that they cannot without much difficulty be removed. The centre-pin of the Willis holder is often screwed in, and then so riveted. In such a case the pin can be left in its place, as may also the slotted tool-holder if not too large. Fig. 4 represents such an arrangement, A being a part section, and D the front face of this swinging tool-box hinged as before. The bolt of the original tool-holder B is seen passing through a central slot. It may or may not project. As this centre-pin would prevent a tool from passing through the vertical mortise in the usual manner, I have arranged a shorter mortice below it and placed the clamping screw lower down. This arrangement will give all the advantages of the usual swinging tool-box, and the whole can be removed in a couple of minutes, leaving the slide-rest quite free for its ordinary use. The shape of the back gives a good abutment to support the back of the tool during its cutting stroke. If the same kind of tool-box is adopted to receive the tool-holder of the slide-rest when the latter is a stout slotted pedestal—a very common form in small rests—the swing-holder will become a mere frame in the upper part with tool receptacle below like E, or something similar. Perhaps such a swinging tool-box might be hung directly from the old tool-holder itself by centre screws at F. A block may be needed behind it, or a projecting screw to touch the plate behind to form the point of resistance to the tool. The sole object of such a holder is to obviate the necessity of removing the ordinary one; but if it can be removed, by all means substitute a proper one. Figs. 5 and 6 are given to show details of a self-acting feed suitable for this kind of planer. It may be modified, of course, in any particular; but I think it is as good as any, and will render the planer very complete. First of all is a wheel like the 'scape-wheel of a clock fitted on the square end of the slide-rest screw; on the same screw, but to turn freely upon it, is the long bar D weighted at one end. This is forked like Fig. 6, and embraces the ratchet-wheel. It also carries the pawl which drops on the teeth of the wheel so as to cause it to revolve each time the lever is raised; but when it is lowered the pawl drops over one or more teeth without turning the wheel. This is a common arrangement as used in the ratchet-drill and sawing-machine and many others where automatic feed is required. As the lever must not move the screw of the rest except through the medium of this ratchet, but the wheel itself must revolve with the screw, a short sleeve will have to be fitted over the squared end of the latter and turned cylindrical for the lever to turn upon, or the wheel itself must have a long boss, and upon this the lever must work. The end of the slide-rest screw is seen squared in Fig. 6, and the lever working on the rounded boss of the wheel on the further side next to the slide-rest; the end of the screw is generally cylindrical for a short distance before the square part for the winch-handle commences.

In the first paper I think I spoke of the rack of the Britannia Company's Lathes being attached to the slide-rest. If I did it was a lapsus of some sort—pennæ, memoriæ, mentis—as the case may be, for the rack is in most cases a fixture to the lathe-bed, and the handle with the pinion and its socket is the part attached to the rest with which it travels. It by no means comes to the same thing, nevertheless, which way it is arranged, although the effect in either case is to shift the saddle bodily along the lathe-bed. If possible, which it is not always, the rack should in this case move with the rest, as it will be found to work thus much more smoothly. I have found it with a small lathe difficult to wind back the rest by taking the handle of the winch in the hand, if the lever is at all a long one, and we want here a very steady motion to give a nice smooth cut. If a lathe-bed and stand is given up, therefore, to the purpose of planing, it will be much more satisfactory to attach the rack to the rest.

FIG. 4

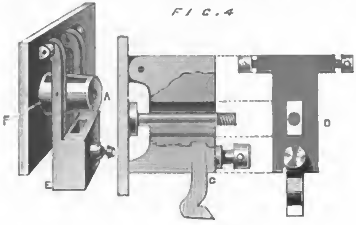


FIG. 5

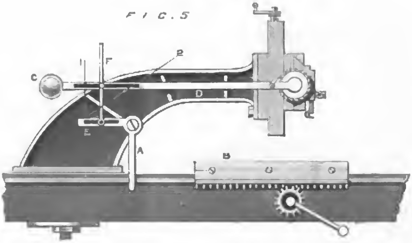
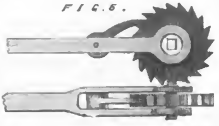


FIG. 6.



If the latter is to remain, and the lathe generally used as such, we must make the best of it; but in this case the winch with two lever-arms and handles will be found to work much better than an ordinary one. The weighted end of this long lever D is slotted to receive a pin to form the hinge of the connecting rod F, by which it is attached to another slotted arm of a crank E, A, turning on a screw fixed to the planer-head. By means of the slots F E can be put at various angles with C and E, thereby altering the length of stroke. The longest stroke will be when E, F, is at the dotted line 1; the shortest when in the position of dotted line marked 2. The black spot near D is a pin to prevent the lever falling too far. The upright arm of the crank A, which sets the feed in motion, is so placed that the planer-bed or saddle strikes it every time it arrives at that point. To give still greater range to the feed, there might be two or three holes for this pin so as to allow the long lever to drop more or less after each stroke. This will allow the arm A of the crank to stand in a somewhat advanced position towards the bed of the machine, so that the latter meeting it sooner would move it through a wider arc, and thus lift the longer lever higher, acting thereby during a longer period upon the ratchet-wheel. Of course it is easy to manage this; but I think the range given to the stroke by slotting the levers will suffice for nearly every imaginable case. A very coarse feed is so seldom needed that it may be said that the general desideratum is, on the contrary, a very fine one. Certainly it is so for all small work, and this machine is not meant for any other. Very frequently, too—perhaps in the majority of cases—the winch-handle will only need to be swung to and fro through a small arc which is not at all a fatiguing movement to the arms, and will give the short quick stroke of a shaping machine. For longer work, which is, properly speaking, *planing*, and not shaping, the double-armed, or, if desired, the four-armed, lever-handle will tend greatly to the facility of the operation. As far as *power* is concerned, although it must be obtained at cost of muscle, it will be found to be ample even for heavier cuts than one cares to put upon the tool.

J. L.

AN OLD ASTRONOMER.[*]

JOANNES HEVEL, or (as, according to the fashion of the day, it was Latinised) Hevelius, was, as is tolerably well known, a Polish nobleman, born at Danzig during the early part of the 17th century. In 1641 he built an observatory furnished with a quadrant and sextant of 3ft. and 4ft. in diameter respectively, and more than one large telescope of his own construction. His best known work, "Selenographia," containing a description of the Lunar surface, was issued in 1647. This was followed by various other volumes, and in 1673 he published the first part of the "Machina Cœlestis," three chapters of which, with their translation, form the basis of the work which has served as a text for these remarks. It involved him in a quarrel with the English physicist, Hooke, who did not particularly shine in the matter. Hevelius was elected F.R.S. in 1664, and in 1679 his home, observatory, books, and instruments were utterly destroyed by a fire, in which perished nearly the entire edition of the Second Volume of the "Machina Cœlestis," which is now consequently of the utmost rarity. In no way dismayed, he erected a fresh observatory, and continued the active pursuit of Observational Astronomy until his death in 1687-8. His "Firmamentum Sobieskianum," a standard catalogue of 1926 stars, was published two years afterwards.

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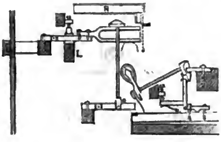
[*] The illustrated Account given by Hevelius in his "Machina Celestis," of the Method of Mounting his Telescopes and Erecting an Observatory. Reprinted from an original copy, with some Remarks from C. Leeson Prince, M.R.C.S., F.R.A.S., F.B. and S.M.S., &c., 1882. Printed for private circulation.

What Mr. Prince has done is to reprint Chapters XVIII., XXI., and XXII., of the "Machina Cœlestis" in the original Latin, and to follow them by a singularly faithful and literal translation in English, illustrating them by fac-similes (apparently reproduced by photo-lithography) of Hevel's original plates. Chapter XVIII. treats of Hevelius's ingenious helioscope, which consisted in effect of a telescope used as a camera, the object-glass being directed towards the Sun, and the eyepiece brought into a darkened room. The image was, of course, projected on to a sheet of paper, or other flat white surface. The ingenuity of the contrivances, by the aid of which the telescope was made not only to move equatorially but to follow the Sun's proper motion, can only be appreciated by the study of the original work. It must suffice here to say that a ball-and-socket joint (the telescope passing through the ball) and a framework carrying the receiving-disc, and bolted to the eye-end of the telescope, furnished the foundation of them. A somewhat complicated arrangement of wheel-work behind the disc supplemented this. The succeeding Chapter XXI. describes the construction of Hevelius's great telescope, which had a focal length of no less than 150ft.! Of course, in the days when, as yet, it was believed to be impossible to achromatise the object-glass, such enormously long foci furnished the only means of obtaining a moderately-magnified image, pretty free from aberration. The mechanical ingenuity exhibited by the great Polish astronomer seems nothing short of marvellous; as he succeeded in constructing a tube —or, rather, a trough, for it was open—of thin plank, and yet, by sufficiently simple means, insured its rigidity. Full details of its construction are given in the plates; while one of them furnishes a perspective view of the entire instrument as it appeared in use on the occasion of a visit paid to its constructor by the king. The third chapter (XXII.) gives equally elaborate details of the method of erecting a great tower or observatory whence several of such telescopes might be employed. What renders this work so interesting is the idea which it gives us of the indomitable energy and perseverance (to say nothing of the astonishing mechanical aptitude) of the man who, in his own person and solely at his own cost and charge, rendered such eminent service to exact astronomy. In curious contrast to the descriptions of the instrumental difficulties under which the observer had to struggle during the 17th century, are the details of the fittings and appliances of his own observatory at Crowborough, in Sussex, with which Mr. Prince supplements this volume. Incidentally, he introduces some very curious matter on the history of the earliest discoveries made of the minutiæ of Saturn's ring, giving woodcuts of the planet as seen by Gassendi, Hooke, Huyghens, Cassini, and the Brothers Ball. He very effectually disposes of a claim which has been sometimes made for the last-named observers, that they, or one of them, first detected the primary division in Saturn's ring. We may add that admirably executed portraits of Hevelius and Gassendi, together with woodcuts of Mr. Prince's two Equatoreals, also adorn this little volume.

We can only regret, in conclusion, that so instructive an illustration of the manner in which Hevelius did his admirable work should have been issued for private circulation alone. It is a book which, could Mr. Prince be persuaded to issue it in the ordinary way, might be read with pleasure and profit by everyone interested in the History of the Science of Astronomy.

TUNING-FORK PIANOS.

FOR want of some more euphenious title musical instruments in which the tones are produced by blows of hammers on metal bars, as distinguished from strings, are called tuning-fork pianos, or piano harps. Several endeavours have been made to produce successful instruments of this class, but hitherto they have not attracted much attention. Mr. W. Fischer, of Dresden, has, however, recently patented "improvements in pianos," which consist in the special mode of connecting the forks to the soundboard of the instrument, in the means employed for rendering their sound more pure, and in a device by which the strength of the sounds may be modulated at the will of the player. The illustration represents a sectional view of a piano comprising a part of the improvements. The sounding-forks hitherto used in pianos have always been rigidly fixed within the same. When a fork so arranged is struck by a hammer of the piano-mechanism, the percussion thus caused is always more or less audible, in consequence of which the musical effect is considerably impaired.



For the purpose of remedying this deficiency, Mr. Fischer makes the connection between the forks and the soundboard by means of joints or hinges, as shown. The fork is screwed by its stem to a part of the hinge, while the other part is fixed to a bar attached by means of stays, or in other suitable manner, to the soundboard. In order to keep the forks in their proper position, the hinge-parts are supported by a ledge L, faced with soft material, such as felt or leather, while a screw provided with a knob, which is also covered with felt or leather, presses gently from above on each of the parts. Instead of the screw, a spring or a weight may be used. The fork may also be stayed by means of two strings or other flexible connections fastened with one end to the movable hinge-part and with the other to a fixed part of the piano, one, at least, of these connections being elastic, or consisting partly or entirely of a spiral spring. This arrangement, which allows the fork to yield to a certain extent, when it is struck by the hammer, has proved very efficient, not only for preventing the blow of the hammer from being heard, but also for rendering the sound more sonorous. According to the experiments hitherto made, it is advantageous in respect to the quality of the sound to place the forks perpendicular to the soundboard. In case the latter is horizontal the forks should therefore have a vertical position. The arrangement of the forks parallel, or at a sharp angle to the soundboard, is, however, not excluded.

The part of the hinge to which the fork is screwed may be made in one piece with the stem of the fork; but the patentee prefers to construct both hinge-parts of wood, and to attach the fork as shown in the drawing. Instead of the hinge, however, a springing connection between the parts may be employed, and, in this case, especially when the forks are in a vertical position, the support L and the screw above may be omitted.

The second part of the invention consists in the means for improving the purity of sound of the fork. When a tuning-fork is made to vibrate, the sound produced is not a simple musical note, but a combination of the fundamental note of the fork and of a higher note (called in acoustics the harmonic), which latter increases in strength as the pitch of the fork becomes lower, and which in the bass-forks even predominates over the fundamental note. This higher note, which impairs the purity of the sound, may be suppressed by means of a ring or band made of, or lined with, an elastic material, and placed tightly around one of the prongs of the fork at a certain point of the same. It has been found that a ring of indiarubber, with a piece of felt underneath, is particularly suitable for this purpose. The true position of the ring must be determined by experiment, but generally it will have to be located at about one-third of the length of the prong from its point of union with the other prong.

The third part of the invention relates to the modulation of the strength of the notes. To effect that, the patentee uses resonance-tubes R, together with a slide S, by which their sound-holes may simultaneously be closed more or less. The tubes, which must be tuned in unison with the forks, are fixed above, or in general, close to the same. When the distance between the tubes and the forks renders it necessary, their sound-holes, which are opposite to the ends of the forks, are provided with tubular attachments as shown. The slide S, consisting of a thin bar of wood or metal, or of other suitable material, is so connected with a pedal, that it may be brought before the sound-holes or their attachments, or shifted away from them, at the will of the player. Considering that the vibrations of the air in the resonance-tubes are caused by the transmission of the vibrations of the forks through the sound-holes, it is evident that the former will become fainter the more the free area of the sound-holes is reduced. The arrangement thus affords the means, not only of producing sounds of greater or less strength, but also of increasing or diminishing the strength of any note or chord after the forks have been put in vibration.

DR. HENRY DRAPER.

BY telegram from New York, we hear with regret of the death of Dr. Henry Draper, Professor of Physiology in the University of New York, and well known for his skill in what may be called celestial photography. Henry Draper, a distinguished son of a distinguished father, was born in Virginia in 1837; but the family removing to New York in 1840, young Draper was educated in the university he subsequently adorned. His first scientific work was a series of experiments, in 1857, on the functions of the spleen, carried out by means of microphotography. A visit paid to Lord Rosse's observatory induced him to turn his attention to the construction of reflecting telescopes, and with one of these he obtained his famous photograph of the moon. In 1872, with an equatorial reflector of 28in. aperture, entirely his own work, we believe, he succeeded in photographing spectra of the stars, and also a photograph of the diffraction spectrum, which has remained unexcelled to the present time. In 1874, Dr. Draper was appointed superintendent of the photographic department of the United States Transit of Venus Commission, and in the same year received the honour of a special gold medal, bearing the motto "Decori decus addit avito," from the Government—the first public recognition ever accorded a scientific man in the United States. In 1877, Dr. Draper issued his famous paper on the "Discovery of Oxygen in the Sun," a discovery which it will be remembered, gave rise to much discussion in scientific circles. In 1877 Dr. Draper went to the Rocky Mountains for the purpose of making experiments on the steadiness and transparency of the atmosphere at different heights up to

11,000ft., and in the following summer returned to the same region as conductor of an eclipse party, when he succeeded in photographing the diffraction spectrum of the solar corona. His subsequent triumph was the successful attempt to photograph the Nebula in Orion on March 11, 1881, after an exposure of 104 minutes. Dr. Draper's loss will be regretted throughout the scientific world, for he has been cut off in the prime of life, and in the full flush of a distinguished career. His laboratory in New York, and his observatory at Hastings-on-Hudson are well known to all scientific men who have visited America, but it may well be doubted if the costly and elaborate apparatus with which they are fitted will again find such an owner.

ASTRONOMICAL NOTES FOR DECEMBER, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 49 14·08 ,,	16 30 12	21 50 55	16 40 57·75
6	11 51 15·10 ,,	16 51 56	22 31 50	17 0 40·53
11	11 53 29·41 ,,	17 13 53	23 1 45	17 20 23·32
16	11 55 52·96 ,,	17 35 59	23 20 16	17 40 6·10
21	11 58 21·30 ,,	17 58 10	23 27 7	17 59 48·89
26	0 0 50·46 p.m.	18 20 22	23 22 12	18 19 31·68
31	0 3 16·58 ,,	18 42 31	23 5 34	18 39 14·47

The Method of Ascertaining the Sidereal Time at Mean Noon at any other Station will be found on p. 390 of Vol. XXXIV.

At 10 p.m., on December 21st, the Sun is said technically to enter Capricornus; and at this instant Winter is supposed to commence. This is also nominally the shortest day; but on the 20th and 22nd, as well as on the 21st, the Sun, in London, will be only 7h. 44m. above the horizon—and of course 16h. 16m. below it—so that the description may be applied indifferently to either one of the three.

At 10 a.m., on December 31st, the Sun will be in Perigee—or, it would be more correct to say, the Earth will be in Perihelion, or in that part of her orbit which is nearest to him. Accepting the official Solar Parallax, an interval of 90,808,434 will at this instant separate us from our great centre of light and heat. Signs of activity in the shape of spots, faculæ, and prominences persist on the Sun's disc.

The Moon

Enters her Last Quarter at 2h. 56·4m. in the afternoon of December 2nd, and is New on the 10th at 3h. 37·6m. p.m. She will enter her First Quarter at 4h. 39·3m. p.m. on the 17th, and be Full on the afternoon of the 24th at 3h. 41·1m.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	20·5	4 55·8 a.m.
6	25·5	8 28·0 ,,
11	0·8	0 40·1 p.m.
16	5·8	5 4·6 ,,
21	10·8	9 29·4 ,,
26	15·8	1 11·4 a.m.
31	20·8	4 57·4 ,,

The Moon will be in conjunction with Venus at 4 a.m. on the 10th, and with Mercury 3 hours later; with Mars at 3 p.m. on the 10th; with Saturn at 2 p.m. on the 21st; and with Jupiter at 3 a.m. on the 24th.

Mercury

Is a Morning Star up to 5 a.m. on the 17th, when he will be in Superior Conjunction with the Sun. Travelling to the Eastward after this, he of course becomes an Evening Star. He is about as badly placed for the Observer in every respect as he well can be. His diameter varies from 4·8″ at the beginning of the Month to 4·6″ by the middle of it, returning to its former value after the 24th or 25th

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
14	ν Aquarii	4½	7 53 p.m.	Dark	154	189	‡8 37 p.m.	Bright	250	287
17	λ Piscium	5	2 45 ,,	Dark	116	85	3 53 ,,	Bright	296	274
17	B.A.C. 8276	6½	†7 12 ,,	S.S.E.	27	41				
17	22 Piscium	6	8 44 ,,	Dark	95	124	9 47 p.m.	Bright	313	347
19	π Piscium	6	†7 5 ,,	N.N.W.	204	196				
20	39 Arietis	6¼	†6 0 ,,	S.S.E.	20	349				
21	B.A.C. 1096	5¾	†7 33 ,,	S. by E.	15	348				
22	ε Tauri	3½	†5 14 ,,	S. by E.	10	329				
24	χ^2 Orionis	6	6 28 a.m.	Dark	138	176	6 56 a.m.	Bright	207	243
27	B.A.C. 2872	6	†4 30 ,,	N. by E.	158	188				
27	κ Cancri	5	‡6 58 p.m.	Bright	97	62	7 49 p.m.	Dark	238	200
29	14 Sextantis	6	1 29 a.m.	Bright	56	32	2 47 a.m.	Dark	253	244
29	19 Sextantis	6	6 39 ,,	Bright	345	17	6 53 ,,	Dark	323	356
30	55 Leonis	6	†4 46 ,,	S.S.W.	332	338				

† Near approaches. ‡ Stars below the horizon.

Mercury

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 53·6	20 2·5	11 12·8 a.m.
6	16 26·2	22 2·6	11 25·6 ,,
11	16 59·6	23 35·9	11 39·3 ,,
16	17 33·9	24 39·2	11 53·8 ,,
21	18 8·9	25 9·4	0 9·1 p.m.
26	18 44·4	25 3·8	0 24·8 ,,
31	19 20·0	24 20·1	0 40·7 ,,

Starting, thus, from a point to the S.W. of β Scorpii, Mercury will cross a small portion of that constellation, the Southern part of Ophiuchus, and so travel into Sagittarius. He will pass just to the North of θ Ophiuchi on the 13th, and be close to λ Sagittarii on the 23rd. He will be in Conjunction with Venus at 11 a.m. on the 9th, and with Mars at 6 a.m. on the 15th.

Venus

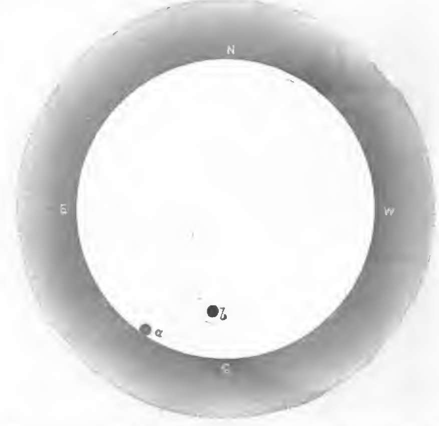
Is an Evening Star up to 5 p.m. on the 6th, when she comes into inferior conjunction with the Sun. After this, she, of course, passes to the west of him, and becomes a Morning Star. Her angular diameter, which is 1′ 1·8″ on December 1, increases to 1′ 2·8″ by the 5th, subsequently gradually diminishing to 48·8″ by the end of the month. Save on the 6th the planet is most unfavourably placed for the observer.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 5·3	24 21·8	0 24·3 p.m.
6	16 55·7	23 7·4	11 52·5 a.m.
11	16 41·3	21 9·6	11 21·0 ,,
16	16 31·5	19 38·9	10 51·6 ,,
21	16 25·2	18 25·6	10 25·6 ,,
26	16 23·0	17 35·1	10 3·8 ,,
31	16 24·8	17 7·9	9 45·9 ,,

The whole of the retrograde path indicated in the above Ephemeris lies in the Southern part of Ophiuchus, a region destitute of conspicuous Stars. Venus will be in conjunction with Mars at 7 p.m. on the 6th, and (as stated above) with Mercury at 11 a.m. on the 9th.

The Transit of Venus

On December 6th has already been treated of in these columns, by our correspondent "F. R. A. S.," in connection with the principles on which its observations are utilised for the



determination of Solar Parallax; and the method by which, and the localities in which, they will be made. It only remains here, then, to give the leading numerical details of this most important and noteworthy phenomenon.

Greenwich Mean Time.

		H.	M.	S.
External contact at ingress..	Dec. 6	1	55	57
Internal contact at ingress..	,,	2	16	18
Least distance of centres 10′ 41·4″	,,	5	4	2
Internal contact at egress ..	,,	7	51	46
External contact at egress..	,,	8	12	9

Angle from Sun's North Point

Contact at ingress 145° towards the East	as viewed with the naked eye.
Contact at egress 114° towards the West	

Our diagram represents the Sun, as seen by direct vision, when Venus has just entered on to his limb at *a*. Hence she will travel diagonally upwards across his disc, but will only have arrived at *b* at 3h. 50m. when the Sun sets in London. Both Venus and the Sun are drawn accurately to scale in our illustration, whence it is pretty obvious that Venus will be easily visible to the naked eye, defended simply by a piece of coloured or smoked glass. The student should assuredly spare no pains in his endeavours to witness a spectacle which, by no possibility can he ever again behold: the next Transit of Venus not occurring until the year A.D. 2,004, i.e., 122 years hence.

Mars

Comes into conjunction with the sun at I a.m. on the 11th, and is, of course, wholly invisible.

Jupiter,

Will be in opposition to the Sun at 8 a.m. on the 18th; is now visible all night long; and being about as well placed as he probably can be, presents to the observer a spectacle of perennial interest. Not only does the marvellous detail of the planet's own surface furnish abundant material for study; but, as will be seen by our subjoined table, the phenomena exhibited by his Satellites are very numerous also. Jupiter's angular equatorial diameter increases from 44·2″ on December 1st to 44·6″ by the middle of it, regaining its original value at the close of the year.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	5	54·0	23	2·7	1	14·8	a.m.
6	5	50·7	23	2·8	12	47·9	p.m.
11	5	47·9	23	2·7	12	25·4	,,
16	5	44·9	23	2·5	12	2·8	,,
21	5	42·0	23	2·0	11	40·2	,,
26	5	39·1	23	1·4	11	17·7	,,
31	5	36·3	23	0·7	10	55·2	,,

Hence it will be seen that Jupiter will describe a retrograde arc in the Eastern confines of Taurus, through the barren region lying between η Geminorum and ζ Tauri.

Saturn,

Like Jupiter, is visible all night long; and is most excellently placed for the observer with the telescope. His angular equatorial diameter slowly diminishes from 18·2″ on the 1st to 17·6″ by the 31st: a decrease absolutely insensible save when tested by a micrometer. No noticeable change has taken place in the opening and configuration of his rings.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	18·3	15	48·3	10	35·6	p.m.
6	3	16·8	15	43·4	10	14·5	,,
11	3	15·5	15	39·0	9	53·5	,,
16	3	14·2	15	35·1	9	32·5	,,
21	3	13·1	15	31·8	9	11·8	,,
26	3	12·1	15	29·1	8	51·2	,,
31	3	11·3	15	27·1	8	30·6	,,

So that Saturn will travel backwards for a short distance in that blank part of the sky to the South-east of δ and ζ Arietis.

Uranus

Is in quadrature with the Sun at 7 a.m. on the 15th. He will reappear, for the observer's purpose, about February, 1883.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Oc R	1	28	A.M.	10	III	Tr E	10	42	P.M.	20	I	Sh I	7	13	P.M.
2	I	Ec D	5	8	45,,	11	I	Ec D	1	31	44 A.M.	20	I	Tr E	9	25	,,
2	*I*	*Oc R*	7	47	,,	11	I	Oc R	3	56	,,	20	I	Sh E	9	29	,,
2	II	Sh E	6	45	P.M.	11	*II*	*Oc R*	4	49	P.M.	21	*I*	*Oc D*	4	16	,,
2	II	Tr E	7	33	,,	11	I	Sh I	10	50	,,	21	I	Ec R	6	34	51,,
3	I	Sh I	2	27	A.M.	11	I	Tr I	11	0	,,	22	II	Oc D	5	25	A.M.
3	I	Tr I	2	51	,,	12	I	Sh E	1	6	A.M.	22	*I*	*Sh E*	3	57	P.M.
3	I	Sh E	4	43	,,	12	I	Tr E	1	15	,,	23	II	Tr I	11	32	,,
3	I	Tr E	5	6	,,	12	I	Ec D	8	0	19 P.M.	23	II	Sh I	11	49	,,
3	*III*	*Tr I*	4	50	P.M.	12	I	Oc R	10	22	,,	24	II	Tr E	2	16	A.M.
3	III	Sh E	5	55	,,	13	*II*	*Sh I*	7	55	A.M.	24	II	Sh E	2	34	,,
3	III	Tr E	7	25	,,	13	I	Sh I	5	19	P.M.	25	III	Tr I	2	35	,,
3	I	Ec D	11	37	22,,	13	I	Tr I	5	26	,,	25	III	Sh I	3	16	,,
4	I	Oc R	2	13	A.M.	13	I	Sh E	7	34	,,	25	I	Oc D	5	8	,,
4	I	Sh I	8	56	P.M.	13	I	Tr E	7	41	,,	25	III	Tr E	5	11	,,
4	I	Tr I	9	17	,,	14	*I*	*Oc R*	4	48	,,	25	III	Sh E	5	57	,,
4	I	Sh E	11	11	,,	15	II	Ec D	3	4	50 A.M.	25	*I*	*Ec R*	7	32	17,,
4	I	Tr E	11	32	,,	15	II	Oc R	5	56	,,	25	II	Oc D	6	32	P.M.
5	I	Ec D	6	5	55,,	16	II	Sh I	9	13	P.M.	25	II	Ec R	9	36	57,,
5	I	Oc R	8	39	,,	16	II	Tr I	9	17	,,	26	I	Tr I	2	27	A.M.
6	II	Sh I	5	19	A.M.	16	II	Sh E	11	57	,,	26	I	Sh I	2	39	,,
6	II	Tr I	5	56	,,	16	II	Tr E	12	1	,,	26	I	Tr E	4	42	,,
6	*I*	*Sh E*	5	40	P.M.	17	I	Sh I	6	16	A.M.	26	I	Sh E	4	55	,,
6	I	Tr E	5	58	,,	17	I	Tr I	6	18	,,	26	I	Oc D	11	34	P.M.
7	III	Ec D	5	12	7 A.M.	17	III	Sh I	11	17	P.M.	27	I	Ec R	2	0	58 A.M.
7	II	Ec D	12	29	18 P.M.	17	III	Tr I	11	21	,,	27	I	Tr I	8	53	P.M.
8	II	Oc R	3	42	A.M.	18	III	Sh E	1	56	A.M.	27	I	Sh I	9	8	,,
9	*I*	*Ec D*	7	3	4,,	18	III	Tr E	1	56	,,	27	I	Tr E	11	8	,,
9	II	Sh I	6	37	P.M.	18	I	Oc D	3	25	,,	27	I	Sh E	11	23	,,
9	II	Tr I	7	3	,,	18	I	Oc R	5	40	,,	28	*III*	*Oc D*	4	4	,,
9	II	Sh E	9	21	,,	18	*II*	*Oc D*	4	19	P.M.	28	I	Oc D	6	0	,,
9	II	Tr E	9	47	,,	18	II	Oc R	7	3	,,	28	III	Ec R	7	43	32,,
10	I	Sh I	4	22	A.M.	18	I	Tr I	12	44	,,	28	I	Ec R	8	29	45,,
10	I	Tr I	4	34	,,	18	I	Sh I	12	44	,,	29	I	Tr E	5	34	,,
10	I	Sh E	6	37	,,	19	I	Tr E	2	59	A.M.	29	I	Sh E	5	52	,,
10	I	Tr E	6	50	,,	19	I	Sh E	3	0	,,	31	II	Tr I	1	47	A.M.
10	III	Sh I	7	18	P.M.	19	I	Oc D	9	50	P.M.	31	II	Sh I	2	26	,,
10	III	Tr I	8	6	,,	19	I	Oc R	12	6	,,	31	II	Tr E	4	31	,,
10	III	Sh E	9	56	,,	20	I	Tr I	7	9	,,	31	II	Sh E	5	11	,,

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Neptune

Continues in a very good position indeed for the observer; although, under any circumstances, he presents but few points of interest indeed as a telescopic object, resembling as he does a very small 7th mag. Star.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	2	59·6	15	7·4	10	16·9	p.m.
6	2	59·1	15	5·4	9	56·7	,,
11	2	58·6	15	3·6	9	36·6	,,
16	2	58·2	15	2·0	9	16·6	,,
21	2	57·8	15	0.5	8	56·5	,,
26	2	57·4	14	59·3	8	36·5	,,
31	2	57·1	14	58·2	8	16·5	,,

The little arc indicated above lies to the North-east of λ Ceti, in a region absolutely void of stars as viewed with the naked eye.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of December 1st, 1882.

Star.	Souths. h.	m.	s.	
α Aquarii	5	17	56·61	p.m.
Fomalhaut	6	9	12·87	,,
Markab..	6	16	56·97	,,
α Andromedæ	7	20	11·62	,,
α Cassiopeiæ	7	51	39·45	,,
Polaris	8	34	25·10	,,
α Arietis	9	18	7·07	,,
α Ceti	10	13	32·98	,,
α Persei..	10	33	19·57	,,
Aldebaram	11	46	20·68	,,
Capella	12	25	5·43	,,
Rigel	12	25	56·30	,,
α Leporis	12	44	32.67	,,
α Columbæ	12	52	22·08	,,

The Method of ascertaining the Greenwich Mean Time of Southing of either of the Stars in the above List, on any other night in December, as also that of determining the Local Instant of its Transit at any other Station, will be found on p. 392 of Vol. XXXIV. It must be noted though, that the rules there given are not rigidly accurate when applied to Polaris or to any other close circumpolar star.

Shooting Stars

Are less numerous than during the previous month. Suspicion exists of several showers; the best marked of which seem to occur on the nights from the 11th to the 13th and again on the 24th.

A POPULAR EQUATOREAL.

AMATEUR astronomers often have difficulty in directing their telescopes (generally without circles) towards a point of the heavens known by its co-ordinates; e.g., when seeking a comet in a somewhat luminous part of the heavens.

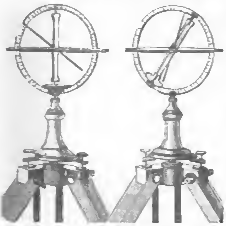
For their assistance in such a case, M. de Boë, F.R.A.S., has recently described a mode of utilising the mounting of a celestial sphere, transforming it into a small equatoreal capable of serving for all latitudes, and carrying, instead of a telescope, a simple rod, designed to point approximately to a place the position of which is known on the celestial vault. The apparatus was alluded to last week by "A Fellow of the Royal Astronomical Society," and we now give an illustration.

The globe of the well-known apparatus is replaced by an axis composed of two parallel rods (connected as shown), between which a needle can move stiffly about a pivot, situated at the common centre of the two circles representing respectively the horizon and the meridian.

To put the apparatus in position, the horizon-circle is first rendered horizontal, with the aid of a spirit-level, and three screws on the tripod-support below. Next the vertical circle is placed in the meridian, with the help of a compass or otherwise. This preparatory process may be obviated by having a fixed mark to show, once for all, the position of the meridian.

It still remains to incline the axis on the horizontal circle, so as to place it parallel to the axis of the Earth; then, lastly, to give the direction to the needle by marking the declination and the horary angle of the object sought, respectively on the vertical circle first, then on a small graduated circle mounted on the polar axis, and visible, in the figure, at the lower part of it. (This circle turns with light friction.)

By placing the axis (Fig. 2) in a vertical position, one may use the instrument as an altazimuth suitable for observation of bolides, falling stars, polar auroras, halos, &c.



As regards elementary education, the instrument may be considered as complementary to the globe, of which it is, indeed, a modification, and facilitating the comprehension of celestial motions. Thus, *e.g.*, placing the axis vertically, and supposing the needle in any position to point to a star, the rotation of the apparatus might illustrate the diurnal motion as appearing to an observer at the pole of the Earth. Then in proportion as the axis is inclined, we have the representation of the phenomenon for less latitudes; the circumpolar zone goes on diminishing, and the stars of the southern hemisphere become increasingly visible. Lastly, on placing the axis horizontal, the spectacle is that presented to a person at the Equator. All the stars then appear successively on the horizon, and for all, as for the sun and the planets, exactly twelve hours elapse between the rising and the setting; at the Equator, then, the day and night are constantly of equal duration.

The apparatus (which is of moderate price) seems likely to prove a useful popular aid in the senses indicated.

PRACTICAL NOTES ON PLUMBING.—LII.*

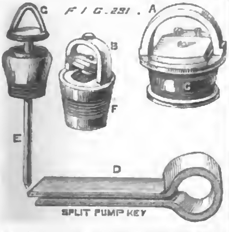
By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 242.)

Long Spindle Valves.

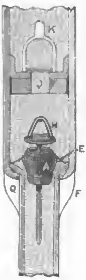
IN Fig. 281, C shows a different kind of sucker valve or box; it differs from the others by reason of its having the spindle E, which works through a guide within the box; these valves are sometimes ground in, at other times leathered. When the latter method is adopted care should be taken to make the seating flat and wide, especially for very deep well pumps. These seatings should be at least ½ in. wide, which prevents the leather getting out by the pressure of the water. There is also another advantage in using these sucker boxes; it is that they may be cemented into the cone of the barrel, or soldered. When the latter is done, it is generally in the manner as shown at E F, Fig. 282, and as follows. First open the end of the suction pipe, as at Q, wide enough to admit the valve A, then tin the valve and wipe a taft-joint as shown at E; next prepare the foot of the barrel as shown, and wipe the joint Q F, but take care not to melt the solder on the inside. The proper way to do this is to wipe the inner joint with a coarser solder than the outer joint, the former of which will require a greater heat to melt it. Of course the spindle can be readily hooked up by what is called a short hook (see the dotted lines, A B, Fig. 279), out of the barrel when required for repairs.

FIG. 281.



SPLIT PUMP KEY

FIG. 282



When selecting these valves see that the spindle is long enough, and that the bridge is well open cone-shaped to allow the end of the spindle to drop easily into the bridge. Although these valves are very good and handy, there is an objection to their use in some pumps unless judiciously selected. The lift is too great; the valve, when the pump is worked quickly, jumps too high, as much as 6in. to 7in., and during its descent allows the water to back, thereby to a certain degree spoiling the useful effect of the stroke of the pump, which is not so much the case with the clack valve B, Fig. 281.

(*To be continued.*)

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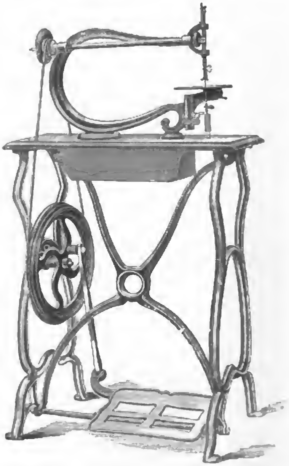
A NEW FRET-SAW.

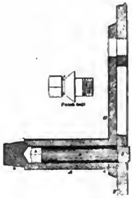
THE Britannia Company have just brought out a new fret-saw. The advantages claimed are a true vertical stroke which cuts cleaner and easier than any machine which is not vertical. There is 16½in. clear under the arm. The table is made to tilt for inlaid work. It is mounted on a firm stand with a flywheel sufficient to give speed and power enough to insure even and easy working. By substituting a drill-spindle with mitre gear-wheels for the saw-spindle, a very effective vertical drill can be fixed in a minute. By means of a rising and falling table the work is pressed upwards against the drill.



PATCHING FIRE-BOXES.

HAPPENING not long since, writes a correspondent of the *American Machinist*, to see a couple of boiler makers deliberately, that is, with plenty of time to spare, *repairing* the fire-box of a boiler by putting on a soft patch with about a pound of putty under it, led to some philosophising on the subject of fire-box patches in general, and particularly as to where a boiler maker ever found sufficient inducement for inventing such a thing as a soft patch. Every one who knows anything about the matter knows that a patch plastered up with putty was never tight, in the fire-box of a boiler under steam, and ought to know that if suffered to remain for any length of time it is a source of danger, from the iron wasting and corroding away, making it liable to let go at any time under the persuasion of a little extra pressure.

Let it be admitted that a soft patch ought never to be used, and still there are good and bad ways to patch the fire-box of a boiler. No boiler maker considers a rivet of any account, whether it shows a leak or not, unless it fills the rivet hole, and yet it is not often that a patch bolt makes any sort of decent pretensions to filling the hole in the patch. It ought to fill it, and it may be about as readily made to do so as to be made the standard $\frac{1}{16}$in. loose, with filing at will; but it don't. Another thing about a patch bolt, as ordinarily used, is the destroying in a great degree of the holding qualities of the head by bending it against the rough, out-of-line surface of the patch, in screwing up, and finally concluding the destroying process by calking the head to make it tight. The accompanying sketch represents (about one-quarter size for ordinary purposes) a useful tool for putting on bolt patches, for which novelty in its general features is not claimed, but which some experience leads the writer to believe might profitably be better known and oftener used than it is. In the sketch, F is intended to represent the damaged sheet, and H the patch. It is understood, of course, that the damaged part of the sheet is to be cut out the same as for riveting. The patch being accurately fitted, holes should be drilled in the patch as if they were to be tapped for the patch bolt. A suitable number of holes (usually three or four will be sufficient) should be marked and drilled and tapped in the sheet for temporary bolts one size smaller than the patch bolts, and with these the patch should be bolted in place. The rest of the holes can then be drilled in the sheet for tapping, the holes in the patch serving to guide the drill in the sheet, thus providing for the perfect



alignment of the holes in the two parts. The holes should then be enlarged in the patch, by the use of a tit drill, to the size of the body of the bolt, or so that the bolt will just turn in the hole, and the holes tapped in the sheet with the patch in place. Three or four bolts can then be inserted, the temporary bolts removed, and the holes they occupy enlarged and tapped. Should still greater accuracy than can be secured in this way be desired, the holes in the patch can be enlarged with the tit drill to within $\frac{1}{64}$in., or less, of the size of the bolt, and then the last tap can be made with the body just above the thread fashioned to cut like a reamer. By this means almost absolute truth can be secured. With reasonable care, however, this latter plan will hardly be necessary. The tool for squaring the patch around the hole is shown at A, in position for use. B is a steel stud, the thread, *d*, of which fits snugly in the holes tapped in the sheet. The outer end, *a*, of the shell A is squared, or otherwise fitted to a ratchet wrench. The hole in this shell is made to fit accurately the stud B, and the end at *c*, is made with teeth like a face mill. It will be evident that by the use of this tool the patch may be squared up around the holes so that the head of the bolt will seat evenly without bending, and will be tight without calking; also that the body of the bolt may be made to fill the hole in the patch without friction or straining in screwing it up. The patch bolts should be nicked under the head with the cutting-off tool in making (as at *e* in the sketch), to insure their twisting off there sooner than in the thread. They should be screwed up evenly, and none of them twisted off until all are properly seated. A good size for patch bolts for $\frac{5}{16}$in. and $\frac{3}{8}$in. iron is $\frac{3}{4}$in., and a good thread 14 to the inch. A patch put on in this way can be as securely calked as if riveted, and can be depended upon for present satisfaction and future usefulness. I am aware that some have a preference for a countersink head patch bolt, but experience with cone-headed bolts in the fire-boxes of locomotive boilers leads to the belief that when properly applied there is no more trouble from them than from an ordinary rivet head. It costs a trifle—not much—more to put on a patch in this way than in several other ways that might be mentioned, but the job has the merit of being worth something.

THE GREAT COMET AS SEEN AT CAPE TOWN.

AT the monthly meeting of the South African Philosophical Society, held on the 25th ult., in the University Hall, Bureau-street, Cape Town, South Africa, Dr. Gill, Astronomer Royal, was called upon to make some remarks respecting the comet, and to exhibit several photographs which had been taken of it at the Observatory. The great comet which now adorned our morning sky, he said, was discovered by his friend and chief assistant, Mr. Finlay. He said this in an astronomic sense, for unless the comet had been previously observed in Australia, and they had received no information of it, the first astronomical observations to fix its precise place were certainly made by Mr. Finlay. There was something said about the comet having been seen on the previous day by a person travelling in a post-cart, but he did not know how far that statement was authenticated, and it was quite certain that no observations of any value could be made from the top of a post-cart. Therefore, so far as they knew, the honour of its discovery belonged to Mr. Finlay, and consequently in astronomical circles it would bear his name. It was first discovered on the morning of the 7th September, when it was shining with the brilliancy of a star of the 3rd or 4th magnitude, and showed a not very brilliant tail of about two degrees in length. It was of a very bright white colour, contrasting in this respect with the comet Wells, which was the last comet visible, and was decidedly of a golden colour. Mr. Finlay had been observing the occultation of a star, and while returning into the Observatory his eye was directed to the unusual object, which he at once recognised to be a comet. On his return to the Observatory, he at once made the necessary observations. These observations consisted in determining the difference of time in which any small star near the comet passed the lines marked on the telescope, and the time in which the comet passed. They were by these means enabled to identify the star and determine its place, and thus to determine the place of the comet. Observations were made on the morning of the 7th, and again on the morning of the 8th. On the morning of the 9th only a very rough observation was made, through the clouds, and then came a series of cloudy days, which rendered it necessary to set about another mode of determining the comet's place. It was essential to have some means to get rapid observations, for the comet was so near the sun that the strong daylight obliterated all the stars. The comet was all this while increasing in brilliancy until on the Sunday morning Dr. Elkin and Mr. Finlay observed it quite plainly by daylight. Unfortunately he (Dr. Gill) was absent just then at Simon's Bay, where he had an appointment with Captain Morris, who was now on his way to Lisbon as chief of the Transit of Venus Expedition at that place. He had, therefore, the misfortune to miss the interesting observation which was then made. Dr. Elkin and Mr. Finlay followed the comet all day, making a great many observations, and towards the afternoon they found it approaching the sun with enormous rapidity, until it was evident that it would actually pass either behind or in front of the sun. At that time it was impossible to say whether the comet was behind or in front of the sun. They watched it with great interest until it approached nearer to the sun, and its tail and coma vanished, and there only remained a small round disc. This did not appear to diminish as it approached the sun, but rather to get brighter, and was distinctly visible through the dark glass necessary to use in observations of the sun. The comet came close up to the sun, and Dr. Elkin and Mr. Finlay watched it until it was lost in the wavy outline in passing by the edge of the sun. They continued to watch it until they lost all trace of it, and there were only five seconds difference in time in the observations of the two observers, showing that both must have seen it very nearly if not quite to the edge of the sun. The next question was whether it had passed behind or in front of the sun. They, therefore, made an examination of the neighbourhood of the sun where the comet had disappeared; but nothing was to be seen, so they thought it was possible that it had gone beyond the sun. The next morning he (D. Gill) observed the comet at Simon's Bay, and saw it rise to the west of the sun and a little before the sun, and he would never forget the beautiful appearance it presented. He was surprised to notice that the sun itself made no difference to its brilliancy. As it cleared the mists of the horizon it became brighter and brighter and whiter and whiter, assuming a much more definite shape, and showing a brilliant white tail. Further observations were made, and Dr. Elkin and Mr. Finlay set to work to get out its approximate orbit. We knew very little of comets in reality. It was known, however, that they contained carbon vapour in some form, and it was known that the present comet contained sodium vapour, which was ascertained by spectroscopic analysis. Whether those vapours were generated from the solid nucleus, or whether they were in the nucleus in a very condensed form, no one knew. On the 9th of September he telegraphed to the Astronomer Royal in England that this comet had been discovered by Mr. Finlay, and giving its position; but he was sorry to say that, somehow or other, that telegram did not reach its destination. The comet was subsequently lost to sight altogether in Europe through bad weather, and he saw by the last English edition of the *Cape Times* that the scientific papers were singularly silent upon the subject. There were telegrams from Paris and Vienna on the 27th September, stating that a brilliant comet had been seen in a position which corresponded with the place of this particular comet; but this discovery of theirs was 19 days after it was seen by Mr. Finlay, and 17 days after the telegram had been despatched by him to England. It was unfortunate that the telegram did not reach its destination, for it would have shown the undoubted claims of Mr. Finlay as its discoverer. When the comet was first seen it had very much the appearance which a great many of the comets possessed with a sharp nucleus and a long retreating tail, like a parabolic cylinder. About the 22nd or the 23rd September the comet's head began to do a most singular thing. Its nucleus, instead of remaining single, began to get longer, and then elongated still more, until there were two little nuclei, which were connected by a strong-looking thread between them. Then they elongated still more, until on one morning he counted no fewer than five of these nuclei, extending to the length of a minute of arc. He could not illustrate their appearance better than by describing them as five little beads strung upon a piece of rough, fluffy thread. The original nucleus remained distinctly the largest and most brilliant. The envelope in front of the head then began to prolong to the extent of two degrees. When Father Perry was here an attempt was made to photograph the comet by attaching the camera to the telescope at the Observatory, but a proper focus could not be obtained. Afterwards Mr. Shoyer, of Grave-street, and Mr. Simpson, of the United Presbyterian School at Aberdeen, obtained photographs, but for scientific purposes they were necessarily useless; for, during the twenty-five minutes exposure of the plate, the comet must have moved something like 70 degrees of arc. The impression also required some little doctoring to make it look a respectable comet, and Mr. Shoyer honestly confessed that he did something to improve the appearance of the comet, and he certainly made it a very good-looking one on paper. There was, however, no picture of the stars in these photographs, and so they were useless for scientific purposes, as the stars were the points to be used with reference to the determination of position. It was due to the enthusiasm, energy, and remarkable desire to do good work of Mr. Ellis, photographer, of Mowbray, that he had been able to procure the pictures he was about to exhibit. Dr. Gill, in conclusion, proceeded to minutely describe the process by which those photographs had been taken, and remarked that science was very much indebted to Mr. Ellis for the enthusiasm he had displayed over the work, and the success that had attended it.

Mr. W. H. Finlay, F.R.A.S., next gave some account of the elements of the orbit of the comet, and the rapidity with which it passed its perihelion. In obtaining those elements of the comet's orbit, the first thing they had to consider was whether this was the return of a previous comet or not. The elements of the comets of 1843, 1880, and 1882 (the present one) were very much like each other; but there were some slight changes, and the intervals were so unequal that he was decidedly of opinion that this was not the return of a comet. In reply to a question by the Chief Justice (Sir J. H. de Villiers), Mr. Finlay said the comet had actually passed through the corona of the sun.

Dr. Gill then proceeded by means of the magic-lantern to exhibit the slides of the excellent photographs that had been obtained at the observatory, and pointed out the various details of the comet.

LIFE-HISTORY OF THE LIVER FLUKE.

AT a recent meeting of the Royal Medical and Chirurgical Society, Mr. A. P. Thomas, M.A., described his researches into the Life-history of the Liver Fluke, undertaken at the request of the late Professor Rolleston on behalf of the Royal Agricultural Society. After mentioning the ravages made by the liver fluke (as many as 3,000,000 sheep being lost by it in this country in the year 1879—80) and referring to the fact that hitherto the search after the particular mollusc supposed to harbour its larval form had been futile, Mr. Thomas described his plan of work. He thoroughly searched meadows for every species of mollusc likely to be an intermediary host, dissecting them without success, until at length he succeeded in finding in the small Limnæus truncatulus, a cylindrical worm or Reedia, containing cercariæ. The cercaria is of tadpole shape, and has the peculiar habit of encysting itself directly it is brought into contact with any solid object, the material for encystation being exuded from some lateral masses in the body of the larva. For some time the inquiry was arrested because of his inability to find any more specimens of the Limnæus truncatulus, even where they had abounded in the previous year. In last July, after floods, however, he found an ample supply in the flooded meadows. The snail in question is more truly amphibious than a water snail, is very small—about a quarter of an inch long—and wandering along the damp roots of grass, its presence may readily be overlooked. He now proceeded with infection experiments, and succeeded in proving that this mollusc was the sole intermediary host of the common fluke. At the same time he was enabled to study fully the metamorphosis of the latter. The liver fluke is very prolific, but so long as the ova remain in the liver they undergo no further change. In artificially hatching them, the embryo is seen to leave the egg by the sudden giving way of the operculum; and once in water the cilia with which the body of the embryo is covered came into action. The free-swimming embryo has a spindle shape and is provided with a double eye spot (two masses of pigment), and is very sensitive to light. If the embryo comes in contact with a Limnæus truncatulus it begins to bore into its shell, the head papilla becomes elongated and sharp, and by a sudden movement the boring is effected, and the body of the embryo passes into the snail. As soon as it gets into the snail the body contracts, its outer layer is cast off, and it degenerates into a sporocyst. By proliferation of cells lining the body cavity and of cells in the body walls, masses of germinal cells are formed from which the cercaria is developed. The sporocyst usually develops in the pulmonary cavities of the snail and the parasite gets into the liver, feeding on the liver cells. The cercaria is formed by the rounded germ-masses becoming elongated, one end being pinched off to form a tail. When the cercaria has escaped and become encysted, it remains quiescent until swallowed by the sheep; when, the cyst being dissolved, the embryo fluke finds its way into the liver ducts of the sheep. Mr. Thomas concluded his statement by pointing out that the real preventive of the disease is salt, a small quantity of which will not only kill the larvæ of the fluke, but the Limnæus also. The salt should be scattered over all land where the snail is believed to be present. It had also been found useful to feed sheep on salt, and this had been long a practice among farmers who had found it valuable in preventing sheep rot, but who had not thoroughly carried it out. Many other animals, including man, were liable to be infested by flukes, and in the case of man the parasite might be introduced through watercress.—Dr. Cobbold exhibited specimens of flukes from the elephant, giraffe, &c., and said that even whales, porpoises, and dolphins were liable to such parasites. He thanked Mr. Thomas for having conclusively proved the Limnæus truncalatus to be the intermediary host of the common fluke; and remarked that, curiously, a year ago he had believed that Leuckart had made the same discovery. But he had since heard that Leuckart thought it was another species of Limnæus, so that Mr. Thomas had succeeded in the search which the great German helminthologist had been so long pursuing.—Dr. J. Harley mentioned the case of a labourer who died from this disease, twenty-six flukes being found in the hepatic ducts, and the symptons being most obscure. It was ascertained that his diet had consisted chiefly of bread and cheese often accompanied by watercress.—Dr. Maclagan mentioned that a gentleman in Dorsetshire had told him that in 1879—80 he had lost none of his sheep from this disease, whilst all round there was great mortality. His immunity was attributed to his flocks being fed with salt.

COPYING-PAPER.

THE following is communicated to the *Polytech. Notizblatt* by E. Dieterich, in regard to the method he employs for making the copying-paper which has obtained so high a reputation in Germany. The manufacture may be divided into two parts—viz., the production of the colour and the application of the same to the paper. For blue paper, Dieterich uses exclusively the blue colour known as "Paris blue," as covering better than any other mineral colour. Ten kilogrammes of this colour are coarsely powdered, and mixed with 20 kilogrammes of ordinary olive oil: 0·25 kilogramme of glycerine is then added. This mixture is, for a week, exposed in a drying-room to a temperature of 40° to 50° C., and then ground as fine as possible in a paint-mill. The glycerine softens the hard paint, and tends to make it more easily diffusible. Then Dieterich melted 0·4 kilogramme of yellow wax with 7·5 kilogrammes of ligroine, and added to this 3 kilogrammes of blue mixture, mixing slowly at a temperature of 30° or 40° C. The mass is now of the consistence of honey. It is applied to the paper with a coarse brush, and afterward evenly divided and polished with a badger's hair brush. The sheets are then dried on a table heated by steam. This is done in a few minutes, and the paper is then ready for shipment. The quantities mentioned will be sufficient for about 1,000 sheets of 50 by 90 centimeters, being a day's work for two girls. For black paper aniline black is used in the same proportion. The operation must be carried on in well ventilated rooms protected from fire, on account of the combustibility of the material and narcotic effects of the ligroine. The paper is used between two sheets of paper, the upper one receiving the original, the lower one the copy.

TABLE-TURNING.

A PAPER giving an entirely novel view of the well-known table-turning experiment was read before the Ipswich Scientific Society on Tuesday week by Dr. Percy R. Wilde. Dr. Wilde remarked that since the earliest times the idea has been put forward, under various forms and by different thinkers, that there is some unknown force passing from the body and capable of affecting external objects. All appeared to have agreed in considering the arm as a conducting medium of this force. The constant recurrence of this belief seems to indicate that there must have been some phenomena not unfrequently noticed to have given rise to it. The well-known experiment of table-turning was an illustration of movement being produced by an unknown agency. In the genuine table-turning phenomena, in which the table was too heavy to be turned by unconscious muscular action, the movement was not a very extensive, but a very remarkable one, for it took place when the muscles of the operators were in a state of rigidity from long maintenance in one position, so that they were almost incapacitated from performing any serious muscular effort. Faraday had demonstrated by an ingenious apparatus shown by the lecturer, that lateral pressure on the part of the operators always accompanied the movement of the table, but the cause of this unconscious lateral pressure had never been satisfactorily accounted for. Dr. Wilde then described a number of experiments, conducted by instruments of his own contrivance, which he exhibited, and by which he found that whenever the hand is held in a fixed position so that its little tremulous movements are stopped, lateral pressure begins to be exercised, and this in a direction from right to left. His experiments proved these movements to be due to the movements of the chest walls during respiration, and further that the forcible pressure took place at the end of inspiration. It was difficult to understand how the inexpansile movements of the chest could produce these results, and Dr. Wilde commenced a re-examination of them. He found that when we expand the chest, there is a slight rotatory movement of the body, and that this explained the lateral pressure of both hands to the right side. The lecturer then described a process of respiration, and stated that we use a force of 3,000lb. to 6,000lb. each minute of our lives, in expanding the chest walls, although we do so entirely unconsciously. He showed that this force could be made to pass beyond the body; by placing an object in such a position as to interfere with the expansion of the chest walls, the object would then stimulate the unconsciously acting muscles of inspiration to increased efforts to remove it. The force thus conveyed beyond the body Dr. Wilde calls the *epimetric* or overflow force. The anatomy of the shoulder-joint and muscles of the chest were briefly explained, and it was shown how the method of procedure required to turn a table set up a contracted condition of the muscles, rendering it necessary that the arm should move with the body and share in its rotatory movement, but the table prevented this movement, and so became a direct obstacle to the free expansion of the chest walls. This stimulated the inspiratory muscles to increased action, and a gradually increased lateral pressure was exercised; at last this exceeded the weight and friction of the table, and movement was produced in it, much to the surprise of the operators, who were thus shown to have been perfectly truthful when they declared that no effort was used by them. Dr. Wilde also explained that this same force was taken advantage of equally unconsciously when we performed great muscular efforts; intuitively we first draw a long inspiration, and then hold the breath during the effort, and by a working model he demonstrated how the expansile force of the chest walls was thus made to aid the action of the muscles.

THE PREPARATION OF CAESIUM.

IT will probably be in the remembrance of many of our readers, says the *Engineer*, that Bunsen and Kirchhoff, when working on the method of spectral analysis, which they completed in 1860, hit upon two metals which gave lines in the spectroscope that were quite new to them. They were called rubidium and caesium. The salts and the metal itself, in the first case, were soon prepared and studied; the second metal has only just now been obtained in a free state. It has been accomplished by Dr. Carl Setterberg, whose paper has been communicated to the Academy of Sciences at Stockholm, and the work was done at Marquart's laboratory in Bonn, where, as a by-product from the manufacture of lithia from lepidolite, the alums of these metals were to be obtained in hundreds of hundredweights. By allowing a hot concentrated solution of the alums of the two metals and of potash alum, for of these it consists, to stand, all the alum of the rare metals first separated out; the process is repeated several times, and in this way 40 kilog. of rubidium alum and 10 kilog. of caesium alum were crystallised out. Boiling water dissolves much more of the rubidium alum than of the caesium alum—at 0 deg. 3·75 times as much and at 80 deg. 4·08. To get the hydrates of the metals from the alum they are treated with barium hydrate, which throws down both the alumina and the sulphuric acid. This was then, in the case of the caesium, converted into cyanide by passing perfectly dry hydrocyanic acid into a solution of the hydrate of caesium in alcohol. It is absolutely necessary that the materials should be quite anhydrous. The reduction of the cyanide was conducted in a little clay cell, as described by Professor Bunsen in his paper on the isolation of other metals, like lithium, calcium, &c.; and a mixture of four parts of caesium cyanide with one of barium cyanide, and a current of the intensity 25, expressed in absolute measure, employed. The actual reduction of the metal from the cyanide was effected at Heidelberg in the laboratory of Prof. Bunsen; and here it was that the long-desired view of the curious metal was first obtained. The metal closely resembles the other alkaline metals in appearance; it is silver white in colour, can be drawn out, and at ordinary temperatures is very soft. It may be stated here that Prof. Bunsen told the writer of these lines some fifteen years ago that he expected caesium would be like mercury, a liquid metal; for in this group of metals the temperature of fusion falls as the atomic weight increases. Though not liquid, it melts at a low temperature, between 26 and 27 deg. Cent.—at about 26·5 deg. Cent. In contact with water it swims on the surface, flame being evolved, as do potassium and rubidium; when exposed to the air it soon takes fire. Two determinations of the density of the metal showed it to be 1·88 and 1·87. All experiments made with a view to reducing the chloride were attended with difficulty, and led to the employment of the cyanide instead. A curious point in connection with the history of caesium was the analysis by Pisani, of Paris, of a specimen of the mineral Pollux, from Elba, which he published in 1863. Plattner held it to be a silicate of alumina and potash, but his numbers fell short to 92·75 per cent., and finding the result inexplicable he published it. It was afterwards found that the supposed loss was due to the oxide present being, not potash but caesia, of which it contained 34·07 per cent., and thus brought the analysis up to the 100, and made it come right. This shows the importance of setting down the results of an analysis conscientiously, without making up the "loss."

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE second meeting of the session of this Society was held on the 8th inst., at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.), in the chair.

Dr. Maddox exhibited photographs of microscopical objects, printed by the platinotype process, which he found very suitable for scientific work, the paper being of fine texture, and capable of giving minute detail.

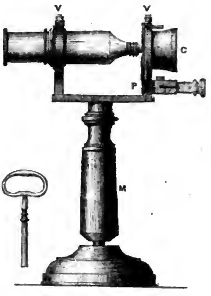
Mr. Curties exhibited several of Zeiss's simple and dissecting microscopes.

Mr. Collins exhibited a portable form of his histological microscope, the special feature of which was the folding up of the heel-piece of the tripod.

Mr. Crisp exhibited and described Guillemare's "School Microscope," and Prof. Abbe's refractometer, for readily ascertaining the refractive index and dispersive power of fluids, to be used for homogeneous immersion.

Some excellent slides by Mr. Krutschnitt, of New Orleans, comprising sections of the ovaries of plants, were exhibited in support of the author's view of the fertilisation of the ovule.

[Guillemare's School Microscope[*] is the design of Professor A. Guillemare, of the Lycée Charlemagne, Paris, and is apparently intended for junior pupils, its speciality being the screws V and V, by which both the tube and the slide are locked, so that they can only be freed by the Professor with the aid of the key shown in the woodcut.



The handle M, by which the instrument is held when passed round a class, is hollow, so that it can be placed on a vertical support, if desired. C is a metal cone polished inside for condensing the light on the object. The object is put between the stage and the spring-plate P, which grips it with sufficient force to permit of its being moved as required; the image is then focussed by the sliding body-tube: the key is then applied at V and V, and the instrument locked before being handed round the class.]

Dr. Maddox read a paper on some new forms of warm stages, which he exhibited in the room, and further explained by means of diagrams.

The President said that the stages were very simple, and very easily used, and would doubtless be of great use in examining blood and other objects, which it was desired to keep at an even warm temperature.

Dr. Maddox, in reply to a question, said that the flow of water was obtained by drawing the air out of the flexible tube, and then leaving it to act as a siphon—the temperature was taken in the can from which the supply was drawn, and the heat of the stage could readily be estimated from this.

Mr. J. W. Groves exhibited and described his improved freezing microtome.

Mr. Stewart said that his own experience was that the ether method of freezing was a great advantage, for the full range of temperature was at command. It was only necessary to take care that the freezing was not overdone, so as to make the subjects brittle. A little practice enabled a person to control the temperature at will.

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[*] The Editor of the *Journal* of the Royal Microscopical Society has kindly lent us this woodcut for our report.

Mr. T. B. Rosseter's paper on the "Embryology, &c., of Stephanoceros" was read, and illustrated by drawings enlarged on the black-board.

Mr. Crisp said that the author of the paper was worthy of every possible encouragement, as his observations were carried on under the greatest difficulties, and much credit was due to him for the indefatigable way in which he pursued them.

The President thought the paper was a very admirable one, whatever difference of opinion there might be as to some of the points touched upon.

Mr. T. C. White said that he was under the impression that as far as the attachment of the ovum to the parent was concerned, it was really attached to the case. The gelatinous envelope could hardly be called a case in the sense of being a thin structure, but it was rather a thick tube with solid walls, and when the creature retracted itself, the portion of the tube to which the ovum was attached was carried down with it. As regarded the viviparous character mentioned, he had observed it in *Rotifer vulgaris*, and had also noticed the fact that the parent died as Mr. Rosseter described.

Mr. Badcock having had an opportunity of previously reading the paper, read some critical remarks which he had written as to the question of the tube being "solid" or not.

Mr. Beck thought that the paper was an exceedingly interesting one, and after the remarks which had been made by their secretary as to the circumstances under which the observations had been made, it was doubly interesting. The way in which the writer had combined observation with experiments, and the manner in which he described the results, was, he thought, very creditable indeed. The fact of the creature making its way out of the cell, not at the top but at the lower end, was very interesting, for it would be natural to suppose that if any injury had taken place it would have escaped in the opposite direction. It occurred to him that this circumstance might afford a clue as to the way in which these objects expanded, whether they gained any kind of grip on the upper portion of the cell, and then by expansion were forced out at the end?

Mr. Michael thought that to a certain extent the question of an attachment to the tube was a substantial one, but whether the case was solid or tubular was more a matter of words. Pritchard could not mean that a cylinder in which a creature moved up and down was really "solid"; what he meant was probably that, instead of being a mere thin shell, it had a considerable thickness approaching towards solidity. The dragging down of the ovum, he thought, commenced before the arms touched the tube.

The President said it appeared to be quite clear that the tube had a considerable thickness, and that the attachment or adhesion to it was by the base only. With regard to the curious twisting round of the animal to get out at the lower end, it should be remembered that these creatures were *vermes*, and that this was just the kind of thing a worm would do under the circumstances. He quite agreed with Mr. Beck in his remarks on the paper, and he hoped they would have more of the same kind.

Mr. Crisp made some remarks on the criticism that had been passed on the paper.

Dr. Maddox read a paper on "Some Organisms Found in the Excrement of the Goat and of the Common Goose."

Mr. Geldart, the President of the Norfolk and Norwich Natural History Society, one of the *ex-officio* Fellows of the Society, was welcomed by the President.

Mr. Geldart said he was greatly obliged to the Fellows for the welcome given to him, and could only express the gratification which it afforded him to be present. He also wished to take advantage of the opportunity to thank them, in the name of his Society, for the privilege afforded to them of receiving the *Journal* of the Society, and profiting by the very admirable summary which it contained of all that was being done in microscopy, both at home and abroad. Mr. Geldart then called attention to a slide of Globigerina which he had brought, with all its spines in situ—so unusual an object that it seemed to be worth bringing for exhibition. It was obtained by the *Challenger*.

The President inquired whether it came from the surface.

Mr. Geldart said that this, and, indeed, all those, few in number, which had been obtained, came from the surface. Those brought up from the floor had the spines dragged off by the towing net. He had never seen more than two.

The President said that in examining some deposits from 14,000 feet he found them crammed with Globigerinæ, amongst which he had the good fortune to find one with spines. He was very glad to have seen this specimen as being an original from the "expedition."

The conversazione was announced for the 6th December, and the meeting was adjourned to December 13th.

METEOROLOGICAL SOCIETY.

THE opening meeting of the session was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers, Mr. J. K. Laughton, F.R.A.S., President, in the chair.

The papers read were:—

1. "On Certain Types of British Weather," by the Hon. Ralph Abercromby, F.M.S. The author shows that there is a tendency of the weather all over the Temperate Zone to occur in spells, associated with certain types of pressure distribution. In Great Britain there are at least four persistent types—the southerly, the westerly, the northerly, and the easterly. In spite of much fluctuation, one or other of these types will often continue for weeks together, and tend to recur at the same date every year. The value of the recognition of type-groups is shown in the following ways:—(1) They explain many phenomena of weather, and many popular prognostics. (2) In some cases they enable forecasts to be issued with greater certainty and for a longer time ahead. (3) We can by their means correct statistical results, by giving the real test of identity of recurrent weather which no single item, such as heat, cold, rain, &c., can do. (4) They enable us to treat such geological questions as the influence of changing distribution of land and sea on climate, in a more satisfactory manner than any other method.

2. "On the use of Kites for Meteorological Observation," by Prof. E. Douglas Archibald, M.A., F.M.S. In this paper the author advocates the use of kites for meteorological observation, and describes the mode in which they may be best flown, so as not to be mere toys, but scientific instruments capable of ascending to great heights, remaining steady in currents of varying velocity, and of being manipulated with ease and rapidity by the observer.

3. "The Meteorology of Mozufferpore, Tirhoot, 1881," by Charles M. Pearson, F.M.S.

HOUSEHOLD HINTS.

Vinegar for the Sick-Room.—There is a French legend that during the plague at Marseilles a band of robbers plundered the dying and the dead without injury to themselves. They were imprisoned, tried, and condemned to die, but were pardoned on condition of disclosing the secret whereby they could ransack houses infected with the terrible scourge. They gave the following recipe, which makes a delicious and refreshing wash for the sick-room: Take of rosemary, wormwood, lavender, rue, sage, and mint a large handful of each. Place in a stone jar, and turn over it one gallon of strong cider vinegar; cover closely, and keep near the fire for four days; then strain, and add one ounce of powdered camphor gum. Bottle and keep tightly corked. It is very aromatic, cooling, and refreshing in the sick-room, and is of great value to nurses.

To Remove Old Paint and Putty.—To remove paint from old doors, etc., and to soften putty in window-frames, so that the glass may be taken out without breakage or cutting, take one pound of pearlash and three pounds of quicklime; slake the lime in water, and then add the pearlash, and make the whole about the consistence of paint. Apply it to both sides of the glass, and let it remain for twelve hours, when the putty will be so softened that the glass may be taken out of the frame without being cut, and with the greatest facility. To destroy paint, lay the above over the whole body of the work which is required to be cleaned, using an old brush (as it will spoil a new one); let it remain for twelve or fourteen hours, when the paint can be easily scraped off.

A Hard Cement for Wood.—The following cement will be as hard as stone when dry, and will adhere firmly to wood. Melt 1oz. resin and 1oz. of pure yellow wax in an iron pan, and thoroughly stir in 1oz. of Venetian red, until a perfect mixture is formed. Use while hot. When cold it is as hard as stone.

Orange Wine.—The oranges must be perfectly ripe. Peel them and cut them in halves, crosswise of the cells; squeeze into a tub. The press used must be so close that the seeds cannot pass into the must. Add two pounds of white sugar to each gallon of sour orange juice, or one pound to each gallon of sweet orange juice, and one quart of water to each gallon of the mixed sugar and juice. Close fermentation is necessary. The resultant wine is amber-coloured, and tastes like dry hock, with the orange aroma. Vinegar can be made from the refuse, and extract from the peels.

THE loss of life, on and near the coasts of the United Kingdom, collision cases included, was, during the past wreck register year, as follows:—East coast, 585; south coast, 94; west coast, 162; north coast, 54; other parts of the coast, 89. Total 984. It will thus be seen that the greatest loss of life happened, as usual, on the east coast of England.

SCIENTIFIC NEWS.

FROM a special Science Observer circular (No. 291) we learn that Mr. S. C. Chandler, junr., has made another approximation to the orbit of comet *b*, 1882. His latest elements are T, Sept. 17·2304 G.M.T.; π 55° 12′ 41″; ω 69° 22′ 7″; ☊ 345° 50′ 34″; i 141° 54′ 56″; log q 7·8835636. Dun Echt Circular No. 65 contains elements calculated by Dr. K. Zelbr T Sept. 17·2485 Berlin M.T.; π – ☊ 69° 56′ 58″; ☊ 346° 13′ 37·8″; i 142° 3′ 7·7″; log. q 7·906820. Mr. Ritchie, junr., has computed an ephemeris from the first-given elements:—

		R.A.			S. Dec.		
Nov.	25	9h.	6m.	8·12s.	27°	29′	38·9″
	29	8	55	13·9	28	16	58·8
Dec.	5	8	37	46·49	29	24	58·1

It seems tolerably certain now that the comet is not that which appeared in 1843 or 1880, but is that of 1881.

Barnard's comet was discovered on Sept 13th, not the 10th, as previously announced.

From Mr. Russell, B.A., F.R.A.S., Government Astronomer for New South Wales, we have the Results of Double Star Measures made at the Sydney Observatory from 1871 to 1881, including measures of Herschel's double stars made in 1882, and new double stars found while making those measures. The catalogue is prefixed by an interesting paper read before the Royal Society of N.S.W., by Mr. Russell, on new double stars and measures of some of those found by Sir John Herschel. Diagrams showing the positions of p Eridani and the Sydney observations of α Centauri are given, with a number of smaller ones, showing the interesting triple or multiple stars amongst those of the Cape Catalogue which have been measured, and similar diagrams of some of the new ones. Mr. Russell says, "There are many stars in the Cape list that cannot be found."

From Mr. Burnham we have Vol. I. of the "Publications of the Washburn Observatory of the University of Wisconsin." The volume contains a description of the buildings and their equipment, the gift to his adopted State of the late Governor Washburn. Prof. E. S. Holden is director, and S. W. Burnham and G. C. Comstock are astronomers. Amongst the contents of the volume are lists of new nebulæ and several lists of new, and measures of, double stars by Mr. Burnham. We note that the observatory is open to visitors during the day, provided one of the astronomers is present, while the early hours of the night on the first and third Wednesdays in the month are also devoted to their reception. Every facility is offered to the students of the University to become acquainted with the wonders of the heavens. A portrait of Cadwallader C. Washburn forms an appropriate frontispiece to the first publication issuing from the outcome of his generous intelligence.

Under the nom-de-plume of "A Disciple of Bacon," and with the aid of old-style type and paper, the views of the patentee whose invention we described on p. 176, have been presented to those who are sufficiently interested in aërial navigation to purchase "The Dragon-fly or Reactive Passive Locomotion."

A photo-electric battery has been devised by M. Saur, we are informed, which consists of a square vessel of glass containing a solution of 15 parts of common salt, 7 of sulphate of copper, and 104 of water, a porous vessel containing mercury being placed in the solution. In the saline solution is an electrode of sulphuret of silver, and in the mercury an electrode of platinum.

At a recent meeting of the Physical Society, Prof. S. P. Thompson stated that in the *Journal de Paris* for 1802, there is a note describing the voltaic arc between carbon points, as produced by M. Etienne Gaspar Robertson at Paris in that year. Laboratory notebooks at the Royal Institution indicate that Sir Humphry Davy experimented with the arc quite as early. Prof. Thompson also exhibited a telephone made by Reis, at Frankfort, in 1861, expressly designed for transmitting speech.

Mr. J. S. Lewis, C.E., of Birkenhead, has recently introduced a self-binding telegraph insulator, patented by him. The Post Office authorities, after a trial, have determined to make a thorough test of its merits, and several railway companies are following suit. The new insulator dispenses with the use of tools, and the wire is fixed in two seconds. The insulator is provided with a coarse conical screw; and a horse-shoe clip being attached to the line wire, the coned portion of the insulator is passed through the clip, when a turn and a quarter clamps the wire rigidly in place. The insulator can be applied in any position and with any sized wire.

Mr. Ellis Lever has offered a premium of £500 to any one who will invent the best portable electric lamp for use in coal-mines.

The sixth edition of Mr. C. E. Stretton's pamphlet on "Railway Accidents" is issued. It contains some additional pages of matter, and two extra plates illustrating the Hugstetten accident. One of these is from a photograph, and the other is a diagram showing the positions of the vehicles of the wrecked train; both illustrate the terrible effects of "telescoping" and "piling up" produced by the absence of adequate brake-power in the rear.

A number of standard and clinical thermometers, made by Mr. S. G. Denton, of Hatton-garden, have been tested at Kew for over 12 months, and, according to the official certificate, the zero has remained constant. The instruments were made in the spring of 1881, and were shown at a recent meeting of the Meteorological Society.

Some curious information about adulterating practices, by which the French are victimised, is given in a recent report by M. Girard, Director of the Municipal Laboratory of Paris. Taking currant-jelly as an example, this is often made from an alga, the colour given with fuchsine, and the perfume with an essence which has not a drop of currant-juice in it, but is composed of acetic ether, 5 parts; tartaric acid, 4; benzoic acid, 4; succinic acid, 1; aldehyde and œnanthic acid, 1. M. Girard also gives the composition of nine other combinations, with which the essences, of rasps, melons, apples, pears, &c., are imitated. With regard to flour, of which about 16 million kilogrammes is consumed in France every day, the most culpable adulteration consists in mixing with it mineral products, often of poisonous nature, such as compounds of lead, copper, and zinc, sulphate of lime and chalk. It has been certainly ascertained that artificial flours are imported into France from Rotterdam, containing as much as 30 per cent. of plaster and 20 per cent. of sulphate of baryta. Of 31 flours examined at the laboratory, 18 were found adulterated, and only 13 genuine. In the mode of making bread, again, frauds are practised, such as baking insufficiently to make more weight. Considering the number and importance of alterations, the Conseil d'Hygiène of Paris lately applied to have certain conditions of manufacture imposed on bakers, and since this course was adopted there has been considerable improvement.

A simple, but little-known, method of having hot water in the morning for toilet or domestic purposes is described by a correspondent of *La Nature*. It consists in filling a wrought-iron ball the night before with boiling water, covering it with a considerable thickness of wool, and placing it on a chair. In this way he prepares his supply at 9 p.m., and next morning at 5 finds the water at a temperature of 60° or 70°; at 7, it is still at 50° or 53° Cent.

A short time ago, Dr. Burcq produced evidence that workers in copper, who absorb a considerable amount of copper dust, enjoy, to a large extent, immunity from cholera, typhoid fever, and other infectious diseases. Salts of copper often, too, protect various materials from parasites. He has lately suggested that cupric impregnation be tried as a preservative against infectious diseases, and also copper salts administered as a remedy. Again, the wood of houses, ships, &c., often becomes a receptacle of contagious matter, which proves extremely hard to get rid of; and Dr. Burcq points out that it might be well, both from an economic and a sanitary point of view, to use, in building huts (*baraquements*), wood injected with sulphate of copper. Articles of furniture and clothing might also be advantageously treated with copper.

An inquiry has been recently made, in France, into the production of paper throughout the world. It appears that there are now 3,985 paper-manufactories on the surface of the globe, and that these produce annually 952 millions of kilogrammes of paper made from all sorts of material. About the half of that quantity, or 476 million kgr., is utilised for printing properly so-called. Journals alone employ annually more than 300 million kgr., that is about 822,000 kgr. per diem. The consumption of paper for journals has increased nearly *one third* in less than ten years. Governments consume annually, for their administration services, 100 million kgr. of paper; schools use 90 millions; commerce 120 millions; industry, 90 millions; private correspondence, 52 millions.

In the course of this winter all the Imperial theatres of St. Petersburg, the Maria Theatre (Italian opera), the Grand Theatre (Russian opera and ballet), the Michel Theatre (French and German comedy), and the Alexander Theatre (Russian and German drama), are to be lit with the electric light. The manager of these theatres has signed a contract with an American company for the purpose.

It has been decided in Belgium to intrust certain posts in connection with the State Railways to women. The Minister of Public Works has published the conditions of admission. Candidates must be (1) of Belgian nationality; (2) aged 17 years at least, or 28 at most; (3) exempt from all infirmities or vices of constitution incompatible with the service; (4) able to give a security of 1,000 francs; and (5) must live *en famille* in the locality where employment is desired. An examination is to be made as to knowledge of the French and Dutch tongues, also English and German, writing, elementary arithmetic, the geography of Belgium and of Europe, management and book-keeping.

A mechanical mouse, selling at 15 centimes (say 1½d.), has appeared in Paris. By pulling at a cord which represents the tail, a double cone on an axis under the metallic body is rotated, unwinding the cord, but also winding up a thin strip of caoutchouc. The mouse being put down and liberated, the reaction of the caoutchouc makes it run forward, while the tail, of impossible length, is wound in.

L'Electricité says electric new year's gifts in Paris will this year be more brilliant than usual. Attention is called to a very convenient piece of apparatus devised by M. de Combettes for demonstration of the working of a Morse telegraph; also a box containing, in a number of divisions, various images formed of light material, to perform curious somersaults, &c., when a rubbed caoutchouc plate is presented to them.

M. Haton de la Goupillière, the French Chief-Engineer of Mines, has lately described, in the *Annales des Mines*, a simple means of descent into mines of small depth, which has been used for some time in Australia, but (to his surprise) was new to him. The method consists in placing a winch over the mine, and winding a rope a few times round the drum. The miner attaches to one end of the rope a bag of sand, weighing about 50kgr., also one end of a second rope, which, like the first, has terminal hooks. The bag is let down to the bottom, then the miner forms a loop at the up end of the first rope (by hooking a knot), gets into this, attaches the free end of the second rope (so forming an endless cord), and lets himself down, with the rising rope between his legs; the bag acting as a counterpoise. On nearing the bottom he slackens his speed by grasping the rope. When he wishes to ascend again, he does so easily by pulling with an effort slightly greater than the difference of his weight and that of the sandbag. When a number of miners wish to descend, the method is somewhat modified.

Blood, it is known, forms a very rich manure; in the dry state it contains 15 to 17 per cent. of nitrogen. An improved way of treating it for the purpose has been brought before the Paris Academy by M. Delacharlonny. Treatment with (neutral) ferric sulphate, as hitherto practised, prevents putrid decomposition, and the pasty mass is dried in suitable apparatus; but the operation is long and costly, the soft paste produced being difficult to dry. In the new process, *acid* ferric sulphate is used. The elimination of water does not increase with the quantity of acid added to the neutral sulphate, but a maximum effect is had with a composition whose formula is $Fe_2O_3 4SO_3$. Nearly half the water is eliminated; in a few minutes after mixture, a firm elastic paste is produced, and after standing a few days, water separates, by mere drainage, to the extent just stated, giving a sort of porous friable cake. Desiccation may also be effected in the cold state by compression with a hydraulic press. It is further mentioned that the new salt forms a hydrate which crystallises easily.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE "MEMOIR OF PROFESSOR DE MORGAN"—THE ENDOWMENT OF RESEARCH IN PRACTICE—COMPETITIVE EXAMINATIONS—MENACING COMETS: WITH A VENGEANCE—THE DIURNAL INEQUALITY OF THE TIDES—ERRATUM.

[20750.]—I have not yet seen the "Memoir of Augustus de Morgan" by his wife; but if I may judge from the review of it which appears in the current number of the *Athenæum* (that for Nov. 14th), I imagine that it must be as instructive as it is amusing. Notably would this seem to be the case as regards that portion of the work which treats of the connection of its eminent subject with Babbage and Sir James South; illustrating, as it does, what the Endowment of Research really becomes in the concrete, as contradistinguished from the "high falutin" description of it and its results in the abstract, with which we have been favoured during recent years by certain (not wholly disinterested) persons. Of course it will be within the memory of many of my brother-readers how Babbage invented a calculating engine—or rather more than one; but it may be news to others that the Government actually spent upwards of £20,000! over this matter, and that even then the machine was not constructed. However, by that time the worthy predecessors of Messrs. Mundella and Co. took alarm, and refused to endow Mr. Babbage with any more of the National funds with whose administration they were entrusted, and, in the words of the reviewer, he "spent his life in abusing the Government and in quarrelling with scientific men who would not recommend the Government to continue their grants." Of Sir James South, the writer of the article from which I am quoting, goes on to add that he "was also an advocate of the endowment of research, who thought himself ill-used by his contemporaries. He had obtained a pension of £300 a year from the Civil List, but desired further aid." I am old enough to remember De Morgan in the flesh, and can well conceive with what withering scorn the grand old mathematician must have regarded all such contemptible mendicancy, and how freely he would have expressed himself with reference to the more recent illustrations of the same spirit, by which British science has been degraded and dragged through the mud.

Another institution now rampant among us, that of Competitive Examinations, seems to have been held very cheaply indeed by De Morgan; who endeavoured to deprecate it whenever and wherever he could: succeeding in securing the acquiescence and sympathy, if not the active co-operation, of Sir John Herschel and Dr. Whewell in the matter. De Morgan himself was, we read, "a most successful teacher, and he held that he could judge of the merits of a competitor from his whole work; but he always refused to reckon the merits by marks. He suggested that perhaps our ancestors' system of disputations, in which a man read a dissertation on a subject of his own choosing, and could be cross-examined on his own argument, was preferable to the method now in vogue. With such a system of examination many would be plucked for not understanding their own meaning." This last sentence is to me the most pregnant of all. How many of the candidates who are crammed up to the very muzzle really "understand their own meaning" might form a curious subject for statistical inquiry. I doubt if a gentleman did, of whom I have heard within the last three weeks, who actually wrote "*Prix*, the price, *frumenti*, of corn, *cecidisset*, had fallen, *ut* as, *hominissimi* most men, *dicunt* say";

and was both surprised and indignant that he didn't pass!

Prof. Piazzi Smyth must really look to his prophetical laurels; inasmuch as a serious rival to him in his peculiar line of vaticination would seem to have arisen, in the shape of M. Faye, the French astronomer. This Gallic genius, as I learn from a morning paper, "attributes the present plague of waters to the innumerable host of comets, great and small, which have traversed the heavens during the past twelve months. His theory is that the comets, absorbing the greater number of the solar rays, deprive our planet of the necessary amount of heat for the absorption of its atmospheric vapour. Such conditions, according to M. Faye, induce continual rains, storms, and flood. Should the comets continue as numerous for several years, as they have been during 1882, M. Faye, seriously anticipates no less a disaster than that the earth will be rendered barren and uninhabitable." Does—I ask, in the utmost anxiety, on reading this terrific prediction—does the Great Pyramid say nothing about this horrible result of (so to speak) a congestion of cometary traffic? By the bye, though, 1882 was, I believe, to witness what Mrs. Gamp described as "the hend of all things"; so that M. Faye's forecast doesn't so much matter, after all. There seem to me to be physical difficulties in the way of the world being destroyed twice over; besides, once will answer every practical purpose.

Mr. Hartshorn (query 48644, p. 260) may find a solution of his difficulty in the reflection that the tides are essentially a phenomenon dependent upon *differential* attraction. He must know that the force of gravity varies inversely as the square of the distance of the attracting body. This being so, we see at once that if (as is actually the case) the Moon is situated at a mean distance of 238,840·25 miles from the Earth's centre, she can only be 234,877·48 miles from that point on the Equator immediately beneath her; and, consequently, that she must attract the water under her to a greater extent than she does the Earth's centre, in the proportion of $238{,}840·25^2 : 234{,}877·48^2$. Hence the heaping up of the water under the Moon. But, again, the Earth's centre is nearer to the Moon than the most distant point of her circumference by 3962·77 miles; and, therefore, the Moon will attract the centre of our globe more powerfully than she will the opposite extremity of that terrestrial diameter passing through both bodies in the ratio of $242{,}803·02^2 : 238{,}840·25^2$, and, so to speak, pull the Earth away from the water on the opposite side; which will hence be left as it were heaped up.

In letter 20724, p. 249, col. 1, line 30 from the bottom, "soon to see again" appears where I wrote "ever to see again."

A Fellow of the Royal Astronomical Society.

THE GREAT COMET.*

[20751.]—As it must be universally admitted that the magnificent comet now receding from our sight is the most interesting, in a popular as well as scientific point of view, of any that have appeared for many years, will you allow me to add the record of a very remarkable phenomenon to the somewhat scanty details respecting its aspect which have as yet been laid before the public? In an extremely valuable letter received by me this morning from a very able and careful observer, Mr. J. T. Stevenson, of Auckland, it is stated that on October 6th and 10th an "anomalous" tail was feebly but distinctly visible, pointing towards the sun. Your astronomical readers will remember that a similar "glowing wake" attended the returning course of Newton's great comet in 1680, distinguished, like the present, by its close approach to the surface of the sun, and a few more cases might be cited. It is, however, of such infrequent occurrence that another instance forms a valuable addition to our stock of information as to these mysterious bodies. I ought to mention that Mr. Stevenson's letter was despatched immediately after his last observation, so that we may hope that, with a climate and position of the comet giving him great advantage over Northern astronomers, he may have been able to trace this singular appendage on subsequent occasions.

T. W. Webb.

Hardwick Vicarage, Hay, Nov. 17.

CASSEGRAIN AND GREGORIAN TELESCOPES — EQUATOREAL STANDS — HYDRO-DYNAMIC PARADOX, &c.

[20752.]—THOSE of my friends who know me to be a tolerably correct draughtsman will, I fear, be rather surprised at the diagram which appears in my letter on page 205. I hope I may, therefore, be allowed to say that the woodcut bears but a faint resemblance to the original drawing.

It has (despite a special request to the contrary) been reduced to half-size; the curved mirror of the Gregorian has been changed to a straight line, the distinctive "dot and dash" lines are ignored, and the reference letters mixed up with the lines themselves. So, too, in the letter-press there are several errors; but for this I suppose my admittedly bad handwriting must be held responsible. Certainly the result, as a whole, is unsatisfactory, after the trouble I took to put the matter clearly.

Equatoreal Stand.—I must differ entirely from your correspondent, "An Amateur" (page 182), as, so far from the differential method "failing entirely," it is in constant use, and is found perfectly easy and very convenient, as I stated in my first letter on the subject. From his remarks I doubt whether "An Amateur" is in the habit of himself using an astronomical telescope.

Replying to "C. J. E.'s" request for a drawing of the stand, I fear it would suffer the fate of the diagram above referred to: otherwise I should have been happy to send it up for insertion in our columns.

Hydro-dynamical Paradox.—For some unknown reason my last letter on this never appeared; but I must protest against the sketch on page 229 being called "a copy of 'A. S. L.'s' figure," as the principle is rendered quite unintelligible by the reversal of the position of the curved passage through the boss. I can add nothing to the explanation I originally gave of the fallacy, except that there is the question of the pressure of the air acting on the bellows during their expansion by the weight.

A. S. L.

OLD METHODS OF WORKING AND TESTING SPECULA.—TO MR. WASSELL AND "ORDERIC VITAL."

[20753.]—BY a most curious coincidence, at the very time Mr. Wassell must have been writing to ask for information on these subjects in our columns, I was engaged at the British Museum Library in making notes from the writings of the Mr. Edwards to whom he refers.—As it may save others the long search which I had myself to make, I may mention that the description appears as an appendix to the *Nautical Almanac* for 1787, of which the Library Press mark is P.P. 2373m. The details there given are very interesting in their difference from modern ideas and methods. A great deal of information is given on the experiments with different alloys, of which I may mention two, the first being that used by Mudge, of copper 32 parts and tin 14½, stated to be "too yellow," and that found by Edwards to be best of all, he tried—viz., copper 32, tin 15 to 16, brass 1, arsenic 1, and silver 1.

It is recommended incidentally to use crown-glass for the eyepiece lenses, in order to neutralise any colour produced by the speculum.

In grinding, the hollowing out is stated to be most easily done with a grindstone curved at the edge as may be required. The rough grinder of lead and tin or pewter. Then a species of hone procured from Edgedon in Shropshire was employed, and it is directed that the diameter of this should be about ½ of an inch larger than the mirror for a speculum of 4 or 5in. diameter.

The next is a most remarkable point—viz., that "the metal must not be too thick, or the parabola will not be reached." For a mirror of 4½in diameter and 18in. focus, a thickness at edge of $\frac{1}{10}$ of an inch is recommended, as a certain degree of flexibility was necessary to allow the mirror to, as it were, follow up the polisher in its movements. The grooving both of polisher and of pitch is referred to, such grooving being stated to be intended to allow the pitch to expand, and a mixture of equal parts of pitch and rosin, spread to the thickness of half a crown, is given as a good medium, "Coleothar of vitriol" (as it is there called) being the material employed to give the polish.

It is also stated that the polisher must be *an elliptic tool*, with the diameters as 10 to 9, the shortest diameter of the ellipse being accurately the same as that of the mirror; and it is added that for "small mirrors" it is best to have a central hole in the polisher, even though there is no hole in the mirror. I presume this refers to the *small* specula of Gregorians, rather than to the mirrors of Newtonians. We next come to the testing of which it is said that since "the small mirror is always spherical," the testing is applied to the large mirror when in its place in the telescope.

It is remarked "Mudge uses diaphragms"; but no account of this method is given, though reference is made to his paper in the "Phil. Transactions"—a reference, however, which I failed to find, as the date is not given.

Edwards' method of testing is then given nearly in these words.—Set up, at a distance of 50 to 100 yards, a disc on which is described a circle half an inch diameter with a broad black margin. On looking at this, and altering the focus, the edge of ring becomes hazy. If the haze becomes more distinct, and the edge of it better defined when the focussing screw is turned to the right than when it is turned to the left, then the figure is spherical; while if the haze becomes most distinct when the screw is turned to the left the figure is hyperbolical; whereas when the haze is equally well defined within and without the focus, the figure is parabolical. This is for the Gregorian. In the Cassegrain the conditions are reversed. I may add that I also chanced to come across some particulars of the polishing of Lord Rosse's specula, and find the following details. The polisher made 80 strokes per minute, and 24½ backwards and forwards for every revolution of the mirror, and at the same time $1\frac{73}{100}$ strokes transversely, the extent of the latter being $\frac{23}{100}$ of the diameter of the mirror. The polisher also revolved in its carrier-ring at the rate of one revolution for every fifteen of the mirror. In conclusion I would desire to thank "Orderic Vital" for his very interesting letter, with reference to which he will see from the above that the small mirror is expressly stated to be "always spherical," though (somewhat in contradiction) the great mirror was tested to find its truth as a parabola, when it *ought not* to be of that figure, if used with a spherical small mirror. Trusting my notes and extracts may (as far as they go) be useful to Mr. Wassell and others, I may now wind up my long letter.

L. L. L.

FLATS OUT OF PLATE-GLASS.

[20754.]—RE LETTER (20731), to Mr. Holmes, by "Prismatique." Most of this letter is, as he says, mere war of words; but one or two things in it, implying my statements are wrong, while avoiding distinctly saying so, require a short comment on my part. Whether the colour-test was good and reliable was the question, not whether it was workmanlike. "Prismatique" can settle this with Dr. Draper and Mr. Brashear. With respect to annealing plate-glass, the statement that it cannot be ground and polished unless annealed, every workman knows to be incorrect. All plate-glass is annealed, but not so perfectly as to remove all variations of material. On the contrary, every one who has the smallest experience of cutting it with a diamond, knows that he will often find places so hard that the diamond will scarcely touch them, while on each side is quite soft. I again challenge trial by "Prismatique" of the facts. I probably know much more of plate-glass than he does, although he implies with his "goodness gracious!" that his knowledge is so perfect as to be past all chance of modification. There is a habit of falling back on this assumed superiority of position on the part of some writers, which may impose on others who go no further than mere assertion.

One other remark, which I invite anyone to test—the fact that polarised light is inadequate to discover internal strains in glass, which are quite sufficient to pull the surface out of all optical truth. Polarised light will only show gross departures from uniformity in pieces of small thickness. This I have proved by subjecting pieces to intentional strains, and by intentional hardening and softening of parts, when a Nicol prism would not give the least indication of any alteration. For the rest, there are more ways than one of arriving at truth, and no doubt "Prismatique" can make a perfect flat by other means. *That* question has not been raised.

With regard to choice of the two classes of instruments, the opinion of "Prismatique" is entitled to much greater weight than mine. I should like to ask him why he would prefer a 4in. refractor to a 6in. reflector? The answer would probably be instructive, since his opportunities have undoubtedly been great. My small experience has led me to think that a 6in. reflector would have as much light and better definition than a 5in. refractor—while being handier in use and much more comfortable—besides the small matter of economy, which has little weight with those who live on the profits. Will "Prismatique" oblige with a statement of the advantages of a 4in. o.g. over a 6in. mirror? I ask for instruction, not argument.

Edwin Holmes.

JERK IN RAILWAY TRAINS.

[20755.]—As a frequent traveller on Metropolitan trains making frequent stoppages, you may perhaps allow me to say that only Mr. Stretton appears to have understood the question of "S. J." on p. 161. If that gentleman will travel on the North London, preferably in the third class, he will experience this "jerk" to perfection, especially if he should ride in the end compartment, when, often, the brim of his hat will be brought into forcible contact with the end of the carriage. From those remarks it will be understood that the question has nothing whatever to do with the position of the passenger, and Mr. Molison's advice (p. 230), good as it may be, has nothing to do with the query. Considering the fact that this gentleman is a "science teacher," his letter is a remarkable instance of how *not* to answer a question—an art in which, I am credibly informed, "science teachers" are as a rule experts. His explanations of the "jerk" are of the usual text-book order, and unfortunately do not apply, for the jerk referred to is that which takes place when the brake is released, or when the train, having come to a position of rest, the buffer springs exert their power. The effect varies with the nature of the brake used. It is most effectively exhibited by the chain brake, for with that, if you rise and get out the moment the train stops, you will not be subjected to a jerk; but if you hesitate you will feel the full force of the jerk imparted by the carriage recovering itself as the brake chain is slackened by the aid of the balance-weight. This effect is, I believe, more definite at the end of the chain furthest from the brake-handle; but certainly if the passenger follows Mr. Molison's advice, and does not rise from his seat until the train has stopped, he will most decidedly experience the jerk. He must either rise and make his exit at the moment of the stop, or he must sit until after the rebound. With the Westinghouse brake, on the contrary, the passenger can rise and vacate his seat at any time before the brake-blocks are released, which should not be done until the driver is about to start again—the only jerk being that referred to by Mr. Stretton, which occurs just after the train stops, when the carriages right themselves. With carriages properly coupled up, there is practically no dangerous jerk with either the Westinghouse or the vacuum brake, the severest jerk occurring at the moment the brakes are applied. Not a few persons have been injured in London by the jerk above mentioned. I hope Mr. Molison will not object to these remarks because they are made over my usual signature (I observe he is one of the carping critics); but if so, if he will advertise his address, I shall be happy to send him my name, age, weight, and any other particulars he may desire. **Nun. Dor.**

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* From *The Times*, Nov. 21.

THE MULTIPLE-PLATE VOSS MACHINE.

[20756.]—With regard to letter 20744 in the "E. M." for Nov. 17, 1882, I sincerely hope that Mr. A. R. Molison will give us a description of the construction of the multiple-plate "Voss" machine. No one who knows the construction of the "Holtz" in its various forms can pretend for one moment to say that there is anything either new or original in the Wimshurst machine, always assuming that the construction has been correctly described; in fact, after I had read the description in "Ours." I was somewhat surprised to find that it was considered sufficiently original to merit an engraving. I believe I am right in saying that for some few years now, Mr. Ladd, of Beak-street, W., has made and sold an almost precisely similar machine, also to be worked in a glass-case to protect it from moisture, &c. I have myself used glass slips, instead of a stationary disc in the Holtz, but with questionable advantage when portability is an object. **M.D., L.R.C.P.**

LEGAL REPLIES.

[20757.]—Coal Club—Payment (48618.)—The coal-merchant is quite right in saying that the treasurer was selected by, and was the agent of, the club. He could not, therefore, be made a loser by the treasurer's defaults. A new contract seems to have been made with regard to the 14 tons now being delivered; and as to this he can clearly charge the members who receive his coals, even though they have paid subscriptions to the defaulting treasurer; otherwise the coals would not be paid for by anybody. The members and managers of these clubs should see that the money was paid into the bank, as well as take care how it is drawn out again.

Annuity—Married Woman (48628.)—In this case it would be as well to know how the annuity was left by the will; for it is very likely to have been given to A. for her separate use, and so would be independent of any husband she might afterwards marry. But in any event, if the husband did not sell the annuity, he could not give it away by his will, although he might be entitled to receive it during his lifetime. At his death it would therefore survive to A., and she would be entitled to receive it in the same way as she was before her marriage.

Married Woman's Property Act (48630.)—It is impossible to answer this question without knowing when the woman was married, and also how the money came to be invested in the joint names as it was. But as the brother is called a trustee, it is very likely that the fund has been already settled, and so is quite safe from the husband's creditors. If I knew more of the facts, I could answer more decidedly.

Right of Way—Sewage—Prescription (48646.)—The first point here is, whether A. had any leave or licence, verbal or in writing, to run his sewage over the adjoining land, and this is not stated. A right of way for sewerage can only be acquired by grant or by prescription. If there is no grant, then D. must show an uninterrupted user of the right of way for sewerage for twenty years. As far as the question goes, I do not think he can do this; so that I am of opinion that C. may take up the pipes in his own land, and so break the connection. But these points as to rights of ways and watercourses are full of difficulties, and C.'s conduct may have amounted to such a delay and acquiescence as would prejudice his position. I must, therefore, answer under all reserve, unless I know the whole facts more fully.

Agreement—Stamp (46836.)—An agreement in writing and simply under hand without a seal, below the value of £5, being expressly exempted by the Stamp Act 1870, will not require any stamp. But it may amount to a receipt or a promissory note; in which cases it will require to be properly stamped as such. If the agreement shows upon its face that the matter it relates to is under £5, then, of course, the case is clear; and where no value is stated, it is for the person who alleges a stamp to be necessary to prove it is for £5 or over.

Post Office Savings Bank—Administration (48652.)—The querist can take out letters of administration; but to do this will be troublesome and expensive, as other relatives may have to be cited. As the sum in question is under £50, the best way to proceed is, after two months from the death have fully expired, to apply to the Post-office authorities to divide the sum in question between the relatives entitled, without there being any administration. This they can do under the regulations as to Savings Banks, which may be found in any quarterly "Postal Guide"; and with that view the querist had better get the proper form from any Savings bank, and fill it up with this application.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

MEDICAL REPLIES.

[20758.]—Enlarged Arm (48530).—Probably a case of elephantiasis (*Elephantiasis arabum*). If so, not curable. Probably due to enlargement of the lymphatics of the limb. Let it alone, and be thankful that it did not come till the patient was 73 years of age.

Discharge from the Ears (48545).—Keep ears clean by syringing them out every night at bedtime with warm water, softened with a little soap. If disease of the ear affects the bones, and spreads internally, it often becomes a fatal disease. If headache, or other symptoms indicating such tendency, persist after the external passage is cleared out by the syringing, the child needs local medical aid. Improve his general health by flannel clothing, and the oatmeal porridge and milk diet, with fat bacon, for details of which refer to replies in former numbers of the "E. M."

Weak Sight (48558).—"A. B. C." has been smoking since he was 15, and, finding his sight beginning to fail at 30, begins to wonder whether this is the result of the tobacco. Probably it is. The use of tobacco is a fertile cause of injury to the optic nerve, and the earlier it is begun the more injurious it is. If you have an enemy, make him a present of your pipes and your present stock of tobacco, and use no more. Improve general health by diet and regimen indicated in former numbers. If sight does not improve after two months, Swift & Son (whose advertisement will be seen upon front page of "E. M.") will measure the refraction of each eye, and give you glasses that will correct any error in the refraction. In eyes that do not focus correctly and at equal distances, the early use of glasses is necessary. The general excitability is also probably caused by the tobacco. People who have not mastery enough of themselves to keep quiet during their times of rest and leisure had better take to sucking their thumbs than to the use of tobacco.

Gout (48647).—The hot water may be taken regularly and continuously until the urine becomes normal in colour and free from deposit on cooling. The water may be drunk hot, or warm, or cold, to suit the taste of individuals. I find that the hot water—taken directly on waking, at comfortable temperature like a draught of hot tea—is absorbed, and passes off through the kidneys the most quickly. Some people feel at first a little sick on taking the water hot, some on taking the water warm, and on taking the water cold some people feel a little chilly and depressed. The effect of this morning draught of hot water upon an empty stomach is to dilute the blood and run off through the kidneys, thus rinsing out the urinary passages, and keeping the system clear of the deposits which are so apt to form in persons who have the gouty diathesis. Practically, the patient does not drink so much tea and coffee at breakfast-time, and this again is an advantage. The object of drinking is to liquefy the blood when too much thickened by cutaneous or pulmonary exhalation in hot weather or under free exercise. Unless the blood contains water that can be comfortably spared, the elimination of effete matters by the kidneys is checked, and these matters accumulate in the blood. Spare water in the blood acts as *the vehicle*, in which effete solids and salines are carried off by the kidneys, and unless spare water be present, they cannot be got rid of, as they are not susceptible of exhalation by the lungs or skin, which get rid only of volatile matters, such as aqueous vapour. Unfortunately, instead of drinking *water* when thirsty, which is the only true solvent for the food, and the only true diluent for the blood, we get into the habit of poisoning our water with tea, coffee, alcohol, and other substances, which should not be taken merely because we happen to be thirsty. The morning draught of hot water is in no way injurious, either to the kidneys or stomach.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

DRILLS AND CHAMFERS.

[20759.]—"Alfojoe" is, no doubt, very correct in his theoretical exposition of drill-making; but, at the same time, I consider that it is only a small percentage of his readers that will find his method available in practice, inasmuch as it requires the hardening and tempering of the drills, which, generally speaking, will be found to be an insuperable obstacle, at least, for drilling into hard metal. In fact, to harden and temper steel to that degree that will make it fit for boring into steel itself, is one of the most difficult operations in mechanical work, and may, properly speaking, be said to be altogether beyond the power of unprofessional hands. Instead, therefore, of following "Alfojoe's" plan, I propose to submit my own method of drill-making for the boring of hard metal; having some experience in that kind of work, and, as I consider, it will be found serviceable to not a few. For making the drills I select steel, hardened to the highest degree consistent with a suitable temper, and it should always be of a degree higher than what is barely necessary for the purpose, because, the harder the drill-head, the quicker and neater it does the work. I generally use sewing-needles for making the drills, but there is only one manufacturer—Holyoake of Redditch—whose needles I find to be at all fit for that purpose, and this fact alone must be enough to show the difficulty of fine tempering. As I do not anneal the steel, and as it would be thus out of question, on account of its hardness, to file it into shape, I make the drill by corroding the needle with aquafortis, diluted with a little water, to which must be added a little spirits of salts, or else a bit of washing soda to make it act immediately. The fluid is to be poured into a small vessel (not metallic), such as the pans used for mixing artists' colours, or else inverting a tea-cup pour it into the recess formed by the bottom rim of the cup. Then place the needle horizontally across the surface of the fluid, and keep continually turning it round until it is reduced to the thickness of the hole required to be made, which generally takes from five to ten minutes. When that is done, you have still further to thin the shank to give it a "clearance," which you can do by inclining the needle upwards, so as to have the part intended for the drill-head above the fluid and, therefore, unacted upon, and finish off by applying a piece of wood steeped in the fluid. The needle will then have a shank, with a bulbous knob at the end (the shank being made no longer than what is just necessary, and generally not more than a third of the length of the needle), and it is to be cut across in the middle of the knob; or, better still, burned off with the corrosive fluid, and the drill-head made and sharpened with an emery file. Finally, the sheaf is put upon the drill, the hole in the sheaf being opened to the right size with a broach, though it will also do well enough to fasten the drill with sealing-wax to the stump of another drill that has a sheaf upon it. **Tubal Cain.**

DIE-CUTTING.

[20760.]—I am much obliged to "R. Crusoe" for so speedily answering my request. The information he has given has interested me much. I had intended last week writing to ask him if he could describe the machine used for sinking medallions. In some of the early volumes "Jack of All Trades" described and illustrated a machine for wood-carving, that is, copying from a model; but I never was able to make out the construction from the description given. I should much like to have it explained, as I presume the one for die-sinking must be on much the same principle. **F. C.**

[20761.]—I am sorry I cannot give "M.M.I.Sc.S." any particulars of the machine for cutting dies on a reduced scale from a large model; but it is constructed on the principle of the pantograph, so commonly used by surveyors to make reduced copies of maps and plans; the pencil being replaced by a revolving cutter, and the framing made perfectly rigid and of great strength. There are, I think, very few of these machines in use. Messrs. Wyon, of Langham-place, Regent-street, possess one; and Mr. John Pincher, of 27, Oxenden-street, Haymarket, has another. These are, I think, the only machines in London. Mr. Pincher will, I believe, undertake work for outsiders. The machines usually produce a "punch" from a model in relief, but can be made to sink a die from the cast of a model in relief.

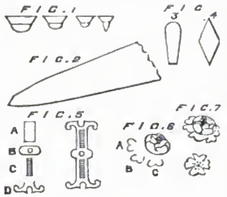
In London, any implement that, by pressure or concussion, produces an indentation, is called a "punch." I think "hub," in the Midlands, signifies only a punch used for making a "die."

Die-cutting and sinking, which includes seal-engraving and the making of dies for coins, medals, buttons, gold and silversmiths'-work, and the stamping out of ornamental work in brass, copper, and nickel, as well as non-ornamental work in the baser metals, as dish-covers and many classes of hollow ware, including ships' boats in sheet-iron, is too large a subject to be treated of in a paragraph.

R. C.

DIE-ENGRAVING.

[20762.]—The tools required are about four cutting chisels (gravers) about 6in. long, forged from square bar-steel, say ⅝in. diameter; they should be left the full size of the rod, at about ⅓ of their length from the cutting edge, and drawn down by a good smith to about ¼in. at each end, the square corners just hammered down to make the section a square with the corners off, and not an octagon. A badly proportioned tool will be constantly breaking at the point, unless the temper is so low as to make it almost useless. Fig. 1 is the end-on view of the cutting-edge (all are half-round); Fig. 2 side view



of same; Fig. 2B, whole tool in miniature. The hand-gravers for finishing you can buy at "Buck," Holborn-viaduct, or similar shops. Those used by copper-plate engravers will do very nicely, if you break off about an inch: otherwise they are too long and weak. Procure two of the section of Fig. 3, and four of the section of Fig. 4; do not select flimsy ones. After softening, file the belly of all of them, slightly rounding like Fig. 2, which is your pattern for all. Leave one of Fig. 3 almost the width of the steel, and the other about ⅔rds of that one. The four tools of Fig. 4 are to be filed like Fig. 1; the belly the half of a flat ellipse; this makes a very stiff tool. Most amateurs make all their tools too light—the point is sure to go if there is any vibration. You may safely use tools of a very hard temper, if the point is nearly in centre (see Fig. 2), and they are also rather gouty in the place where there is likely to be the greatest vibration.

Fig. 3 is chiefly used to perfect the work round the edges. Next you will require any number of punches, from 2 to 2½in. long, both ends drawn down till they are nearly in the shape of a skittle; but the section is square with the corners off.

Lastly, if you are doing light work, like monograms, procure a heavy piece of metal, the heavier the better, to fasten the die on (side screws are better than cement). Use a heavy hammer for punching. For heavy work, a block of wood (smaller over than a butcher's block) is partly buried in the ground, standing out of ground just a comfortable height to work at standing. A blacksmith's sledge hammer, with the handle sawn off to 7 or 8in., will drive a punch $\frac{3}{16}$ to ¼in. square on face easily.

Caution.—If the hammer has been used till the face is highly polished, and there is a film of very hard condensed steel, by all means put it in the fire and bring it to a dull red. If you neglect this, the punch will fly through the window, and the hammer come down on your thumb, which you will then have to put in your mouth, and howl dismally. General rules.—Punched work always looks better than cut work, and it does not take longer to make a punch with fine file and graver than it does to cut direct on die.

Do not attempt too much on one punch. Take several punches, and cut one detail on each. Before you harden the punch, hammer it into a piece of brass, and take a squeeze.

The tools, Figs. 1 and 2, are, of course, used with a lighter hammer. A carpenter's hammer will do, but one with a broader face is better. The example, Fig. 5, would be very easy *with* punches, and every punch would be worth saving, as they might be useful for a very different pattern.

To proceed. Drive punches *a*, *b*, and *d* very lightly; then go over the whole with the hammer or hand-graver, according to the depth required. Again drive punches: file surface of die to get rid of the steel that has risen all round, and take a squeeze. I have supposed a hole drilled in punch *b*, with same drill used on *d*; if the punch *c* is not long enough, no matter. Suppose you have filed 5 fine notches, and you find you want 7, feel your punch into 4 of the notches, strike gently, and you have gained another, and so on; the same applies to *a*; either one could be used as a border of indefinite size.

One more example: To produce a rose.—Cut a punch like a rosebud, drive it in to mark the place, then remove enough steel with first or second tool, Fig. 1 (with hammer), drive punch again, file surface, and take a squeeze; make 3 punches, *a*, *b*, *c*, Fig. 6, deep at the outline, and softening to nothing close to the rose; drive to mark place, use third and fourth tool, Fig. 1, drive again, file and squeeze; and now begins a game of see-saw; by driving the loose leaves you have spoilt your rose; never mind, again drive your rose gently, it is easily felt into the same place, and so see-saw till you produce Fig. 7. The small punches would produce an anemone or something else, with only a few dots in the middle, Fig. 7.

The way to use the hand-gravers is by laying a piece of metal, say, as thick as a shilling, just behind the tool; elevate the hand, feel the point of the tool bite the die, depress your hand, pushing gently forward, and you can either take off a chip or merely scrape as when finishing.

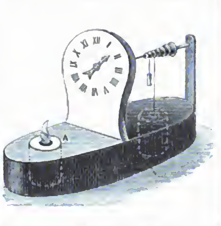
If you want to do letters or figures, you must buy an alphabet and numerals on separate punches. It is a special, and very difficult trade.

Gamma.

A NIGHT-LIGHT CLOCK.

[20763.]—In No. 848, p. 370, you illustrated and described an ingenious form of night-light clock, which had a transparent dial and a small oil-lamp within the case. A float, carrying a rack, is placed in the oil-cistern, and consequently falls as the oil is consumed; so that if the rack is made to engage with a pinion on a shaft carrying a bent arm, the latter will be projected as a shadow on the dial, and will indicate the time with sufficient accuracy. Happening to look over some early volumes of the *Mechanic's Magazine*, I came upon this idea worked out in what I think is a better manner, and I take the liberty of sending you the inventor's description, as it is possible some of your ingenious readers may be glad of the suggestion. The letter bears date, "Parson Drove, near Wisbeach, May 8, 1824, and is signed John Peck." I assume that he was the inventor, but he does not say so.

"A B are two vessels made of tin, about 1¼in. diameter, and the same in depth, communicating at the bottom by a small tube. In A burns a floating wick: in B, a float balanced over a cone-like rool by a small weight hanging on a piece of fine silk. The rool should contain several grooves, and vary in diameter from a quarter to half an inch. The gradual burning of the oil in A will cause the float B to fall, thereby turning the rool, which being fixed on a wire communicating with the hand, through the face, will point the hour of the night. It is necessary to adjust the index to the true time when the lamp is lighted, and some little attention is requisite at first to place the silk in the proper groove on the rool, which acts as a sort of regulator to the quick or slow burning of the oil."

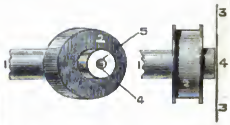


I do not think there is anything needed in addition to that description; but the rate of fall being once found for kerosene, the weight would require no shifting, provided the same sized wick were always used and about the same sized flame. I have traced the original engraving: but nowadays, of course, a chimney would be put over the flame, as a matter of precaution, though not absolutely necessary, and the whole thing might easily be made more ornamental in appearance. To me its chief merit is that it is another instance of how old inventions are resuscitated. I found it while looking for the Thames Tunnel design praised by Mr. Fowler, which was sent to the *Mechanic's Magazine* by Mr. J. Johnson, secretary to the Benevolent Institution of Smiths, on Dec. 20, 1823. About that date there was a discussion in connection with roasted rye as a substitute for coffee—a question which has recently been debated as if the use of roasted or torrified cereals were a new invention of public benefit.

Jonathan Oldhead.

SENSITIVE TELEPHONES.

[20764.]—I have sometimes noticed that the ordinary Bell telephone equals almost in loudness the transmitting power of the microphone, but at other times the sound transmitted seems very distant. I suppose this arises from the diaphragm being precisely adjusted so that the magnet almost, if not quite, touches it, and so for the time being turns it into a kind of microphone. I do not know whether anyone has attempted to make this remarkable loud-sounding result I speak of permanent. How would it do to drill out of the north end of the magnet a small segment of a circle, and insert into it a very small carbon or soft iron ball, the size of a small shot, which, when the telephone is fastened up, should rest between the concave surface of the segment and the diaphragm, touching both? If the ball was made the right size, it might be suspended in the segment below its centre, in which case the action of the diaphragm pressing lightly on it would force it slightly upwards and downwards alternately.



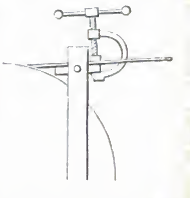
If, as I imagine, the microphonic effect mentioned arises from actual very slight *contact* between the magnet and the diaphragm, would not this secure such effect permanently?

I inclose diagram. References to sketch:—1, magnet; 2, bobbin; 3, 3, diaphragm; 4, ball; 5, concave segment.

L. B. B.

GRINDING CHISELS, &c.

[20765.]—The following simple arrangement which I have found to answer admirably for grinding plane-irons, chisels, &c., may perhaps meet the wants of "Amateur Carpenter" (letter 20717). An upright of flat bar-iron is screwed to each side of the grindstone trough, a hole is drilled through each upright at the proper height to give the required bevel, and a horizontal ⅝in. rod passed through them. A slab of wood having a ¾in. hole bored through its width, which should be about that of the plane-iron, is slipped on the rod, and to this is cramped the plane-iron, which is thus held square, and at an unvarying angle to the stone, while at the same time, to prevent uneven wear of the stone, a traversing motion can be given by shifting the slab along the rod. The angle of the bevel can be varied by fixing the plane-iron more or less forward on the slab. I should not advise using a smaller stone than 20in. A bigger one would be better.



W. A. S.

"A. S. L.'s" HYDRO-DYNAMIC PARADOX.

[20766.]—About six years ago, I made a similar machine to that of "A. S. L.'s"; it was not sufficiently loaded on the bellows to work. I found out that it required a very great amount of weight, for I had placed my fingers in the top bellows, and got a very good squeeze when the machine went backwards, which rather startled me, as I had to pull the machine forward to release my fingers. I broke the machine up, and started making one about one-fourth its size, which I never finished. In the sketch, Fig. 1, the water is forced and sucked from A to C. The machine could be used in water, and the bellows supplied with air.

FIG. 1.

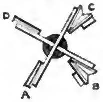
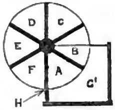


FIG. 2.

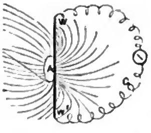


Some fourteen years ago, a machine, Fig. 2, was made in the south of London, which was correct in theory, but failed in practice, on account of the packing used to keep the water-tank tight. The machine was a cylinder, with air cells, *a*, *b*, *c*, &c., fitted with air-tight partitions; water was in the tank *g*, and packed at *h*, &c. To keep this packing water-tight caused too much friction.

Little.

FARADAY'S LAW OF ELECTRO-MAGNETIC INDUCTION—THE GORDON DYNAMO.

[20767.]—A correspondent asks me to explain some of my statements about the production of currents with reference to Faraday's law of electro-magnetic induction. The reconciliation is simple. Let A be the pole of a magnet, and W W' a straight conductor, placed in the magnetic field. The ends of the conductor are joined by a wire, C, which, according to hypothesis, is not influenced in any way by the magnet. W', W, C form, consequently, a complete circuit, and it is not difficult to see that lines of force must be added to or subtracted from this circuit whenever the wire is moved.



Attention has been recently directed to the Gordon dynamo-machine, which is said to be capable of lighting 6,000 Swan lamps at a speed of 200 revolutions per min. At present the machine only lights 1,300 lamps; but I have been told that the cores of the coils get excessively hot. There is nothing new in the machine, save its size, and from a cursory observation it would appear to be worse than some of its predecessors. Taking Siemens' alternating-current machine, or a form of that machine, with iron cores in the coils, the field-magnets are fixed to a cast-iron frame on each side of the armature; the coils of the latter, in which the current is being constantly reversed, pass between these field-magnets, and the heat generated in the coils is consequently carried away in passing through the air. In the Gordon dynamo, however, the coils in which the current is generated are fixed, and the magnets rotate. The former have iron cores, which become hot, and which being fixed to the frame, have less chance of losing their heat. To generate heat in a dynamo indicates a loss of power; but it is a loss which is unavoidable. To prevent the heat being dissipated is serious: it may be fatal to the working of the machine, and it is difficult to see how the machine is to be kept cool at a higher speed, and with much larger currents flowing through it. It is only fair to mention that when the magnets rotate and the coils are stationary, as in the Gramme, Gerard, and Gordon dynamos, no brushes are required to take the current from the coils, the wires being connected simply to their terminals. But with large surfaces of contact I question whether it is not very easy to take off huge currents of low electromotive force without excessive sparking or excessive friction; at any rate, it will be a question of balancing the loss by sparking against the difficulty of keeping the machine cool. The efficiency given is absurdly large; but we shall hear more about it in the future I have no doubt.

E.

TOLMAN'S BATTERY WITHOUT MANGANESE.

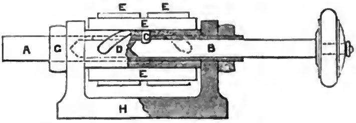
[20768.]—For the benefit of some of the readers of "ours" I may say that I have made a battery upon the plan suggested by Mr. Tolman.

I bored a ¾in. hole through a 7in. carbon block from a Bunsen cell (from top to bottom), in which hole I inserted a round zinc rod, fitted with a small indiarubber band at both ends, to insulate zinc from carbon. I fitted up the battery on the 4th October last, in a half-pint glass cell, using the sal-ammoniac solution, and it has very creditably rung a single-stroke bell at short intervals every day since the date named; through a circuit of about 15 yards.

I think that thanks are due to Mr. Tolman for furnishing the particulars of his battery, which possesses the advantages of being compact, cheap, and durable, to say nothing of the favourable opinion of **Railway Key.**

REVERSING COMMUTATOR FOR ELECTRO-MAGNETIC ENGINES.

[20769.]—I forward an outline sketch, partly in section, of a reversing commutator, for a certain class of electro-magnetic engine—viz., that class which does not admit of being reversed by a simple reversal of current; thinking that it may be of sufficient interest, as it is new to me.



Description.—A spindle, A, tubular for the greater part of its length, in which fits and slides longitudinally a spindle, B, having near the one end a pin, C, at right angles to its axis. The pin C fits and slides in a slot cut along the tubular part of A, parallel with its axis, and projects to a distance equal to the thickness of the side of a tube, D, which fits nicely outside the spindle A so as to turn easily on it. The length of the tube D is equal to the distance between the sides of the frame H, which, as will be seen, are bored through to just take the spindle A. A spiral slot is cut in the tube D, which extends from near the end on one side to the same distance from the other end on the opposite side, embracing exactly one half the tube D. The width of this spiral slot is equal to the diameter of the pin C, which projects into it. It will now be seen that if the spindle B is, by means of the loose button on the end, pushed in or drawn out, its motion acting on D, through the pin C, will cause D to describe one half a revolution on the spindle A.

E is a cylinder of any insulating material fitting closely on D, and carrying the brass contact rings of the usual form of commutator F.

G are two otherwise loose collars held in place on the spindle A by set-screws. Their use will be seen at a glance.

The commutator is driven from the main shaft of the engine by any of the known methods, so as to make equal revolutions with it, by attachment to the end A of spindle. **Jno. C. Clough.**

Auckland, N. Z., October 10th.

THE PULLMAN-CAR DISASTER—COMMUNICATION BETWEEN PASSENGERS AND RAILWAY SERVANTS.

[20770.]—The inquiry into the cause of the disaster to a Pullman car near Leeds, which occurred upon the 29th October, has brought into public notice the very dangerous rule which Midland engine-drivers have to obey, that when the passenger cord communication is used, they are not to stop the train at once "if they fail to observe anything that really necessitates an immediate stoppage."

Of course, many incidents may happen, both in and to a train, in which it is most necessary that it shall be immediately stopped, and yet there might be nothing for the driver to "observe." The Regulation of Railways Act, 1868, requires the companies to provide efficient means of communication in every passenger train which runs more than twenty miles without stopping, and any passenger who uses it without cause is liable to a fine of £5; but, strange to say, our legislators took for granted that when the communication was used the companies would stop the trains: they did not, therefore, I presume, think it necessary to add a clause to that effect. The Leeds disaster has now proved to the public that the Act of 1868 is imperfect, and requires amendment.

The cord communication in the present instance *did* work when required; but still the whole question of "communication" deserves serious attention.

The cord system is quite inadequate, and it has often happened that when required it would not work.

The cord is usually placed outside the carriages, but is only joined together so as to be available for signalling on the off or six-feet side of the train. When running round a sharp curve (with the cord outside) it sometimes happens that the tightness will cause the whistle to be blown or the bell rung, as the case may be.

I have seen cases in which (when the cord has been upon the inner side) it has hung in loops, and become caught upon lamp-irons, handles, &c. A shower of rain when a train is running will sometimes cause the cord to contract to such an extent that a signal is given, and in case of snowstorms or sharp frost the cord becomes fast in the rings or pulleys. At the recent inquest at Leeds, Inspector Loveday, on behalf of the Midland Company, is reported in the *Leeds Mercury*, and other papers, to have stated "*that the present mode* (the cord) *is the best the companies at this time know of.*"

Such a statement as this cannot be allowed to pass unchallenged. The fact is, the cord carried along the side of the train is the very worst system in use, and is not approved by the Board of Trade.

I have carefully examined, at various times, several means, any one of which would perform all that was required. Some of your readers, doubtless, have many opportunities to see the practical working of the electric system upon the London, Brighton, and South Coast Railway. What more perfect communication can any company desire?

In my letter (page 230), I mentioned that if the Pullman car conductor in the recent disaster, had only pulled apart, or uncoupled the hose-pipes of the Westinghouse automatic brake, he could have stopped the train; but, as these men have "no instructions to that effect," they cannot be blamed. Guards' vans are fitted with the pressure gauge and valve, so that the guards can apply the brake; and every Pullman car ought to be similarly fitted, and conductors instructed as to its use in case of emergency. If the Leeds accident causes the Midland Company's dangerous rule to be abolished, it may be the means of preventing still more serious accidents.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Nov. 20th.

AN EXTRAORDINARY VIOLIN.

[20771.]—Many thanks are due to "Captain Cuttle" for his notice of a novel violin. I wish other friends of "ours" would do likewise; but I do not rejoice with him in a supposed necessary soundpost for the production of tone, for I have quite discarded it in my new idea. However, I will now show what has been done in times past in the way of extraordinary invention.

Improvements in Violins.—Both sounding-boards are made straight, and the outer surface plain. The upper board is of hard wood, the lower one of soft wood. The lower one is wider in the middle than the upper one. They are glued to two ends, composed of two solid rings made of hard wood. From each rim proceed three braces, which unite near the middle of the instrument, and are there connected by a steel screw and two brass nuts. By turning the screw a pressure is transmitted from the centre through the braces to the rims, and the requisite strain given to the sounding-boards. One of the middle braces is made out of one piece of wood with the neck, for the purpose of giving more strength to the neck. On each board are glued a circular piece of wood, with its edges flattened in order to give more stiffness and elasticity to the middle of the sounding-board, and a wooden rib usually somewhat diagonally across the board. An orifice is cut in the upper board, and one leg of the bridge descends through it to the lower board or a tripod, standing on the rib of the lower board and glued thereto, ascends through the orifice without touching the upper board. One foot of the bridge rests on the tripod, the other on the upper board. The nut on which the strings rest is made with a flat projection on which the strings bear, and which terminates the vibrations before the strings reach the grooves. There is a similar projection on the bridge. The tail-piece or string-holder is fixed to the instrument by a screw, which passes through its further end and through the upper board into the middle brace. The other end rests upon two props, which rise up from the other braces and pass through orifices in the upper board. A screw descending through the string-holder and an orifice in the board into the middle brace secures it to the props. The sounding-boards may be strained by substituting for the screw and nuts oblique braces fixed to the sounding-boards and rims.

No doubt this invention was the result of a lifetime of thought, always battling against the stupid conditions imposed by the soundpost, and I will add, a curved form. Still, my friends, if you will go on knocking your heads against this post, I can only pity and admire.

With respect to a curved form. Would it vibrate as easily and complete as a straight form? would bent glass, iron, &c.? No; because the middle is out of line with the motive-force, and the more it is forced out by a soundpost the more it will absorb or use the force and rob the sides that should react on the middle. The only advantage that accrues from the curve shape is where the curves can be made to form a circle, in which case a continuous line would result, and the same effect as with a straight line, as in a bell, which sounds as well when flattened into a gong or straightened as a bar, or tensioned string. A round violin is not playable, so it has been elongated, like Capt. Cuttle's walnut; and then comes the post, which must block the vibrations, although required to move the soundboard the right way. But with a flat surface, as in the new violin, we require neither back nor soundpost.

Fiddler.

THE LINK-MOTION.

[20772.]—In reply to A. J. Smith's letter (20722), who asks how the results $d^2 = l\,(l + r)$ and tan. DCO $= \sqrt{(l + r)\,/\,(3\,l - r)}$ are obtained, I mentioned in my letter (20688) that there was another class of curves which I had supposed were supplementary to those referred to. In my endeavour to reconcile a seeming want of continuity between the two classes, I have found that they were both particular cases of a more general relation, and this relation has led to some important results in the theory of the link-motion. In fact, there is a zone of curves, all of which have portions of their branches, more or less, actually coincident with their tangents. It is difficult to explain this completely without giving the mathematical proofs for the results I have arrived at. I have tried to put these results in a form divested of mathematical formulæ.

I am now preparing a topographical chart, which will show the position of this zone. It lies between two groups of curves, those of one group having their curvatures convex to the axis, and those of the other group having their curvatures all concave to the axis.

I hope to have this chart ready for publication in a few days, and I shall then be in a better position to explain the relation, $d^2 = l\,(l + r)$, and also to explain the general theory of the link-motion.

The equation tan. $\mathrm{DCO}^1 = \sqrt{\dfrac{l + r}{3l - r}}$ is obtained from the general equation for this angle given at page 118; thus, if in the equation, tan.

$$\mathrm{DCO} = \pm \frac{l^2 - r^2 - d^2}{\sqrt{4l^2 d^2 - (l^2 + d^2 - r^2)^2}},$$

we substitute $l\,(l + r)$ for d^2, the equation becomes, after reduction—

$$\text{tan. DCO} = \mp \frac{r\,(l + r)}{\sqrt{r^2\,(l + r)\,(3l - r)}} = \sqrt{\frac{l + r}{3l - r}}$$

Milverton.

"LOOPED FIGURES BY MEANS OF GEARING."

[20773.]—The letter of "F. W. M." gives me great pleasure, not because it substantiates and supports what I have written, but because he has come to the fore as a really interested experimenter upon this particular class of lathe apparatus. He also deserves our thanks for his simple but ingenious method of working out the looped figures geometrically. This I could not have done, especially without some clue to the modus operandi by vertical feed of the tool on setting it permanently above the centre. Some figures depend on the tool being set below level of centres, others upon tool being behind or beyond centre line, and in others there was used a tangent-screw, which causes the eccentric disc to revolve upon its axis so as to alter the direction of the eccentricity. There was also a feed-motion, which reduced or increased the eccentricity. I hardly know if these are come-at-able with pencil and compasses, but they complicate the designs still further, and render them almost illimitable in variety. I will now lend the blocks to any other reader who may wish to see them.

O. J. L.

"J. L.'s" ARTICLE ON LATHE PLANERS.

[20774.]—That there was anything "unparliamentary" or "discourteous" in my letter I am unable to see, unless it be so to point out inconsistency on the one hand, and what I conceive to be crude, ill-digested, misleading suggestions on the other; and that I thought it would have been kinder, as well as the more open course, to have referred to the letter and illustration of "F. W. G.," which were freely contributed by him, as the result not of untried theory, but actual practice.

If my hatred of "shoddy" and "padding" has shown itself in my plain English, pray let "J. L." not think it is any personal feeling makes me try to expose *error* or *sham* whenever I see it.

I am sure "J. L." does not desire to act as a "blind guide," or lead anyone "into a ditch." Many who have not yet learned to walk, follow him as a safe leader. Let me now ask him—if after his last he will deign to notice anything I write—Does he still hold that the directions given by him may be *safely* and *implicitly* followed by an amateur who wishes to add a planing attachment to his lathe? And were my remarks *uncalled for!*

As he says he sends away his copy of "E. M.," I shall repeat my objections, which he made no attempt to answer.

I take "J. L.'s" second plan first, as it is the one he most strongly recommends; the greater part of the article having reference to it, because it is the one which, as described and illustrated, has least to be said in its favour, if the drawing, Fig. 2, p. 195, is to be regarded as anything more than a fancy sketch. This will perhaps admit work 4in. by 3½in., which is very small indeed: but the greater length which can be planed may be supposed to make up for this. But does "J. L." think it will repay an amateur for the trouble and time spent in fitting up such a small, insignificant, and for most purposes useless planer, when for a small additional cost—probably less when all was counted up—he could have a well-proportioned set of castings, which would be easier put together. If the holes cast in top-piece are intended to take the rest, *while planing the same surface*, as seems intended, I say the amateur in question would fail to make a fit, in fact it could not be done by anyone so as to give satisfaction. The fitting this piece on to the bed, as shown, would not, I am afraid, be satisfactory either, except done by an engineer, and that is not contemplated. Fixing rack and pinion, too, would trouble the supposed tiro; and then it must be remembered special patterns must be made for all, so that I see little room for saving.

It may have been unreasonable on my part to have supposed that "J. L." would have "happened to have noticed" "F. W. G.'s" letter, written as it was at a time when he was discussing the subject of combinations suitable for amateurs lathes. He says he did not, so that settles the matter. But had he noticed it, a reference to what had been well written on this form of planing head would not have detracted from any credit due to "J. L." for his own plan, in which there is but a very small surface for the head to bear on the lathe-head—nothing, in fact but the webs of the arm.

Nov. 18. **Fredk. Carre.**

MINNESOTA AND THE NORTH-WEST.

[20775.]—My letter (20634) in the "E. M." for October 13th, has brought me a deluge of letters from mechanics, painters, electricians, clerks, and others. I am delighted to find that so much confidence is placed in me. It will, of course, be impossible for me to answer my correspondents individually through the post. I intend this week, if possible, to take the letters I have received, and go in person to men engaged in the different branches of business, and ascertain the facts from them as to the demand for labour, remuneration, &c. To secure practical replies to the many practical questions put to me, I am willing to spend a couple of days, if necessary. Then I will trouble the editor with my replies. I hope my correspondents will have patience for a short time.

R. M. Tuttle.

P.O. Box 206, Minneapolis, Minn., U.S.A.

MICROSCOPICAL.

[20776.]—I have recently had my microscope fitted with a Tolles amplifier, with such satisfactory results that I venture to suggest its adoption with the ordinary student's microscope. My amplifier doubles the magnification of the objective, and this without injuring its definition. This simple accessory would place at the disposal of the student a double range of powers, and at a trifling cost.

A student's microscope fitted with, as is generally the case, a 1in. and a ¼in. objective, would, by the addition of an amplifier, be equivalent to one with objectives of 1in., ½in., ¼in., and ⅛in. focus, and this at an extra cost not exceeding a guinea, whilst the same increase in powers obtained by adding a ½in. and ⅛in. objective would cost at least four and a half guineas. One modification I would suggest—viz., that instead of the amplifier being screwed into the draw-tube, as is usually done, it should be fitted in a box, and made to slip in and out of the microscope tube, like the prism in the Wenham binocular.

A. E. Davies.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45768.]—**L. and N. W. Engines.**—The numbers of Atlas, Wyre, Councillor, &c., are—Atlas, 2150; Councillor, 981; Wyre, 1166; and Elwy, until lately, was 1167. The dates of Atlas, Newton, &c., are—Atlas, Nov., '74, Newton, April, '68, Hecate, Oct., '51, Kestrel, May, '79, Medea and Centaur are both 1879, Mastodon, May, '79, Pegasus (482), Nov., '80, Caractacus and Commodore about 1880, Tubal, Aug., '64, Delamere and Caithness about 1862. The following are the sheds of Atlas, Alaric, Pegasus, &c.—2150 Atlas, shed 10; 990 Alaric, 482 Pegasus, and 506 Sir Alexander Cockburn, 8; 477 Caractacus, and 478 Commodore, 15; 765 Herald, and 209 Petrel, 12; 379 Sedgewick, 26; 790 Hardwicke, and 418 Zygia, 27; 927 Latona, was 3 the last time I saw her; 603 Langdale, was stationed at Nuneaton (branch of shed 8) the first time I saw her, and was 3 the last time I saw her; 978 Mammoth, Nuneaton; 1523 Marlborough was 10 for a long time, but is now 19.—Prometheus.

[47450.]—**Repairing Mirrors.**—I sent a short reply to this query which was inserted in the number for Sept. 1, and in the following issue Mr. Holmes stated that quicksilvered mirrors could not be repaired in that way. I noted that Mr. Holmes did not give any other method, and I also noticed his lame and impotent evasion (p. 70) of a pertinent question put by another correspondent, who had also been contradicted in the curt manner which seems a special property of Mr. Holmes. I find that there are really three ways of repairing quicksilvered mirrors—one by the simple mercury and tinfoil patch; another by the addition of a slip of paper placed between the glass and the foil; and still another by the use of silvering amalgam, an alloy of varying proportions, but which may be briefly described as one of the very fusible mixtures—equal parts of lead, tin, and bismuth, with ten parts of mercury. The second is, I believe, the best. In that the bare place on the glass is carefully cleaned with boiled or distilled water, dried with blotting-paper, and polished by rubbing with the end of a roll of blotting-paper. The amalgam is prepared by cutting up tinfoil and mixing it with mercury into an amalgam, which is spread on a piece of tinfoil. The bare spot on the glass is then covered with a thin piece of paper, large enough to leave a hold beyond the area of the spot. The amalgam with the tinfoil is then placed over the paper, with a flat piece of wood over the tinfoil, and while gentle pressure is exerted, the slip of paper is jerked out, the object being to bring a clean surface of amalgam on to the glass, and to remove as much as possible of the surplus. The looking-glass is then carefully stowed away for a fortnight or more, with the patch weighted down. If Mr. Holmes knows of a better method, perhaps he will send it.—W. T. S.

[47808.]—**Telephone.**—To Mr. Lancaster.—I should advise you to remove your present magnets, harden and temper to a light-straw colour; then remagnetise them. This is not much labour, and I feel confident the magnets are the cause of failure; still they should give an articulation even now. But I can assure you it would be but a weak attempt on the part of the receiver to make audible its vibrations. Remagnetise, then put together, and see that each coil is a continuous one. Test with the current from a Leclanche, and, if satisfactory, couple up; and then let some one take one telephone to the other part of the house, and you will most probably hear the sound, as you should if you have not adjusting screws to the magnets. Then the easiest way to put them into proper position is to cut an extra ferrotype plate, any shape, to place on the top of magnet; then put circular plate in position, and, with a flat surface, push the whole down until the large plate is level on wood; then remove the under-plate, and screw the mouthpiece on to telephone. You have sufficient wire on the bobbins, and you must not use a Leclanché at all in the circuit. Let me know how you succeed.—W. J. LANCASTER.

[47900.]—**To Mr. Lancaster.**—Assuming that you do have indications with your present storm-glass, then I will tell you all I ever found them good for. First, then, I found that when the wind was, or was about to blow from the N.W., N., or E., the precipitate would crystallise, and would invariably adhere more to the side from which the wind was, or would be blowing. On the other hand, when the wind blew from an opposite direction, the precipitate became flocculent, and in warm weather fell to the bottom of the glass, and in colder weather spread more or less throughout the mixture. On the approach of rain, small stars or crystals in suspension were, five times out of ten, noticeable; but as to other indications, I never found any reliable. The only way to make such an instrument reliable is to watch it attentively for months, and make notes of every change, and then make further notes of the weather following.—W. J. LANCASTER.

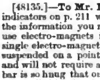
[47921.]—**Magic-Lantern.**—To Mr. LANCASTER.—About the best achromatic front you can make would be the following:—Flint (ordinary) 2¾in. diameter, 5 by 18, crown 5 by 5, cemented; flint (ordinary) 1¾in. diameter, 2½ by 6, crown 2½ by 2½, cemented. These lenses should be mounted ¾in. apart, their convex surfaces being towards condensers, then in a sliding tube to move between 1in. and 4½in. from anterior surface of small lens, have a concave 36 by 36; this will form a sort of enlarging and diminishing lens in one. By moving towards the combination the image will be reduced, and by moving outside the focus of the combination the image will be enlarged.—W. J. LANCASTER.

[48043.]—**Chemical Black.**—The metal requires to be very clean, but not necessarily bright; it requires no preparation. Apply the varnish hot. If it sets on the metal, it requires more turpentine added. If properly done a very thin layer of sulphur will show on the surface; allow the turpentine to evaporate, and hold the work over, but not into, the gas or spirit flame, the object being to prevent the work getting smoked.—AULD REEKIE.

[48132.]—**Bacteria in Beer.**—Kindly allow me a last few words on this subject for the present, in reply to Mr. Heron, p. 256. Mr. Heron is misleading in stating that I have seen the yeast-cells developing into bacteria. I stated that I had seen, and can at any time show, the disaggregated protoplasm escape from the cells as bacteria; and the development of linear bacteria, first into spherical micrococci, and after, in a suitable medium, into torula, is beyond the powers of human observation, but, to the unbiased mind, within the power of reason. In persistently describing my statements of facts as blunders or mistakes, Mr. Heron is studiously insulting. We have not, I believe, reached finality in biological research, and the value of truth is inherent in truth itself, and not in him who utters it. Till Mr. Heron can bring forward facts to refute those I have given, I will not notice him further.—W. A. THOMS.

[48135.]—**To Mr. Lancaster.**—The drawing of indicators on p. 211 will no doubt have given you the information you required; but you will have to use electro-magnets in place of bobbins only. A single electro-magnet, with an oscillating magnet suspended on a point at its centre, will work well and will not require any delicate adjustment. The bar is so hung that one of its poles can be attracted or repelled by the electro-magnet, so that there is no necessity to have a cord to pull the indicator back. If you have not made yours as yet, I shall be pleased to give you a drawing of a simpler form than the one on p. 211.—W. J. LANCASTER.

[48160.]—**Hood for Camera.**—To MR. LANCASTER.—I have much pleasure in sending drawing of my compound focusser. The brass tube or body is 1¾in. diameter, and 1in. deep; at the top, there is a thread into which screws another tube, containing two lenses, each 1¼in. diameter, and 2½in. focus, mounted with their surfaces ⅜in. apart, and having a diaphragm between the two ⅜in. diameter. You will see in a moment that the bottom of tube being placed against the ground-glass forms really a dark chamber, and as you can easily move it all over the ground-glass you can obtain an accurate focus without a dark cloth; the thread on the tube is for the adjustment at first to suit your own vision. Any further information with pleasure.—W. J. LANCASTER.



[48155.]—**Substitute for Hops.**—No wonder "J. C. A." wants to find a substitute for hops, as East Kent Goldings are at £35 per cwt. Gentian, camomile, quassia, and other bitter substances are perhaps considered substitutes. The report of the German Brewers' Association on hop substitutes was: "Hop substitutes do exist, but their use is not to be recommended." For further information I must, like "Essar," recommend "J. C. A." to consult the *Brewers' Journal*, where he will find hop substitutes advertised. I may say that I would not risk a brewing of beer by using any of the above.—W. L.

[48165.]—**Valve-Trumpet.**—If "Clarini" is already a cornet-player, he will no doubt be quite at home with the valve-trumpet in the time he specifies, as far as the fingering is concerned. A greater difficulty will be found in the uncertainty in production of the notes desired, which requires considerable practice to conquer. I do not think he will find it always a satisfactory substitute for the cornet; the latter instrument being more suitable for rapid passages, dance-music, &c. The production of a good tone depends very much on the possession of a muscular lip well under control. But all valve-trumpets, as far as my experience goes, are harder to blow, and inferior in tone and correctness of intonation to the slide-trumpet, which is, however, of course much more difficult to master.—COMMA.

[48180.]—**Wood-splitting Machine (U.Q.)**—If this querist lives near Bradford, and will visit the exhibition now being held there, he will see a machine at work. The action is, as he says, very like a mortising machine. The blocks of wood are fed in at one end, the knife or knives descend, and the split wood falls down a shoot behind to the bundling machine. If the querist will advertise his address, I will send him the name of the firm making the machines.—W. L.

[48196.]—**Teeth of Mortise-Wheel.**—Having left off on page 188 with cog ready for driving, I will now proceed with filling the wheel. The cog should be driven firmly, care being taken, however, not to split mortise. Strike gently at first, and if you think they are too tight, drive out and pare all the touching parts, the great object being to get them to touch all over. After they are all driven home, wedge up tightly, and you are ready for turning up. For this part you will require the assistance of an obliging friend to turn the crank-handle, which you can fix on the shaft. See that your traces are firm, and place a plank across them for a rest. Get your friend to drive up pretty smart, and turn down the sides to the required breadth; now fix your cog-rake, Fig. 1, to describe the outside circle, and then the centre of cog or pitch-line. Set dividers as near required pitch as possible, and starting from the centre of a cog on the pitch-line, go round them all very lightly. If you have caught the exact thing the point of dividers should drop exactly into starting mark; but as this will not likely happen the first trial, you must just shift dividers the least thing out or in as required until you are right. This settled, go round again, marking every cog firmly. Now set off dividers to a quarter more than the pitch, which would in this case be 1¼. Starting again on one of your marks, describe the segment of circle on the next cog, as shown, Fig. 2. Then turn up face of cogs to the outside circle, and square over your draughts. All that remains to be done now is to pare accurately to the circle from the outside to the pitch line, and from there to the face of wheel square down. The chisel I commonly used for paring was 1in. broad and about 6in. long. The difference in pitching a bevel-wheel is that, instead of squaring your draughts across, you draw them from the centre as in Fig. 3. I hope that this rough outline will give you an idea of the process of cogging. Any other information of the same kind would be willingly given by—MACK.

FIG. 1.

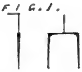


FIG. 2.

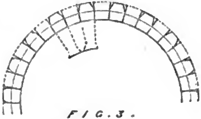
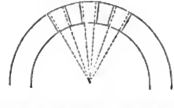


FIG. 3.



[48213.]—**Leclancha Cells.**—Your old materials are in all probability no use at all: at any rate, it is wise economy to use fresh ones. Apparently, you want what is known as the agglomerated cell. It was described in No. 803. The "carbons" are made up of carbon-plate, crushed carbon, and manganese, cemented together with rosin under pressure.—E. G. M.

[48217.]—**Blower.**—This query was answered in a back volume, and in some recent back numbers.—T. P.

[48218.]—**Varnish.**—Add some boiled oil to it.—PAINTER.

[48220.]—**Binocular Field-Glass.**—Most likely a chemical stain. With best glue and skilful fingers. "Twelve lenses" should mean what it says; but as to lines, the line is the twelfth of an inch.—J. B. C.

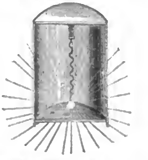
[48227.]—**Automatic Lift Valve.**—Have you tried asbestos washers? Are now made in a variety of sizes; and, without knowing exactly what is wanted, I should think something of this kind would suit.—ESSAR.

[48233.]—**Bisulphide Prism.**—It has been stated several times that glue is best thing; but see p. 22, Vol. XXXIII., as directions are there given in full.—NUN. DOR.

[48233.]—**To Mr. Lancaster.**—You can, of course, use a bisulphide prism; but I should recommend a dense flint one in preference. You gain in every way by the use of the flint against the bottle. I shall be pleased to give any further information you may require.—W. J. LANCASTER.

[48238.]—**Setting Slide-Valve.**—"Learner" would find this subject explained in back numbers; but as he only wants to know how to set the expansion, it ought to be marked on the rod or whatever is provided for altering the expansion-valve. The only way is to take off the cover and mark the position, if not done.—DURHAM.

[48272.]—**Magnesium Lamp.**—To MR. LANCASTER.—I send herewith a drawing of my lamp.



The body of the lamp is made out of silver rolled on copper, and from top to bottom is part of a paraboloid. You can cut a template out, first, by describing an ellipse, letting the point, to which the magnesium wire is to be attached, be one of the foci; then bend the metal on a block made to the template, and well hammer it until the whole surface is true. Then it must be burnished all over the inner surface until it forms a perfect reflecting surface. A small spring clip is to be fastened into the top, and then, to use it, coil 6in. of magnesium wire round a thin penholder, stretch it out into a spiral form, and light the bottom. The lamp should be held about 3ft. from sitter, and moved about, so as to obtain good modelling. The lamp works exceedingly well, and each picture costs less than ½d. for wire. I shall be pleased to send a carte of myself, taken by my lamp, to anyone who is interested in fireside photography.—W. J. LANCASTER.

[48273.]—**Lighting Gas by Electricity.**—Have a little coil of platinum wire over each burner and copper leads to studs where you can hitch on a battery. Cost would be considerable.—LAMPLIGHTER.

[48301.]—**Gas Consumption.**—Not having seen a satisfactory reply to this question, I would advise G. Fryer (also "Nun. Dor.") to procure a good aërorheometer, connect it to his gas supply, and put on (say) a Bray's No. 4 burner; adjust the tap, so that the instrument indicates 4½ft. per hour passing. Now light the gas, and in a very short time he will find the indication only 4¼ft. (or less). After this let him blow out the light, and the indication will again rise to 4½ft. This, to my mind, is very conclusive.—REXSAT.

[48314.]—**Electric Pendulum.**—To MR. LANCASTER.—I cannot possibly answer queries through the post. I am willing to do my utmost for the readers of the MECHANIC, but I can only do it through the MECHANIC. I do not refer to business questions at all, but to queries. I take a pleasure in answering in the pages of "Ours." Of late I have been so very busy that I have been unable to keep up my correspondence; this I regret much more than those to whom I desire to be of use; but I must here say that I have received several letters of an indignant type, and it is evident from the contents of several of these that the writers consider I am a paid correspondent of "Ours." This I need hardly say is a totally wrong idea: I have never had or asked for one farthing compensation from the proprietors of the ENGLISH MECHANIC, and don't want it; and although I am continually receiving "offers" from all sorts of papers, I am, as I have been in the past, desirous of helping on the good work of the MECHANIC, and all my leisure time, which is precious little, shall be devoted to the pages of "Ours." Having said so much, I do not wish to include "T. J. O'C." in the batch of indignants, and I shall be only too pleased to give him all the instructions he needs if he will send the particulars I asked for to "Ours" at once.—W. J. LANCASTER.

[48343.]—**Bread.**—I cannot describe the chemical process of breadmaking. The ferment is put away in tubs and allowed to rise and fall; it is then made into a sponge by mixing more liquor (water) a required heat, and strained into the trough and mixed with flour; then it is banked up, allowed to rise and fall twice, more liquor is added with salt to break up the sponge into a batter, then made into dough, which rises and will not fall again, so that it has to be moulded and put in the oven to bake. But the effects you speak of are dependent on the yeast you use, as different kinds do not work alike. This process is with brewer's yeast or barm, which requires time and great attention; for instance, if the sponge is disturbed, falls and rises again, then taken for use it will cause bread to have a dry crust and small; the same if the liquor is used too cold. It entirely depends on the yeast, as other mixtures will work in the same manner, though the salt that is used is of great importance, as too much will bind the dough, and too little will allow it to work at random, or what is termed ragged. I hope this will be of use.—J. G.

[48355.]—**Silver Printing on Opal or China.**—The following is a good formula for collodio-chloride, and I expect the same would answer equally well with gelatine:—Plain collodion, 2oz. This should be mixed with an excess of ether, say 3 parts to 1 of alcohol, and should also be somewhat thicker than usual to allow for the subsequent dilution. Nitrate of silver, 30gr.; dissolve in half a drachm of water, and add alcohol 1dr., employing heat if necessary to effect solution; then pour gradually into the collodion with constant stirring or shaking. Next dissolve 8gr. of chloride of strontium in 1dr. of alcohol, and add to the collodion in a similar manner. Lastly, add 4gr. of citric acid dissolved in half a drachm or so of alcohol, and in about a quarter of an hour the mixture will be ready for use. Any of the usual formulæ for paper prints will do for toning, the acetate being perhaps the most generally useful and reliable. If you understand the ordinary process of colouring and firing porcelain, and know what colours will stand the fire, I should think you would experience little difficulty in colouring upon a photographic basis; but this is a matter in which I have had no personal experience, and am not aware that any reliable directions have ever been published.—W. ROBINSON, JUNR.

[48364.]—**Toning Lantern Transparencies.**—To MR. LANCASTER.—You ought to be able to tone with chloride of gold. You can mix the gold, if you like, with the hypo. in the proportion of one grain of gold to 5oz. of hypo. solution; then leave in until of a nice tone, or you can tone with platinum-chloride instead of gold-chloride; but whichever way you attempt you must gain experience before you will be able to get a good tone.—W. J. LANCASTER.

[48367.]—**Induction Coil.**—To MR. LANCASTER.—You will decompose more water with the battery-current alone than by using the induced current from an induction-coil. A couple of quart Bunsen cells will decompose a good quantity of water in five or six hours. Let me know if you wish to do anything out of the ordinary experimental way, and I will do my best to help you.—W. J. LANCASTER.

[48429.]—**Garden Bed.**—"Jack of all Trades" is so vague in his answer to my query that I cannot make it out. F. O'D. Hoare gives me the way to construct an ellipse whose semi-arcs are those of the given ellipse, plus 2ft. But I am told on high authority, that if one outline of a garden path is elliptical and the path is of *uniform* width, the other outline is *not* elliptical. So it would appear that F. O'D. Hoare's solution is only *approximate*, but not *accurate*. I wanted the path to be uniformly wide.—JARDIN.

[48444.]—**Lamp-light Photography.**—You should have some arrangement for diffusing the light, such as a piece of fine ground-glass or tissue-paper placed in front of the lamp; or, what is more frequently done in artificial-light arrangements, the lamp might be placed within the focus of a large concave reflector. The light should be placed pretty well up in front and somewhat to one side of the sitter, as a general rule, though this is a point which requires the exercise of some artistic taste and skill, just as in lighting and posing in daylight. Deep shadows may be modified by the judicious use of white reflectors to throw back the light upon the sitter.—W. ROBINSON, JUN.

[48470.]—**Enlargements.**—A piece of fine ground-glass or tissue-paper placed before the lamp would probably remedy the defect complained of—at the expense, however, of an increased exposure; but to enlarge properly by artificial light, you should have an arrangement of lenses similar to a magic-lantern.—W. ROBINSON, JUN.

[48476.]—**Metropolitan Railway Engines.**—To E. E. R. TRATMAN.—"E. W.," in his reply last week, stated that the L. and N. W., 4ft. 7½in. tank engines are numbered above 2000. There are 21 above 2000, and eight below, of which three are stationed at No. 2 shed, Willesden; thirteen at Walsall, 9; eight at Birmingham, 10; one at Crewe, 15; and two at Manchester, 16. I will send a sketch of one of these handsome engines, if it would interest any correspondent. Nos. 102, 119, 207, 208, and 227, are the new goods wing-tank engines, stationed at Birmingham, designed by Mr. Webbe, for local goods traffic; of the same class, 241—247, and 602 are stationed at Walsall.—PROMETHUS.

[48476.]—**Met. Ry. Locos.**—With regard to the L.N.W.R. tanks working over the Met. Ry., all the outside-cylinder bogies that I have seen are fitted with two spring-balance valves on dome, in same way as the locos. of the Met. and District Cos., and not with Ramsbottom valves, as stated by "E.W." They are numbered 2055-2070. A driver told me that they were built by Beyer, Peacock, and Co., which seems probable, from their stong resemblance to Met. Co.'s engines made by that firm. They have, however, the L.N.W.R. standard pattern number-plate—red ground with yellow or bright brass figures, and "L. and N.W.R. Co.," "Crewe Works." 228 and 361, two of Mr. Webb's 8-wheel radial tanks, also work over the Outer Circle. All these classes have No. 2 shed No., which is Willesden, I think. It would be interesting if details of the work done by the new compound express loco., No. 66, "Experiment," were given. The date is Jan., 1882, and shed No. 15 (Crewe). In appearance the engine resembles the "Precedents," the chief differences being the small outside high-pressure cylinders, and the fact that the leading-wheel is directly under the smoke-box and covered by a splasher.—TITTESWORTH.

[48481.]—**Rigging Boat—Yawl.**—I am much obliged to "Robinson Crusoe" for his information (48481), and send him the further information he requires. The term "yawl" is used here for a boat sharp at both stem and stern. She is 25ft. keel, 6ft. 8in. beam, and 2ft. 9in. deep, and is considered will be a good sea-boat for use on the open sea. I shall feel much obliged for information as to the best mode of rigging her, with full particulars.—S. S.

[48490.]—**Bell Indicator.**—To MR. LANCASTER.—Will you be good enough to refer to my answer No. 48135 in present issue? If insufficiently answered to meet your requirements, I shall be very pleased to send working drawings of the plan I have found most satisfactory.—W. J. LANCASTER.

[48491.]—**Magnesium Lamp.**—By referring to No. 48272 in present issue I think you will find all that you require. If not, I shall be pleased to give you the further information you require. I forgot to mention in 48272 what would be apparent—viz., that as the wire burns up the light is all the time in the focus of the lamp. This is the principal feature in my lamp, and is really the point that has foiled so many experimenters in this direction.—W. J. LANCASTER.

[48494.]—**Micro-photography.**—Having accurately focussed the object to the size required, expose a sensitive plate on the slant, with the line of sharpest visual definition passing as nearly as possible through the centre. Then, after development, place the plate carefully in the same position, and measure the distance between the line of visual definition and the line of actinic definition, as shown on the plate.—W. ROBINSON, JUN.

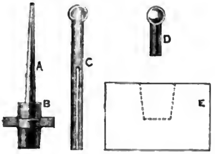
[48494.]—**Micro-photography.**—I have used the following method for finding the actinic focus of my objectives. I place a slide on the stage, of some object with details which can be accurately focussed, and which have no "depth," if one can use the expression. A longitudinal section of coniferous wood, showing the dotted cells, acts well for low powers. The slide is tilted by means of a wedge between it and the stage, so that the bottom is ¼in. or so higher than the top. This is then focussed on the screen. It will be found, of course, that when one part is in focus, the rest is out of focus; focus some dots near the top of the screen; expose a plate. When developed, this will be found, unless the two foci coincide, to show the dots focussed for, out of focus, but other dots nearer the middle of the plate, sharply defined. Note some very sharply in focus, and then move the screen inwards, or move the fine adjustment if you intend to use that as your register, until the same dots appear sharp on the ground-glass. Note the distance, which is that between the foci. You can then verify this by exposing another plate, with the object flat on the stage, and if the dots focussed for most accurately have not the same sharpness on the plate, the process of focussing can be gone through again with reference to any other dots which may happen to be in focus on the plate. This method, I believe, is as correct a one as could be found, and avoids the hit-or-miss uncertainty of exposing plate after plate until the focus happens to be right. I have not yet used this method for an objective of higher power than 4-10th in., but unless your ¼in. works very close indeed, I do not see why it should not be available for it. I intend to try it for a 1-5th in. shortly.—DENSITY.

[48497.]—**Plating Brass.**—I would take it as a favour if A. Hughes would tell me how to silver-plate things without either heat or a battery?—WILLIAM BOYD.

[48504.]—**Roman-Candle Stars.**—You are not likely to succeed with your stars. I should imagine your formula was taken from some book—a source not to be depended upon for practical pyrotechny. Follow faithfully what I shall tell you, and you shall make stars that will do credit to a professional. No. 1, Bright Stars.—Saltpetre, 4oz.; sulphur, 1½oz.; meal-powder, 1½oz.; regulus antimony, 1oz. No 2.—Saltpetre, 4oz.; black sulphide antimony, 1½oz.; sulphur, 2oz.; meal-powder, 2oz. Each formula will give good results, but the first is the most brilliant. Make into a paste with starch of ordinary consistence, or gum-solution may be used. Gum-arabic 1oz., water 10oz. The most expeditious way of forming stars is to pump them, a description of which I shall be glad to give at any time; but if this method is not adopted, the stars must be formed of the same shape—viz., cylindrical, about ⅝in. long, and to fit the bore easily. Green Stars.—Barium nitrate, 5oz.; sulphur, 1½oz.; potassium chlorate, 2oz.; mercurous chloride, 1oz.; charcoal, 65gr.; shellac, powdered, 120gr. Rich Crimson.—Strontia nitrate, 10oz.; sulphur, 3oz.; potass. chlorate, 3½oz.; mercurous chloride, 1½oz.; charcoal, 120gr.; shellac, powdered, ⅝oz. These last two must be moistened with a solution of shellac in naphtha, or methylated spirit, strength, 1oz. shellac to 10oz. of spirit. The sulphur employed should be quite free from sulphurous acid; otherwise you will have a serious accident when least expected. All coloured fires should be made with washed sulphur, for if made without this precaution, spontaneous ignition will certainly follow, and in this alone, perhaps, we can now trace the cause of many serious fires. In my own experience I have known most alarming occurrences through ignorance of this most important precaution. To wash sulphur proceed in this manner—Place the sulphur in a deep pan and add sufficient boiling-water to form a paste; mix up well with your hands, breaking all the caked pieces, which you will always find in powdered sulphur, and then pour on plenty of boiling-water, allow it to settle, pour the water off, and repeat the washing with three or four changes of water. In the last washing-water place a handful of washing-soda, drain on calico, and pour some more water over to free it from soda; and finally spread out to dry. When large quantities of sulphur are washed it is best to press it all through a hair-sieve after it is mixed with the first water. This separates all the caked pieces at once, and you are then sure that all is thoroughly washed. For bright stars, or any composition in which chlorate of potassium does not form a part, the common sulphur of the shops, unwashed, is quite safe, and may be used without apprehension.—J. S. ROCHARD.

[48507.]—**Sky-Rockets.**—Why does Mr. Bell object to clay-stopped rockets? Has he ever tried them? I have, and never use anything else up to 1¼in. in diameter. They are recommended by "Practicus," whom he quotes, but in a work long subsequent to the articles in the *Boy's Magazine*. This book (which I have already recommended) is published by Messrs. Bailey and Son, Wolverhampton, and contains no rubbish, as I can testify.—J. F. E.

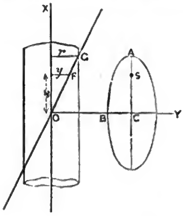
[48507.]—**Sky-Rockets.**—Rockets, of whatever size must be choked, and there is no inner case. Your compo is useless. Try the following; but if you require greater altitude, I will give you a formula of my own:—Saltpetre, 1lb.; charcoal, ½lb.; sulphur, ¼lb. You will require an iron spindle, and two wooden drifts, and a mallet: this will be quite sufficient for a beginner. The following drawings will explain: A, the spindle; B, the nipple; C, the hollow wooden drift; D, solid drift; E, wooden block. The spindle should be, for ¼lb. rockets 4in. long, a little more than ¼in. diameter at the base, and half this diameter at the top; nipple, ⅜in. diameter, and same in length. The collar under the nipple is to support the apparatus upon a woden block, which should admit the piece below the collar. The hollow drift is pierced 4in., and of the same diameter as the bottom of spindle. Your ¼lb. rocket case should be ¾in. diameter. Pass the case over the spindle, and firmly press the choked part on to the nipple, and proceed to fill with the hollow drift, and when the top of the spindle is reached with compo, give a heading of composition of at least ⅜in., firmly compressed with a solid drift. Make use of your scoop at least six times in filling the rocket up to the top of the spindle, and upon each scoopful of composition give twelve blows with your mallet. Either finish with clay or a small wooden plug. Several hollow drifts are usually employed in rocket-making; but, with a mallet of proper weight, I have always found one drift to be amply sufficient for small rockets.—Any further information I shall be glad to give.—J. S. Rochard.



[48510.]—**Electro-Motor.**—To Mr. Lancaster.—By all means get permission to use a gas-engine. The expense and trouble in keeping a dozen large Bunsens going continually would be very great. I will give you the information you ask for, but I know from experience that it would be at the finish only a waste of money, time, and patience.—W. J. Lancaster.

[48512.]—**Steam Fishing Vessels.**—Steam "carriers," that is steamers for collecting and bringing in fish from the fleets of fishing vessels in the North Sea, sail regularly from the Thames. They are mostly owned by large firms connected with Billingsgate Market, and are vessels of about 400 or 500 tons, strongly built and fitted to enable them to encounter very heavy weather. Steam trawlers are built and equipped at Leith and some other Northern ports. They are about 60ft. or 70ft. long, 14ft. or 15ft. beam, and are fitted with two-blade screws and engines of about 40 b.-p., rigged as yawls, or as fore-and-aft schooners. Some few of the larger French fishing luggers sailing from the Northern ports have been fitted with screw-propellers, and most of the larger French fishing-boats carry small donkey-engines for hauling in nets, weighing anchor, and hoisting their heavy lug-sails. I cannot say whether steam-power would render fishing vessels safer or more economical; but for safety a large decked fishing-smack of 30 or 40 tons takes very high rank. We continually hear of vessels in distress being assisted by smacks, and of crews being rescued by them. It is the small open or half-decked cobles that are lost in such numbers when caught in gales out at sea.—Robinson Crusoe.

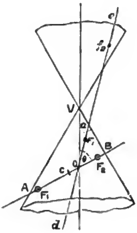
[48513.]—**Geometrical.**—In replying to this query as above, I omitted to give my solution of the problem involving the conic sections referred to at the end, on the grounds that if the required curve were to be found by an equation between its co-ordinates, the problem would be very complicated; but by using polar ordinates, the problem becomes a very "elegant" study in conic sections. The diagram represents a double cone, the lower one is crossed by a plane perpendicular to the plane of the paper; and, therefore, seen edgeways in the line A B. It revolves on the axis O, at right-angles to the axis of the cone, and we require to find an equation which will give the position of the foci of the resulting ellipse for any given angle V O B or θ. Call V O = l, and angle O V B = a. From these data we can find the length of the half-major axis of the ellipse (call it b) in terms of θ, and the constant qualities l and a; it will be found that $b = \frac{l \sin. a \sin. \theta . \cos. \theta}{\sin.^2 \theta - \sin.^2 a}$. The half-minor axis (call it c) will also be found to be $c = \frac{l \sin. a . \sin. \theta}{\sqrt{\sin.^2 \theta - \sin.^2 a}}$. Also the distance from C, the centre of the ellipse, to O the origin, can be calculated. It will be $\frac{AO - OB}{2}$ and will be found $= \frac{l \sin.^2 a . \cos. \theta}{\sin.^2 \theta - \sin.^2 a}$. Now, if we call O F_2 (the radius vector), R, C O + R will be the distance from centre of ellipse to focus. The value of C O has just been given, so we have now got the value of the semi-major axis, ditto of the semi-minor axis, and ditto of the distance of focus from centre; if we call the latter f, from the property of the ellipse we get the equation $f = \sqrt{b^2 - c^2}$, substituting the above found values of these symbols, we get an equation from which R may be found in terms of the other symbols. After some reduction, it will be found that



$$R = \frac{l \sin. a . \cos. \theta}{\sin. \theta + \sin. a}$$

which is a very simple result after all the trouble in obtaining it. Let us now see how this equation is applicable to all the sections of the cone. If θ = O, R = l, this is for a vertical section. If θ = 90° R = O, which gives us a circle. If θ be greater than a (as in the figure), the resulting figure is an ellipse; the equation as it stands will give us the position of F_2, and in order to find the other focus F_1 the radius vector must be swept round in the direction of the hands of a watch till θ becomes 180° + θ, the sine and cosine of which are both negative; we must, therefore, change the signs of the sine and cosine of θ in the equation, and the resulting value of R gives us the position of the other focus. When $\theta = a$, the curve will be a parabola, and the value of R will be $(l \cos. a) / 2$ but if the signs be changed as before, the denominator = O and R is infinite, so there is only one focus. If θ is less than a, as when the plane is in the position $d\,e$, the curve will be an hyperbola, one curve being in the lower cone and the other in the upper. In this case, when we change the signs as before, R becomes negative, showing that we must measure from the origin in the direction contrary to that of the radius vector, giving f_2 as the conjugate focus.—M.I.C.E.

[48513.]—**Geometrical.**—The diagram represents part of a cylinder of indefinite length, cut by a plane of indefinite length (seen edgeways in the diagram). This plane revolves round an axis, passing through O at right angles to the axis of the cylinder—required an equation between the ordinates x and y of the focus of the varying ellipse caused by the intersection of the plane with the cylinder. The ellipse is shown to the right of the cylinder; its minor axis will always be equal to the diam. of the cylinder, but its major axis will vary, and the position of the focus will vary as the plane revolves. Now, according to one of the properties of the ellipse, $BC^2 = CA^2 - CS^2$. Call the radius of the cylinder r (which is equal to BC), so we have $r^2 = OG^2 - OF^2$ (these lines being the same as CA and CS). Again, by similar triangles—



$$\frac{OG}{OF} = \frac{r}{y} \text{ and } OF = \sqrt{x^2 + y^2}$$

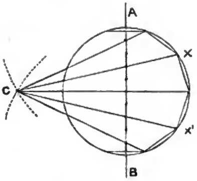
$$\therefore OG = \frac{r\sqrt{x^2 + y^2}}{y}$$

Substitute these values of OG and OF in the above equation, and we have—

$$r^2 = \frac{r^2(x^2 + y^2)}{y^2} - (x^2 + y^2)$$

By reducing and transposing, we will find $y^4 + x^2y^2 = x^2r^2$, from which y may be found by solving the quadratic. This equation gives four values of y, but two of them will be found impossible. With regard to the second part of the query, where a cone is to be substituted for the cylinder, I find that the problem becomes very complicated, owing to the fact that as the plane revolves both the major or minor axes of the resulting ellipse will vary, which is not the case with the cylinder.—M.I.C.E.

[48516.]—**Dividing Circles.**—On looking through some old MSS., I found the following method of describing a polygon of any number of sides in a given circle; it was attributed to an Italian, whose name I forget. Draw a line perpendicular through centre of circle; the diameter A B is the radius C; divide the diameter A B as required. I think if "M. E. I." were to divide X . X¹ into 10 equal parts, on the edge of a brass straight-edge, he could divide any other segment, either larger or smaller, by placing the divided straight-edge nearer or farther from perpendicular A B.—Gamma.



[48523.]—**Instantaneous Shutter.**—To Mr. Lancaster.—There is evidently something wrong with your shutter. I cannot tell what without seeing it; but I never have liked shutters which open and close from the centre: there is a fatal objection to their use. You perhaps have a spring too strong, or the shutter catches when part of the way across. You should try to obtain a photo from an upstairs window, keeping the camera firm down on the window sill, then expose, and if the image is single the fault is in the stand. I should like to see one of the prints from a present negative, then I could tell better what is wrong.—W. J. Lancaster.

[48524.]—**Photographic.**—Your best plan will be to pass a current of sulphuretted hydrogen, or to pour in a strong solution of sulphuret of potash. The resulting silver sulphide may then be collected, washed, dried, and fused with an equal weight of mixed carbonates of potash and soda; but if there is any considerable quantity, and you are unaccustomed to the work, you would find it to your advantage to hand the sulphide to a professional refiner, who will give you cash or fresh silver nitrate, as you prefer. Gold can be recovered from old toning-baths by pouring in solution of protosulphate iron, and reduced to the metallic state by fusion. In order to form fresh chloride, however, it is simply necessary to well wash the precipitate, and re-dissolve in aqua regia.—W. Robinson, Jun.

[48531.]—**To Engineers.**—"Rydal Mount" supplies so little information as to dimensions, purpose, length of traverse, &c., that one cannot be certain of suggesting the best or even a good plan. However, a rack and pinion—pinion to have a space without teeth to produce the momentary rest—would give an intermittent motion.—Scotch Working Mechanic.

[48533.]—**Angles of Pyramid.**—The distance from apex to middle of any side of base being radius, half the side of base will be the sine of half the angle made by any side with the side opposite. In tables of natural sines they are calculated to radius; therefore divide the above sine by the radius, then from table find the angle corresponding to this new sine (sine of same angle, but to radius 1), which multiply by 2 for the angle any side makes with the side opposite.—Scotch Working Mechanic.

[48533.]—**Angles of Pyramid.**—Let $a\ b$ be the sides of the rectangular base upon which the pyramid stands; *d*, double of one of the slanting edges of the pyramid; θ, the angle between two plane faces of the pyramid: then $L \cos. \theta = 10 + \log. a + \log. b - \frac{1}{2} [\log. (d - a) + \log. (d + a) + \log. (d - b) + \log. (d + b)]$. (The proof can be sent if desired.) The angles between the edges of the pyramid are found by ordinary "solution of triangles."—W. H. BLYTHE, M.A.

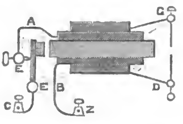
[48542.]—**L. and N.W.R. Locos.**—To "CARSTAIRS."—I can only give distribution of weight of the "Precedent" class:—Weight on leading-wheels, 8tons; on driving-wheels, 10tons 10cwt.; and on trailing-wheels, 10tons 10cwt.; total weight, 31tons 8cwt. Engines of the 1121 and 2200 classes are stationed at Willesden, Bletchley, Northampton, Doncaster, Rugby, Walsall, Bushbury, Manchester, Birkenhead, Chester, Springs Branch (Wigan), Liverpool, Shrewsbury, and Abergavenny. One of the oldest of this class that I know the date of is 2207, which is September, 1875, and one of the youngest is 2451, whose date is 1882. Engines of the 518 class are stationed at Willesden, Nuneaton, Leamington, Coventry, Walsall, Birmingham, Bushbury, and St. Helen's. The engines I have seen of this class bear dates from 1848 to 1852 inclusive. Engines of the "Chimera" class are stationed at Northampton, Rugby, Birmingham, Derby, Stafford, Manchester, Chester, Warrington, Springs Branch (Wigan), Liverpool, Preston, and Shrewsbury. One of the oldest I have seen of this class is Diomed 821, which is May, 1863; and one of the youngest is 479 Mastodon, May, 1879. Engines of the "Precursor" class are stationed at Crewe, Leeds, Bangor, Shrewsbury, and Carlisle. Date of Thunderbolt is November, 1874, and of Pearl, February, 1879. Engines of the 2007 class are stationed at Camden, Bletchley, Northampton, Rugby, Leamington, Birmingham (Vauxhall and Monument-lane), Derby, Burton, Bushbury, Stafford, Crewe, Manchester (Longsight), Leeds, and several other places; date of 437 is October, 1860; and of 2036, September, 1871. Concerning 1820, I may state that it is stationed at the Vauxhall part of Birmingham sheds. It is a six-coupled goods engine, and resembles 14, 2007, 130, 743, &c., in general appearance, has a four-wheeled tender, and no cab. I see it nearly every day of my life, and it is used (together with 20, 913, 914, and 1018) for shunting at the Lawley-street goods-station; sometimes it takes a truck of coal to an engine-house at Aston. If Puck were a Small Bloomer, its cylinders would by 16 by 22, but as it is one of the 81 class, its cylinders are 16 by 20.—PROMETHEUS.

[48544.]—**Drilling Engine.**—For one revolution of crank-shaft, nut revolves $\frac{19}{24}$ and screw $\frac{23}{24}$ of a revolution; consequently, screw has gained $\frac{4}{24}$ or $\frac{1}{6}$ of a revolution and advanced $\frac{1}{6}$ of $\frac{1}{4}$in., which ($\frac{1}{4}$in.) is its pitch. Now $\frac{1}{6}$ of $\frac{1}{4} = \frac{1}{24}$ for one revolution of shaft; hence, as $\frac{1}{24}$in. : 1ft. :: 1 : 288 revolutions of crank-shaft for 1ft. screw advances drill.—SCOTCH WORKING MECHANIC.

[48550.]—**Bricks, Tiles, and Kilns.**—In reply to the query of "H. G. B.," ENGLISH MECHANIC of Nov. 10th, I can recommend a capital book on the subject, namely, "The Manufacture of Bricks and Tiles," by Edward Dobson; illustrated, 3s.; published by Crosby Lockwood and Co., 7, Stationers' Hall, Court, London.—F. EVERITT.

[48552.]—**Electric Bells.**—In the single-stroke bells no contact-breaker is used; the two wires from the coils are attached one to each binding-screw. The magnet is placed so that the armature strikes it just before the clapper reaches the bell. You will find a good description of continuous-action bells on page 132, last volume, No. 890.—SEAWEED.

[48561.]—**Induction.**—In the annexed diagram is shown the plan of an induction coil with the wire connections and contact-breaker. The wire A proceeds from the inner end of the primary coil to the pillar E, which carries the contact screw. The wire B is from the outer end of the primary to the binding-screw Z. Another short wire connects the other binding-screw C with the pillar F, which carries the vibrating spring and hammer. In a spark-coil the condenser wires are attached one to the pillar E, and the other to the pillar F, and the ends of the secondary coil are brought to the glass pillars G and F. In a coil for shocks G and F are only common binding-screws, and no condenser is wanted. The battery is connected to the binding-screws C and Z. Glued or sized paper is less value than unsized paper as an insulator.—J. SUTCLIFFE.

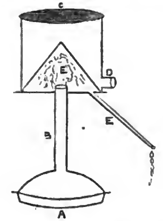


[48566.]—**Zinc Cleaning.**—To clean zinc, mix one part of sulphuric acid with 12 of water. Dip the zinc into it for a few seconds, then rub with a cloth.—SEAWEED.

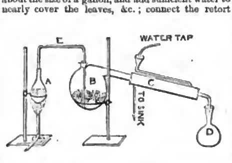
[48573.]—**Spindles in Woollen Mills.**—I hope no one will be discouraged because "South Eastern" has not been successful in using up the above. Such spindles, I know, can be bought from almost any ironmonger, and are largely used for drills, chisels, tools of various kinds; also pins, studs, and other machinery uses. I am proud to own a collection of drills for ratchet brace, made from slubbing frame spindles, and find they will stand at least as much rough usage as drills from ordinary tool steel. I have also other tools made from spindles. The point to be careful in is in forging; don't heat too quickly, and temper, say for a drill, to blue.—LABOR OMNIA VINCIT.

[48576.]—**Nuisance—Smoke—Smith's Shop.** To MR. WETHERFIELD.—Please accept thanks. Here follow the answers to your several questions respecting my query:—1. Seven years. 2. Uncertain. 3. An ordinary low red-tile chimney, level with my own building. 4. About two years. 5. An organ pipe-making factory. Shall be very grateful for early reply.—A. P.

[48578.]—**Distilling.**—"One in a Fix" should put his leaves, flowers, and herbs in a saucepan with some clean water, and then put the apparatus described below on the saucepan. Boil the contents over a slow fire, and the steam condensed by the apparatus will be what is required. The apparatus is made of tin. A is a cover made to fit tight to the boiler or saucepan; B is a tube leading from the top of A into the bottom of C; C is a round vessel, and is to be kept filled with cold water. When the water gets warm, draw it out of cork-hole D, and refill with cold water. E is a kind of funnel, put, in the making of the apparatus, between the bottom and the body of C. F is a tapered tube fixed to the bottom of C, from which drops the condensed steam. If "One in a Fix" likes to advertise his address, I will tell him where to buy an apparatus cheap.—W. H. PARK.



[48578.]—**Distilling Herbs, &c.**—(1) To obtain an aqueous solution of the odour of flowers, leaves, herbs, &c., the process generally adopted is to place the bruised leaves, herbs, &c., in a retort of about the size of a gallon, and add sufficient water to nearly cover the leaves, &c.; connect the retort with a Liebig condenser, and the condenser with a receiving vessel; apply the heat of a Bunsen burner to the retort, and distil half the quantity of water added, and you will find that the distillate contains a fine odour of the plant, &c., used. (2) "The process by which volatile oils are usually obtained from flowers, leaves, &c., on a small scale, is to place the bruised material in a retort, B, adapting the retort to a Liebig condenser C, and passing steam, generated in a flask A, through a glass tube E, to the bottom of the retort. The steam, in its passage through the substance, will carry the particles of oil over the neck of the retort into the condenser, and thence, liquefied and cooled, into the receiving vessel D, when the oil will be found floating on the water." The oil may be collected by running off the contents of D through a glass funnel, having a stopcock in the neck. After this is done, you will find that the water contains a much finer odour of the substance used than in the first instance.—BLAKE BENJAMIN.



[48591.]—**Screw-Taps.**—I have made dies frequently with the usual working taps: they always made practically a good enough job.—SCOTCH WORKING MECHANIC.

[48591.—**Screw-Taps.**—"Young Turner" should not stigmatise as impossible the making of dies from ordinary taps, simply because he is not acquainted with the method. I venture to give the method I followed in New Zealand, in a part of that colony where hubs or lathes were out of the question altogether. Stock (double chamfer) made in usual way; dies well fitted and screwed hard home; hole drilled from the centre of the division of dies, and carefully tapped. On removal from stock, sufficient filed off to allow dies to close, and clearance holes drilled, relief to cutting edges, &c., filed, and the dies carefully tempered. I have in my possession a lot I made in above manner from $\frac{1}{16}$ upwards to $\frac{3}{8}$in. of Whitworth's and brass threads, and their work will compare favourably with that of almost any shop-tools of the kind ever used. I am not an amateur, but a practical fitter of 25 years.—TAKAPUNA.

[48598.]—**Tinned Meats.**—It is mere fancy, as Mr. Scott supposes, the idea that tinned meats do not contain as much nourishment as fresh meat. The fancy may have arisen in this way—that Australian mutton, for instance, is not so rich as ours, and, being thoroughly cooked, one can eat a great deal of it. Personally, I like the fat of boiled Australian mutton, and it likes me, whereas I can't eat the fat of a cold shoulder. Hence, if I sat down to the tinned meat I should eat more than if it were Southdown cooked yesterday. All fresh joints that are intended to be served as boiled should be put into hot water in order to avoid, as much as possible, the waste by extracting the juices.—NUN. DOR.

[48600.]—**Speeding.**—The simplest way to find the speed of pulleys and gearing-wheels is, I think, as follows: Multiply the diameter in inches, or number of teeth in driver, by its speed per minute, and divide the product by the required speed of driver.—D. WOODHEAD.

[48601.]—**Transparent Photo. Views.**—Your ideas seem to be somewhat mixed. Given suitable negatives, you can, as a matter of course, obtain any number of transparent positives from them, either by the wet collodion or gelatine dry process. Transparencies might be made from paper prints, but the result would be a long way inferior to those made as above. In copying, a good deal depends upon the care and skill with which the copy is made; but there is always a little falling off in quality as compared with a print from a good direct negative.—W. ROBINSON, JUN.

[48605.]—**Photographic Enlarging.**—Probably the apparatus described in Vol. XXXIV., p. 225, would suit you.—W. ROBINSON, JUN.

[48612.]—**Silvering Process.**—"Altair" will find Brashear's silvering process in No. 794, for June 11th, 1880. His other question as to what I mean by "commercial process," I can only answer by saying the process which is followed by those engaged in the trade of silvering looking-glasses with pure silver. It is a trade secret, and is kept so. I think it is a modification of Rochelle salt process. It is very cheap, gives a very firm, hard, adherent deposit, of any thickness. I have a flat so silvered, which is absolutely impervious to sunlight, and seems perfectly certain in its results on the largest surfaces. I do not believe a surface of 100ft. superficial presents any difficulty whatever.—EDWIN HOLMES.

[48614.]—**Warping of Lathe-Beds.**—I believe I am right in supposing that every casting is more or less in a state of tension, and is what in an animal we should call "hide-bound." If, therefore, the hard skin of the upper surface alone is removed by the planer, this surface will become convex, whereas, if planed on both faces, the bed will be level. I think this convexity may increase gradually, so that when issued from the factory, the defect may not be recognised. All lathe-beds should be first planed at bottom, and afterwards finished on the upper surface; but very possibly some makers of the small lathes may deem it unnecessary to do more than face the top. But if the bed is not substantial, it may even be made convex by screwing up too tightly the bolts attaching it to its standards.—O. J. L.

[48617.]—**Horse-power and Screw-Propeller.**—I am sorry I cannot give the approximate h.p. of engines: but I will give you a hint about propellers. I am engineer of a boat, 85ft. long, 18ft. beam; her draught is 7ft. 6in. aft, and 6ft.

forward; cargo, 130tons. The engines are 20 nominal h.p.—viz., high p., 11in., low, 22in., with 18in. stroke. Boiler-pressure is 65lb., revolutions, 130. Propeller is 5ft. 4in. diam., 7ft. 6in. pitch; speed, 10 miles in still water (River Ouse). We have Norfolk's patent propeller, it being the only one of that kind afloat; it is 2 miles per hour faster than the propellers in general use. I have pleasure in recommending this propeller to you, believing it will speed your yacht to 11 or 12 miles. I may also say the boat is got under way very promptly, either ahead or astern, and the violent agitation of the water and side wash, usual with the common form of propeller, are altogether done away.—J. Gridgeman, s.s. *Two Roses*, York.

[48617.] — **Horse-Power and Screw-Propeller.**—The h.p. derived from your engine when running at 135 revs. per minute, is approximately 90. I could have told it you with more certainty if you had mentioned, among your other dimensions, the volume of the receiver; but not knowing this, I have taken the pressure of steam on entering h.p. cylinder at 6lb., and a mean back-pressure in the h.p. cylinder equal to about 5·5lb. I presume it is a printer's error that I read, vacuum 35·5in., and I think you mean it for 25·5in., and I have used this latter number in my calculation. It is absurd to cut off steam at $\frac{1}{10}$th of the stroke; you had better alter your valves so as to cut off at $\frac{1}{4}$ or even $\frac{1}{3}$ stroke. This explains why the draught-plates are required to be closed so often. In cutting off at $\frac{1}{10}$th stroke you scarcely use any steam, though what does enter the cylinder is of 70lb. pressure; and as you cannot very well get up a higher speed, your boiler generates steam faster than you can use it, and consequently you have to shut the draught-plates. With regard to the pitch of propeller required for a faster speed, you are probably now using one of 7·4ft. pitch, and to obtain a speed of eleven knots per hour you will want one of 9¼ft. pitch, allowing for a positive slip of 15 per cent. if you continue to run your engines at the same speed. But for eleven knots an hour you must have three times the power required for 8½ knots, and consequently your engines will have to be of at least 270 h.p., since the power varies as the cube of the speed. You will, of course, obtain a greater power from engines by making more use of the boiler and not expanding so much; but I am afraid you have trouble in getting 11 knots an hour as you wish.—H. B. G.

[48620.]—**Portrait Lens.**—There must be some mistake; either your camera does not expand sufficiently, or you have forgotten what was said about using stops. Your proposed combination would not answer at all, though you might make a doublet by obtaining another lens similar to the front lens, and placing them with the flat sides towards one another, at about 1in. apart and with a stop between.—W. Robinson, Jun.

[48621.]—**To Mr. Lancaster.**—You cannot produce positives in the camera direct. You must first take a negative, and then print a positive from the negative. This, of course, you know all about; if not, I will tell you.—W. J. Lancaster.

[48623.]—**Moleskins.**—A very cheap and efficient way to preserve moleskins is the following. I have often tried it, and can thus vouch for its answering:—Stretch the skin well on a board, with the fur downwards, and keep it in position by nailing it with tinned-tacks round the edge. Then saturate it with spirits of camphor, and rub it in; after this pour about a teaspoonful of rum on, and rub this in with common yellow soap, and leave it to dry. In two or three days it will be ready for taking off, and will be found to keep stretched, though limp through the application of the soap. They will keep thus for any length of time in a fairly dry place.—H. B. G.

[48623.]—**Moleskins.**—I am about trying the following, as soon as I can get a mole; perhaps it may be of some use to "A. C. W." It appeared in *The Country* in 1878:—"Nail the fresh skin tightly and smoothly against a door, keeping the skinny side out. Let him next proceed with a broad-bladed blunt knife to scrape away all loose pieces of flesh and fat; then let him rub in much chalk, and be not sparing of his labour; when the chalk begins to powder and fall off, let him take the skin down, fill it with finely-ground alum, wrap it closely together, and keep it so in a dry place for two or three days; at the end of that time let him unfold it, shake out the alum, and his work is over."—T. E. L.

[48626.]—**Toning Solution.**—To Mr. Lancaster.—Toning solution: chloride of gold, 1gr.; acetate of soda, 30gr.; distilled water, 8oz. This should be made up a day before being used, and will keep for a long time.—W. J. Lancaster.

[48639.]—**To "M.I.C.E." or Fred. Walker.**—Steam obeys the same laws as regards compression, expansion, and consequent increase or reduction of pressure, as air or any other elastic gas. If we have a cylinder and piston, the piston being at one end, and we push the piston half-way down the cylinder, the pressure will then be double of what it was at first. If we push it still further so that the steam or air is reduced to a quarter of its bulk, the pressure will be four times what it was originally, and so on. The pressure will, therefore, be inversely proportional to the bulk or volume. This is usually shown graphically by taking a straight line to represent the length of stroke. Divide it into a number of equal parts, and from one end draw a line perpendicular, on which mark off to any scale the pressure that there is in the cylinder (if air, at ordinary pressure, it will be nearly 15lb. on the inch), then raise perpendiculars from the other points and mark off the various pressures calculated as above. The line joining the ends of these ordinates will form a curve which is called the hyperbola, one of the conic sections. In the case supposed in the query, where the back pressure is 15lb. on the inch, I presume that this means the absolute pressure, that is to say, that it includes the pressure of the atmosphere, which itself is nearly that amount. When the exhaust port is closed by the valve, the piston being 3in. from the end of its stroke, and 4in. from end of cylinder, the pressure in the inclosed space is 15lb. on the square inch, whether steam or air. If the piston is then moved on 3in. the volume will be reduced to one quarter, and the pressure will, therefore, be four times 15lb., or 60lb. on the square inch; but before then the "lead" would have opened, which would either increase or reduce this pressure, according to the pressure in the boiler.—M.I.C.E.

[48639.]—**To Fred. Walker.**—Boyle's or Marriotte's law reads thus:—"The volume of a given weight of gas varies inversely with the pressure; the temperature remaining constant." Showing, therefore, that when steam is cut off in the cylinder of a steam-engine during the stroke, the pressure decreases in direct proportion to the increase of space that the steam occupies; and the same law of course applies to the case you cited, that decrease of space between the piston and cylinder-cover is followed by an increase of pressure in the same proportion; temperature supposed to be constant.—Fred. Walker.

[48643.]—**Photography.**—As the defect complained of might arise from various causes, it is difficult to point out the precise reason, in the absence of full particulars as to formulæ used and method of working. Supposing your collodion, bath, and developer to be compounded according to any of the usual formulæ, the most likely reasons are insufficient sensitising, or too short exposure. Then, again, beginners who have never seen the operations performed, are apt to make curious mistakes in manipulation, such, for instance, as taking up a large bottle of developer, and pouring it over the plate like water from a tap. Did you do anything of that kind?—W. Robinson, Jun.

[48641.]—**The Diurnal Inequality of the Tides.**—If the writer of this query had submitted his difficulties to a few minutes' consideration, I should almost imagine they would have disappeared altogether; however, here is the explanation he requires. The distance between the moon's centre and the earth's surface directly under it being less than the distance between their centres, it follows that the attraction upon the waters on this side of the earth is greater than that upon the earth's centre, the waters, not being rigid like the earth, are pulled away from it and heaped up under the moon. Again, the distance between the moon's centre and earth's centre being less than that between the moon's centre and remote side of the earth, it follows that the earth (the earth must move with its centre) will be pulled away from the waters on this side, having them heaped up to the same extent as on the side directly under the moon.—L. Bentley.

[48645.]—**Pump.**—The simplest pump you can have for your purpose, and the one that will give the least trouble, is a bucket-pump. So you may proceed to take your ideas from an ordinary kitchen pump (which is one of the same class). Let the barrel be 8in. diam. inside, and the bucket have 12in. stroke. The bucket should be packed with leather, and is best made of brass. There should be a joint on the top to allow for the vibration of bucket-rod, or what is better, let the bucket-rod work through a guide, and use a forked connecting-rod. The suction and bucket-valves may be of leather, weighted with lead. The engine should drive the pump by gearing, so that the engine will make 3 revs. to 1 of the pump. A pin may be fixed in one of the large wheel-arms to work the pump. Taking the speed of pump at 40 strokes per min., this size bucket will deliver over 80 gals. per min. A centrifugal is a good pump when in good hands, and, I think, would be beyond your means to make. Besides this, it requires pinning before you can use it, unless fitted with an exhausting arrangement, and is moreover a ticklish pump to put into inexperienced hands. I, therefore, incline to a bucket-pump for reasons stated above. If you require any further particulars, write again.—Labor Omnia Vincit.

[48649.]—**Bean-Mill.**—The rollers are, no doubt, chilled. They cannot be softened and then re-hardened. You must use a diamond tool to cut them.—Labor Omnia Vincit.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47936. Machine for Making Jack Chain, p. 45.
47943. Locomotives, 45.
47954. Sea-shore, 46.
47965. Glaze for Fireclay, 46.
47967. Pattern-Making, 46.
47968. Dynamo, 46.
47971. Gas-lighting Spark Coil, 46.
47978. Violin, 46.
47981. Steam Plough Engines, 46.
47989. Scroll Chuck, 46.

48209. Shive-making Machine, p. 145.
48212. Dynamo, 145.
48223. Irish Locomotives, 146.
48224. Torches for Processions, 146.
48228. Artificial Birds' Eyes, 146.
48230. North London Engines, 146.
48236. Iron, 146.
48237. Equatorial Circles, 146.
48240. Insulation of Coil, 146.
48245. Burning Ballast, 146.
48248. Potato-mashing Machine, 146.
48253. Spiral Apparatus, 146.
48255. Breaking Weight of Rolled Joist, 146.
48257. Milky Way, 146.
48266. Cutting Cotton Cloth, 146.
48270. Locomotives, 146.
48272. Magnesium Lamp, 146.

QUERIES.

[48654.]—**Heating Apparatus.**—I should be glad if some practical engineer would give me information respecting the cheapest efficient mode of warming a chapel. The seating capacity of the building is 450. The people who worship in the building are very poor, and cannot afford a costly apparatus; but several of them could construct one if furnished with a simple plan. Kindly give some idea of the required outlay.—Clericus.

[48655.]—**Model Locomotive Coupling-Rods.**—Can any reader tell how to put the gunmetal bushes into coupling-rods? Also, how to cut the slot for the cotter? The rods are cast in malleable iron.—Shakespear.

[48656.]—**Model Axle-Boxes.**—Can any reader help me? I want to make axle-boxes with closed fronts for a tender. The diam. of journals is 5-12in. I should be much obliged for a sketch, as I have no drawings, and have to make tender by guesswork.—Shakespear.

[48657.]—**Ground Landlord and Tenant.**—To Mr. Wetherfield.—I am the owner of a plot of freehold land, upon which is built a couple of leasehold houses on a lease of 99 years. The owner of the said houses has paid me the ground-rent regularly up to eight years ago, when he borrowed money on these houses from an auctioneer, who now collects the rents, and has possession of the deeds, &c. On the occasion of his paying me the ground-rent, he has paid me less the income tax, from which I am exempt; and not only has he done that, but he refuses to let me have the receipt which is given in such cases, so that I might claim exemption. Is he not acting contrary to law by so doing, and what should I do to right myself in the matter?—Fair Play.

[48658.]—**To Dr. Edmunds.**—I am suffering from a scrofulous disease, and am thinking about emigrating to one of the Colonies or America (Far West), I don't care which. What place would you advise me to go to that would most benefit my complaint?—Progress.

[48659.]—**Magnetic Generator.**—I thank "Sigma" for his reply respecting dynamos, but I have since decided to make a powerful magnetic generator on the principle of the Alliance machine, in which electros revolve past the poles of powerful steel magnets, as it is difficult to arrange commutators to act several times in one revolution. Will the alternate current that will be generated light the incandescent form of lamp, as this alternate method would be simpler to construct?—Electra.

[48660.]—**Legal.**—To Mr. F. Wetherfield.—A. sells two houses to B., which let weekly. C., who lives in one, has been receiving the rents. As A. had borrowed money on the title deeds, B. paid A. £70 on the Tuesday in advance, to enable A. to get the documents from D. The "conveyance" was signed, and remainder paid on Thursday, when A. promised to give tenants notice to pay rent to B.; but when B. called the next Monday, A. had not done so, but C. had drawn the rents as usual. Is B. entitled to that week's rent that the purchase is completed on Thursday? Kindly advise me what to do.—Act Square.

[48661.]—**Sick Child.**—To Dr. Edmunds.—I shall be much obliged for any advice Dr. Edmunds can give me: My little boy, aged 7, has been for the last three years subject to a periodical disturbance of the stomach, lately becoming more frequent. About one week in every four he is laid up. I have consulted a medical man more than once, but without effect; and I cannot afford a doctor's bill every month. The attack begins with loss of appetite, head-ache, and lassitude; his face becomes grey and pinched, with dark circles round his eyes. In a day or two sickness and vomiting ensue, which gradually pass off; but his appetite does not return for a week. I give him senna as soon as I see the first symptom. The child becomes weak and thin, and then just as he is picking up another attack comes on. I am careful to give him nothing but plain, wholesome food—no sweets or anything to upset him, and he has as much outdoor exercise as possible, and, except in winter, a cold morning bath. In summer nettle rash accompanies the upsets; but last summer this was not very noticeable. Would tonics or cod-liver oil do him good? Is he likely to grow out of it?—A. Bartlett.

[48662.]—**Painting Iron Tank.**—A cast-iron tank has been constructed and fixed on a tower for the supply of water to a town. The tank was fixed about 18 months since, and painted with ordinary oil-colour on inside faces. This is now patchy, and it must be done again or treated in some other way. It is very desirable to have a quick-drying process, as much in convenience would be felt if the tank was long empty. Would two or three coats of ordinary limewashing answer as well as paint, and preserve the cast-iron, or can any correspondent suggest a method which he has known to answer? Experiences are sought.—Tank.

[48663.]—**Printing on Bone.**—Can any reader tell me how the best tooth-brushes are printed. I have tried a smoked punch, but that is not good enough. I want to print on a round surface.—S. W. J.

[48664.]—**The Laws of Moving Bodies.**—Given the weight of a flywheel revolving at a certain speed in feet per second, how am I to calculate the force it would give out in resisting an increase of speed in a very short time, say half a second? Could it be got by the formula $\frac{\frac{1}{2} m (v^2 - v_1^2)}{t}$? Take the wheel of a Silver's marine governor which is loose on its shaft, but kept in place by a spring. Say the wheel weighs 20lb., and revolves at a speed (at the rim) of 15ft. per second. If that speed is increased to 20ft. per second in half a second of time, what force or pressure would the spring have to exert in order to just overcome the inertia of the wheel, and thus prevent it from hanging back, as it were, at its normal speed. It should be understood that, the wheel being loose on its shaft, all turning power is given to it through the spring.—J. G. H. B.

[48665.]—**Water.**—With 100ft. head of water, what number of gallons per hour would pass through a 2in. pipe at one mile distant from head, the 2in. outlet being on a 6in. main? In reply, would correspondent kindly give simple rule for working this out, and oblige—Pressure?

[48666.]—**Jams and Pickles.**—Wanted information on the above subject. Hints on the selection of fruits, the kind of sugar used, the construction of the boiling-pans, the material for covering the jars when filled, &c.—J. L. T.

[48667.]—**Induction Coil.**—I am making an induction coil, and after having wound on a few layers of the secondary wire, I am unable to get an induced current by testing it in the usual manner. If the secondary wire is connected with the battery, the needle is at once deflected, thus showing the secondary is not broken, and a like result is obtained when testing the primary. I use two Leclanché cells for testing, and have inclosed the core of iron wires in a piece of iron tubing. I shall feel extremely obliged if any of your valued correspondents will tell me what is wrong, and how to remedy it.—Zero.

[48668.]—**Sawing Meat by Machinery.**—I carry on a large butchering business, and would like to know if sawing beef by machinery could be introduced. I have a good gas-engine for working a chopper, and would like it I could get a saw or saws of the proper kind driven so that the different joints could, I think, be cut much better and certainly much quicker.—J. Branagh, Belfast.

[48669.]—**Methyl and Ethyl Cacodyl.**—Would some kind reader give a method of preparing each of the above, with equations?—Beginner.

[48670.]—**Estimation of Nitric Acid in Nitrates by Fusion with Potassic Dichromate or Quartz.**—Would some reader who has used this process kindly favour me with full working details of it or of some equally simple process (gravimetric)? I have never succeeded in making a satisfactory determination of nitric acid by it, but I expect it is owing to errors of manipulation, as the details given in most books are very meagre.—Beginner.

[48671.]—**Micro-Photography.**—Can "Orderic Vital" or some other correspondent please inform me whether the visual and actinic foci of a micro-objective in use for photography are the same distance apart, whatever the distance of the ground-glass screen (or sensitive plate) from the objective? If not, of course it follows that a different correction would be required when the screen is near the objective from that required when it is at a distance from it. If the distance varies, please give a formula for caculating the correction at different distances, and then that for one distance has been found experimentally.—Density.

[48672.]—**Sand-Blast Files.**—Some years since the "E. M." republished an article from an American paper, illustrating and explaining the process of sharpening worn files by the sand-blast. Having been struck with the novelty of the process, I had several files blasted at the sand-blast works in Gray's Inn-road. At first they cut well—actually better than new;—but the edge soon went off, and on the whole I concluded that new files were the cheaper in the end. From conversations with others who had tried them, I found my conclusions generally confirmed. Lately, I have heard new sand-blast files mentioned with praise. Have any of the "E. M." readers had any experience with them?—J. C.

[48673.]—**French Locomotives.**—To Mr. Gobert.—As you have kindly volunteered information on the above subject, I venture to ask you the following queries:—Can you give dimensions of single engines on the Western Railway of France by Buddicour? They have driving-wheels 6ft. 7in. or 6ft. 10in. (I think). Last June, I travelled behind one of this type on the Tidal express, ex St. Lazare as far as Rouen. The date was 1853. There was a smaller class came out in 1843 with 12¼ cyls. and 5ft. 6in. drivers. There are some tank-engines shunting about Paris and other stations between Rouen and the Capital with what seemed to me to be an enormous length of stroke (cyls. outs., and leading and driving-wheels coupled). Can you tell me anything about them? Secondly, with regard to the P.L.M. locos., can you give me any information as to the express engines which succeeded the Cramptons, and have been in their turn succeeded by the enormous eight-wheel four-coupled express engines which now work the express traffic to Switzerland and the South of France. I have noticed two classes of goods engines—First, outs. cyls., date about 1873; secondly, ins. cyls., date 1878, or so. Can you give particulars of these classes?—Carstairs.

[48674.]—**Dimensions of Focal Images.**—To "F.R.A.S."—As I cannot make the results of actual trials agree with the figures kindly given some time ago by "F.R.A.S.," I hope he will excuse my again putting the question in a simpler form, discarding the eyepiece, and giving the query in the shape of an example. Suppose, then, we direct a telescope, whose object-glass is of 56in. focal length, to the sun when the sun's angular dia. is 32′, and (having removed the eyepiece) carefully focus the image on a card. What will be the diam. in hundredths of an in. of such image, and so for any other object or focal length?—Lens.

[48675.]—**M.R. Engines.**—Wanted principal dimensions of 51, 71, 82, 84, 115, 115A, 146, 147, 150, 1090—1101. Also size of cylinders of the rebuilt singles 141A, and Peacock's 174.—C. H.

[48676.]—**Disconnecting Traps.**—Can any of your readers who are learned in sanitary matters give me any information regarding "disconnecting traps" to be placed at the point where house-drains run into the main sewers. I should like to know the arrangement of the trap, mode of action, and approximate cost of the trap, also the name of the maker? The disconnecting trap was recommended in the report of a sanitary officer; and as reference to gully-traps and deep siphons was also made, I imagine some special form was intended.—Lavant.

[48677.]—**Sharpening Gimlets.**—Will "Jack of All Trades" kindly tell me how to sharpen twisted gimlets? I have often tried, but have never made a good job of it.—Mechanical Puddler.

[48678.]—**Oiled Paper.**—Can any of your readers help me as to the best method of preparing oiled paper so as to insure rapid drying and freedom from stickiness? I have for some years used boiled linseed oil specially prepared with dryers for this purpose, with very uncertain results: sometimes the paper turning out all right, and at others just the reverse. Or can they suggest any other preparation for waterproofing paper which would be more satisfactory. Parchment paper is too expensive for my purpose.—A Manufacturer.

[48679.]—**Spiral Turning.**—Will some one be kind enough to tell me the way spiral wood-turning is done by the common lathe or the machine lathe?—J. H. B.

[48680.]—**Horizontal Slot Drilling-Machine.**—Would some one kindly inform me how the horizontal slot drilling-machine is worked? How is the driving-strap kept tight while the saddle travels up and down the bed of machine?—A. B.

[48681.]—**Hydraulic Cement.**—Will some of ours kindly give formulæ for making a cement containing silicate of soda that will not take longer than 48 hours to set?—Inquisitive.

[48682.]—**Analysis.**—Will Mr. Allen, or some other kind reader, give a method of determining quantitatively the amount of free cyanide of potassium in a silver-plating solution? If it is possible to estimate volumetrically, please mention what is the best sol. to use as an indicator to show the completion of the reaction.—Iodine.

[48683.]—**Rain-Gauge.**—To "F.R.A.S."—Thanks for your reply; but would you please give the weight of a 1in. rainfall from a 9in. square gauge in avoirdupois ounces, as glassmakers refuse to take an order for one truly cylindrical vessel 2in. diam.; whereas if I know the weight, I can graduate it (the vessel) by measure or weight.—M.M.I.Sc.S.

[48684.]—**To Mr. Wetherfield.**—I have supplied a party with goods, and duly rendered my invoice, which bears a heading that interest will be charged on overdue accounts, and all discount forfeited. I have received the net amount of the invoice long after the time; but my customer states he never agreed to pay interest, and refuses to do so. Can he resist my claim for it?—Sartor Urbanus.

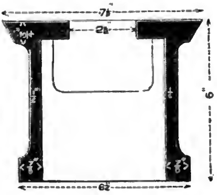
[48685.]—**Churchyards.**—To Mr. Wetherfield.—Recently I believe there has been a new Act to regulate parish churchyards. Could you or any correspondent inform me if, when an existing vault is inclosed with stone coping and railings by the legal representatives of the deceased, the clergyman of the church has either any legal right to fees or any legal control over the vault whatever? I understand he has neither a claim for fees nor any other control than interference if there is obvious indecency in the epitaph or construction?—Shah Jehan.

[48686.]—**Focal Images.**—To "F.R.A.S."—In letter 20460, Vol. XXXVI., p. 11, occurs: "One will scarcely succeed in raising a satisfactory disc on a star with less power than about 35 to an inch." Is it then satisfactory to see a star as a disc, rather than as the bright star a lower power gives? With 130 on 4in., I see a disc with one or two encircling rings that are baffling with closer doubles. Is this a fault in the o.g., or is it unavoidable? I should be glad to see more of "Prismatique's" practical application of "Orderic Vital's" admirable papers on the o.g.; for if a larger aperture be reasonably attainable in an o.g., I, for one, will not "bother more about specula" and their difficult adjustment and general unreadiness.—R. K. P.

[48687.]—**Length of Slot-Link.**—Would some one give me a rule for finding the length of a slot-link such as used in locomotives?—E. S.

[48688.]—**Condenser.**—Could any reader inform me if the following form of condenser would suit a small pair of double compound engines, h.p. 2in., l.p. 4in. diam., and 3in. stroke? I propose making my condenser in the form of an injector, having the exhaust steam for drawing the injection, and having a small jet about ⅛in., in order to keep a constant flow. Do you think would the steam be condensed quickly enough by its contact with the water, and whether it would form a good vacuum, and whether the condensed steam and water would have sufficient momentum to carry itself away any distance?—Norra.

[48689.]—**Lathe-Bed.**—I wish to make my own pattern for lathe-bed according to section. It is intended to be 6ft. long, and to have a gap, with three or four strengthening ribs as shown, and to be cast face down. From the practical experience shown by some of our friends a few weeks ago, in the discussion on casting and castings, I am inclined to ask those who are practically acquainted with the subject to tell me, from the section given, will the bed come from the moulder's hands with a straight face? If not, will it be round or hollow? Knowing this, I can make allowance in the pattern. I think this is a question that will be of some importance to others as well as myself. I have had some experience with patterns and castings, but not in the shape of lathe-beds. In reply to "W. E. H.," No. 48614, regarding lathe-bed being out of truth, I may say that putting aside the case of castings which have been drawn, as we say—that is, hammered to make them straight before put on to the planer table, because these always go back more or less when the hammer marks are planed out—I may say that I have seen castings that have been straight when put on the planer, turn out sometimes hollow and sometimes round. I think much depends on the metal (and the casting may have been sprung by careless fixing to the table). Sometimes the planed surface seems to expand, open out when the surface is taken off, and so, when liberated from table, proves to be round. On the contrary, at other times it will be hollow. When possible, it is better to plane both sides of a casting. I suppose with cheap work, if a bed don't turn out to be just straight, they don't care to take another cut—which would make the work better. Although I must say I have taken cut after cut from a casting, and got little improvement for my trouble. Perhaps some of our friends may be surprised when I say that if I can get a straight casting from my pattern, I intend to chip and file it true, face as well as angles. I have no doubt I will get it more satisfactory than some planing I have seen. My intentions are to bolt the bed and standards together, then make the bed true as it stands with its own weight.—E. P., Liverpool.



[48690.]—**Magnetic Storms.**—An extraordinary magnetic storm is reported from America. It disarranged all the telegraphs, and yet messages were sent 700 miles without a battery! Will some one say, though, is it possible for an electric light, which ordinarily requires an 8-h.p. engine (rather a large light), to be worked by a magnetic storm? The statement is definite: the "electric light was kept burning for some time by the storm alone."—Down East.

[48691.]—**Quinine and Iron Tonics.**—To Dr. Edmunds.—I have been advised to take a little iron internally, for poorness of blood, by several doctors. Iron and quinine is often recommended for this purpose; but one medical man informed me it was a wrong combination, as iron should always be taken at or after meals; quinine before meals. Taking them together spoiled their effects. As this is a very important question, I should be glad of the opinion of Dr. Edmunds or others.—J. B. B.

[48692.]—**Geneva Cylinder.**—To "A F.W." on "Alfojob."—Will you please give instructions how to gauge or arrive at the proportions of a cylinder—i.e., how to find depth of cylinder below slot, height of balance, &c., in case a Geneva watch is presented for repair without cylinder? Also tools required.—Hall.

[48693.]—**Spontaneous Generation.**—I should be much obliged to any reader who would kindly direct me to literature on above subject, and also to that on minute organisms. At the same time I should be glad to know the size of tubes used by Tyndall in his experiments.—L. V.

[48694.]—**Displacement, &c., of Steamships.**—Can any reader tell me how to find the displacement and immersed midship section of steamships, so as to compare the results?—W. Robinson.

[48695.]—**Medical.**—Could any reader advise me what to do with my feet? I have had rheumatism this last twelve years; but this last year or two it seems to affect my feet, as though it would settle in them. I can hardly walk, they are so painful.—E. R. B.

[48696.]—**Saddles.**—Will some reader kindly instruct me as to making above?—Saddler.

[48697.]—**Fan.**—Can any one inform me how many vanes a 10in. fan should have?—A. Rolls.

[48698.]—**Legal.**—A. having bought a house and shop from B., and B. leaving a portion of the purchase money on mortgage, A. neglecting to pay either interest or principal, can B. take anything from A., more than the house and shop, A. having purchased the stock at a valuation, and paid cash? If B. can take more than the house and shop, what can be take?—Bolton.

[48699.]—**Pilgrim Signs.**—To Antiquaries.—Will some of our readers interested in antiquities kindly give me any information they may have relative to the above? What pilgrims were they made for, why, and how worn or used? What do the characters and inscriptions on them mean? Are they always the same, always of lead? I have one in my possession in very good preservation, dated 1002, with an inscription, and on one side the figure of a king with crown and sceptre held horizontally over his shoulder, and on the reverse side an inscription surrounding two little figures seemingly dressed in chain mail, and bearing upright rods in their hands, or spears. This lead medal-shaped sign has a sort of square handle projecting from its upper rim, which looks as if it was meant to be threaded by some ribbon or something for suspension. Are these signs of any value now, and if so, what is the probable value of mine? I forgot to say that it measures about 3in. across. Where are they generally found?—anywhere else besides in Thames valley gravel and mud? If not clear enough, I will, providing Mr. Editor thinks it sufficiently interesting, send a sketch with inscriptions, &c., in form of a letter.—John Hale.

[48700.]—**Lantern Transparencies.**—I have been successful in producing some very fair transparencies, but do not know how to tone them and give them that fine black appearance seen in bought ones. Any advice on the subject will be very thankfully received by—F. M. B.

[48701.]—**To J. Brown, Belfast.**—Having tried a mercury brake for a coil I have made, I find that though the coil gives a fair spark, yet the brake soon gets deranged. The mercury breaks up into globules, and a grey powder (the sub-oxide, I suppose) is formed which is held in suspension in the spirit. Now, I cannot think this is right. Would you please tell me if it is necessary to use platinum amalgam instead of mercury, and whether absolute alcohol is needed? I used methylated. Also, please say if the grey powder ought to be formed, and, if so, whether it can be prevented by the use of platinum amalgam? I shall be much obliged if you will answer these questions for me.—B. B.

[48702.]—**Model Loom.**—I am constructing a small model loom (power) in brass to the scale 1½in. to the foot. Should be grateful if any of your readers would kindly give a few hints showing how to proceed to polish and lacquer the prominent parts of framework. I also wish to give the retiring parts a good glossy black appearance. What kind of paint will produce this? Also, can miniature bolts be obtained for connecting the parts, or are there any nails which could be easily fashioned into small bolts?—L. Bentley.

[48703.]—**Legal.**—To Mr. Wetherfield.—My father died, leaving the place to his widow for her life, then to revert or go to one of his sons, A., for his life, then to his other son B., absolutely. If A. outlives B., and B. dies, willing the place to some person or brother other than A., has he, B., power to do so, or must it revert to A.? The widow is still alive. B. is the elder of the two.—Esquirer.

[48704.]—**Microscope Lamp.**—Can any reader suggest a cheap portable microscope lamp, one that could be carried in the pocket for use at meetings without fear of getting the clothes saturated with oil? Is there any small portable lamp for burning wax or composite candle? —C.

[48705.]—**Size of Back Workshop.**—I and another apprentice work in a shop as watchmakers which is 5ft. wide, 11ft. long, 7ft. high, and is heated by two ordinary paraffin lamps, which cause an unpleasant smell and give us the headache. Would someone kindly say what size a back shop for two to work in should be?—A. Hallett.

[48706.]—**Cement for Tobacco Pipes.**—Would "Jack of All Trades," or some other mechanic, kindly say what is a good cement for tobacco pipes? Something that the oil will not penetrate.—A. Hallett.

[48707.]—**Glass Colouring.**—Would some of my fellow-contributors kindly inform me how it is possible to illuminate glass borders by a process of colouring that will remain permanent, leaving the centre of the sheet of glass blank? I believe there is a good system of embossing or painting on glass that would answer the purpose, but I am ignorant of the process. Also the best means of obtaining correct copies of photographs.—A. A.

[48708.]—**Wood Turning and Bobbin Making, &c.**—I should be thankful if any reader of the "E. M." would give me any information that would assist me in commencing the above business, what kind of machinery to use, and how to buy the timber?—Young Joiner.

[48709.]—**Simplex Telephone.**—I am much obliged to "W. H." for the capital description of the switching arrangements in the above telephone (48417); but there are two points in his account about which I am not clear. He says, "In coupling the instrument, the L of one is connected with the E of the other." What does this mean? And again, near the end, "they can only be used in pairs, unless a separate switch is used with each instrument to reverse the poles of the battery." What does *they* mean; also, *in pairs*? I shall be grateful to "W. H." or anyone who can enlighten me on these points.—Cantab.

[48710.]—**Electric Indicator.**—I have fitted up a house with electric bells and indicators, and wish to know the best way to use them in connection with a five-cell Leclanché battery. At present the circuit is through battery, indicator, and bell. Now, would it be more advantageous to split the battery into two and use some of the cells to work the indicator and the others the bell through a relay? If so, what is the best division? I thought two cells for the main or indicator circuit and three for the bell. The farthest room is not more than twenty yards from indicator. Also, what is the least number of wires that can be taken from the batteries (in the next room) to the relay? Can it be done with three?—Cantab.

[48711.]—**Gearing for Lathes.**—To "O. J. L." and Others.—In "The Lathe and its Uses" favourable mention is made of Robertson's frictional gearing for this purpose, but I have not heard of it being used. If it answers as well, or nearly so, as the ordinary gearing, it seems to possess many advantages over it. It could easily be applied to a mandrel running in collar and back centre without interfering with the existing speed pulley. Would reverse cones of a wooden and iron wheel give bite enough for the purpose? If not, an extra wooden one could be fixed in front of the large speed. An opinion on this and hints in fitting up would oblige.—Nemo.

[48712.]—**Electric Light.**—Will any reader kindly say if it is possible to light incandescent and arc lamps from the same dynamo. Also, give approximately the resistance of a twenty-candle incandescent lamp and the average arc lamps.—Lux Sperans.

[48713.]—**Organ in Small Room.**—Four-stop pipe organ required to stand not higher than 4ft. 6in. Will some kind reader help me? I have been considering plans which appeared in this paper years ago—bellows made like two feeders, windchest placed under keyboard; but where pipes must be 4ft. 6in., that plan is not so advantageous. I desire to know whether or not I could put the windchest an inch from the floor and make a bellows to be placed at one end of the windchest, after the double-feeder style reared on one end? Or would it answer better to make a tall bellows with rings at each corner of ribs to rise on iron rods. Would this style of bellows give good supply of wind? It would, of course, add to length of instrument, but reduce height. Existing instrument just bought has stopped diapason throughout, diapason metal to tenor C, gamba to tenor C, principal metal throughout. About to reduce to size stated, I also wish to know, first, how to alter large wood pipes which give sound like those produced by blowing in a barrel. Other pipes, large metal, give false notes first and then come true. Gamba, a new stop, is voiced so soft that there is no real difference between it and open diapason, and gives a muffled sound. Can it be made loud and stringy, or can I alter stopped diapason to "open" Da., and make metal diapason into some other stop, as it is faulty in parts? Clear, full, round tone with power being required, what is best to be done?—Beta.

[48714.]—**Hydraulics.**—To Fred. Walker.—Please oblige me with the following information:—How many gallons of water should be discharged per minute from an iron tank of the following dimensions?—the tank 5ft. square, and 4ft. to the centre of the orifice to top of tank, and from the centre of the orifice to the end of a perpendicular pipe 2in. inside diameter, and 30ft. in height. —S. E. O.

[48715.]—**Watch Repairs.**—Would "A Fellow Workman" give a few hints on putting in new cylinders, the best way for taking proportion for watch, height of balance, &c.? Also, how to read a Jacot pivot gauge—the meaning of the different numbers at each side? Do they lead to the size of jewel-holes as well as the size of pivots?—X. Y. Z.

[48716.]—**Flat Feet.**—To Dr. Edmunds.—On reading your able letter in a recent number, I have come to the conclusion that I must be suffering from weakness of the muscles supporting the arch of the foot. I experience a curious dull pain under the instep, especially when I get out of bed in the morning, which is still more noticeable if I have been standing much the previous day. I believe a spring is sometimes placed in the waist of the boot to support the foot. If so, could you tell me how to make the spring, or inform me of some other remedy? I take the liberty of asking this, believing that many others are suffering in a like manner.—F. S.

[48717.]—**Screw Presses.**—Although a reader of the "E.M." for a number of years, I have not seen an article on screw presses that have to do with the production of brass checks. What I wanted to know is, whether our die-cutting friends could tell me what kind of press should be used for the production of checks from 1in. to 1½in.? If our kind friend "Robinson Crusoe," or "M.M.I.Sc.S.," would say what kind should be used, and whether the blanks could be cut with same, and state mode of fixing die to stamp head, &c., I should esteem it as a great favour?—A Tin-Plate Worker.

[48718.]—**Electric Switch.**—Will some of "ours" help me to make a switch for use at a colliery? I want to be able to switch one underground engine plane "off," and another "on." There are three wires along each road, and no earth wires. I propose placing switch at the junction of the two roads. A sketch would oblige—F. W.

[48719.]—**Engine Query.**—Will some one kindly tell me what size the steam ways should be for a 2in. stroke cylinder? Also diam. of flywheel for two cylinders of 2in. stroke each, and the substance of the crank-shaft?—M. M.

"**Hot Water.**"—On Monday evening Prof. Thorpe delivered a lecture on "Hot Water" before a large audience assembled in the Philosophical Hall, Leeds. In explaining the relation of heat to water, and of water to heat, the Professor showed how, unlike any other liquid, water was at its maximum density at 39·1° Fahr. This anomaly played an important part in nature, and in climatic influences, for ice being below this temperature, was lighter, and therefore floated upon water, instead of sinking and forming a continuous series of ice strata, which the heat of a long summer could scarcely melt. The effect of diminishing the atmospheric pressure upon water was next illustrated by a number of experiments, among which was the familiar process of making water boil by pouring cold water upon the flask in which it was contained. The application of the principle of rapid evaporation to freezing machines, was also demonstrated in a popular and attractive manner. But of the many experiments of the evening, the two that brought the lecture to a close were perhaps most appreciated by the audience. The one was the freezing of water upon a red-hot plate with the aid of liquid sulphurous acid; and the other was the plunging of the lecturer's hand into a mass of molten lead, as a proof positive of the fact that steam is a bad conductor of heat, and that the cushion of steam which separates a spheroid of water from close contact with a hot metal plate upon which it is formed, is the cause of the spheroid's failure to maintain throughout the temperature of boiling water.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 22, and unacknowledged elsewhere:—

J. J. Banks.—J. T. Chapman.—T. B. Etty.—R. Lloyd and Co.—S. L. Gregson.—S. A. Stewart.—W. F. Stanley.—Hunter and Sands.—W. G. Peudry.—J. T. H.—Yemllaw.—F. A. M.—Scotus.—Cock Laundress.—Spon.—Dicuram.—J. H. J.—E. S. Beaven.—A. le C.—Perplexed One.—Laundryman.—Felix.—D. Jones.—G.—Fred. Carre.—James Fearnley.—F. W.—A. H. Allen.—Mack.

Embark. (A little coil of fine platinum wire surrounding the wick is in circuit with a battery. On completing the circuit, the wire is heated by the current. A bichromate cell would, perhaps, be best, and the action would then consist in pressing the zinc down into the liquid. 2. No. 3. It depends on what you mean by "practical"; but the best book, so far as dynamo-machines are concerned, is "Electric Illumination," edited by J. Dredge, published at the office of *Engineering.*)—Seaweed. (The usual course is a mechanical engineer's shop, and such a book as Sprague's "Electricity" for a knowledge of the principles.)—F. Stelfox. (No one can answer your question merely from the shape of the piano. The sizes of the wires are usually marked on the wrest-plank.)—Mechanic. (See p. 17, No. 885, also many places in back volumes—even in recent numbers.)—Acourt W. B. (See list of back numbers in this column, Nov. 10.)—Pesico. (About five shillings.)—Fire. (We suppose so, but cannot say without some definite idea of what you wish to do.) —A. J. W. (It is not safe for a tiro to do much in the way of cleaning pictures. You may take it out of the frame and lay a clean towel over the paint. Make the towel wet, and sprinkle it with water from time to time. After a day or two remove, and wipe the picture with a sponge and clean soft water. Repeat the processes until the dirt is washed out. Give a final wipe down with the sponge, and when dry rub it gently with a little nut oil on a soft pad. The tear can be mended with piece of calico and glue or thick varnish or white lead and oil applied at the back.)—J. J. J., B'ham. (The word means indivisible; literally cannot be cut into two.)—P. A. G. (There are so many issued by all the publishers of such books that we must ask you to choose for yourself.)—A. C. B. (The scraper is the easiest, but if you want to repolish, remove with warm methylated spirit. 2. Thin it with turpentine.)—Amateur. (They are turned in a lathe, if you mean the wooden ones.)—J. Peck. (No, a combination of all colours.)—Out of It. (Draw a larger size down to the dimensions required.)—A Subscriber. (No, gun-metal is best.)—One in a Fix. (You can learn only by practical experience, although you may acquire the principles by a study of books.)—H. S. C. (They appeared in Nos. 695 to 700, all of which can be had except the last; but Vol. XXVII. is still in stock.)—Geo. Goldsmith. (Various recipes in back volumes; but spraying over with skim-milk is very effective.)—Gerra Adni. (The engine in question was illustrated and described on p. 638, No. 567, Vol. XXIII. It works by hot air.)—W. H. P. (For cold soldering see p. 81, No. 888. It is not suited to such work as you mention.) —D. A. S. (Possibly the simple stain by beer will suit you. However, you will find particulars in many places in back volumes.)—Tillet. (Gum-arabic is the usual thing; but if you want something stronger, dissolve 2dr. of gum tragacanth in 9 fluid ounces of boiling water; macerate for about a day.)—Microscopist. (Heat the parts and rub over with spirits of wine on a tuft of cotton. Clean by pickling in acid. Wash, heat, and relacquer with the best pale lacquer.)—Country Blacksmith. (You can make wooden wheels and glue emery cloth or powder on; but the emery wheels proper are more cheaply bought.)—Thos. Neilson. (It is due to changes in the earth's magnetism, some of which occur very slowly, while others take place every year. You will find the subject treated as fully as is possible in most textbooks on magnetism.)—Photo. (Yes, certainly.)—Opacity. (What you say now shows clearly that nothing can be done for you by certain experts, and yet you seem to think that those who have had no opportunity of ascertaining what is the matter, can do something for you. Why not try what they can do at the General Hospital?)—J. C. (Dissolve zinc in sulphuric acid; but you can buy it cheap enough under the name of white copperas.)—Takapona. (No one can say without seeing it, but, from your brief account, it must be the seed of a tree, not a caterpillar.)—Navigator. (Several. See the records of the Patent Office.) —Cuarvorane. (We believe it would answer just as well. 2. We suspect you must consult the postal authorities. Any of our advertisers would quote a price for the wire and fixing.)—W. S. F. (We do not know.)—C. W. Hobson. (We do not know, but the inventor is well known, and a letter addressed to him at Geneva would no doubt reach him. 2. We can only refer you to the advertisement columns.—W. S. Brown. (See back numbers, especially p. 336, Vol. XXXIV., for a table.)—Edward. (We do not know of one.)—Magnus. (See the list of back numbers, p. 298, under the head "Copying Processes.")—D. B. and S. (They will be published in volume form, with additions by the author.)—E. Phillips. (No works specially devoted to it; but any good course of mathematics will give you the groundwork.)—W. B. (You will find a simple one in No. 738, p. 192; but directions have been frequently given.)—Nomenclature. (The question has been frequently answered: certainly not.)—Tabula. (You will find a full description in Specification No. 1,267, of 1880, which can be seen in the Patent Office Library. The special feature is the shape of soft iron core, and its method of suspension.)—S. W. H. (A series of articles appeared in Vols. VIII. and XI., and much information on details in subsequent volumes. Directions for making an American Organ were given in Vol. XXVI. That volume can still be had.)—C. F. P. (It is not clear what you mean; but if you will look through recent indices you will probably find what you want.)—C. W. A. (See p. 531, No. 854. No varnish at all, finishing coat is black Japan.)—Carbonic Acid. (Books on Chemistry and Light contain articles or paragraphs on the subject; but it is chiefly in such papers as you mention that the facts are elaborated and their bearing explained. Look through the indices of your back volumes.)—Countryman. (Do you not see that an answer to your query would be a gratuitous advertisement?)—Stanko. (Incubators, not to go further back than recent volumes—in Vol. XXX., pp. 465, 73, 586; Vol. XXXI., pp. 311, 44; Vol. XXXII., p. 141; Vol. XXXV., p. 553. In each case the page first mentioned contains an illustration.)—T. Brilliant, Canada (?). (Numbers ready, but address, unfortunately, mislaid. Kindly repeat on post-card.)—W. T. (No room at present; but you will find some good sketches for cheap artistic furniture, with full details and descriptions, in the *Building News* of Nov. 10, 17, and 24. The three numbers can be obtained post-free from this office for 1s. 1½d. in stamps.)—Fred. Walker. (Anyone can call himself a "C. E."; the majority of those who are like the people you mention, have very little reason or right to assume the designation.)—Guardsman. (Better inquire at the Horse Guards. Lawyers have nothing to do with such matters.)—Ivanhoe or Bolton. (We do not know. An advertisement in the "Address Column" might procure for you the information.)—E. Shaw. (We know nothing of the maker named; and, if we had the money to spend, should certainly stick to Holtzapffel or Evans. The Britannia Co., of Colchester; Milnes, of Bradford; Lee and Hunt, of Nottingham; and Selig, Sonnenthal and Co., of Queen Victoria-street, London, are all good firms, and worthy of support.)

CHESS.

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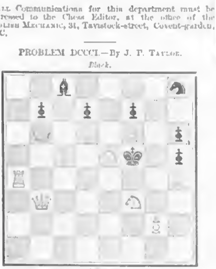
All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCI.—By J. P. Taylor.

Black.

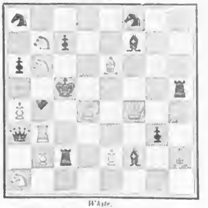


White.

White to play and mate in two moves.

PROBLEM DCCCII.—By H. F. L. Meyer.

Black.



White.

White to play and mate in two moves.

Solution to 797.

White.	*Black.*
1. K takes P	1. P moves
2. K takes P	2. P moves
3. R takes P	3. K moves
4. R Mates	

Solution to 798.

White.	*Black.*
1. P to K 6	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 797 and 798 by Donald Mackay; to 794 by W. Stevens; to 795 and [illegible] by Schmucke; to 795 and 796 by Dicky Sam; to 795 by W. T. Layne; to 797 by H. M. B. Lascelles.

In the Game Tourney, Mr. Blake has beaten Mr. Reynolds; and Mr. Mainwaring, Mr. Selwyn.

Game between Messrs. W. T. P[illegible] and J. P[illegible].—

(King's Gambit declined.)

W. T. P. *White.*	J. P. *Black.*
1. P-K 4	1. P-K 4
2. P-K B 4	2. P-Q 4
3. P takes Q P	3. P-K 5
4. Q-K R 5 (a)	4. B-Q 3
5. B-Q Kt 5 (ch)	5. P-Q B 3
6. P takes P	6. P takes P
7. Q-Q 5	7. Kt-B 3
8. B takes P (ch)	8. K-B sq
9. Q-B 4	9. R-K 1
10. Q-K 4	10. Kt takes B
11. Q takes Kt	11. B-Q 4
12. Q-B 3	12. B takes B P
13. Kt-K 2	13. B-B 2
14. Castles	14. Kt-Kt 5
15. Q-Q B 3 (ch)	15. K-Kt sq
16. P-K R 3	16. B-Q Kt 3 (ch)
17. K-R sq	17. Kt B 7 (ch)
18. K-R 2	18. P-K 6
19. P takes P	19. B-B 2 (ch)
20. Kt-B 4	20. Q-R 5
21. K-Kt sq	21. Kt takes P (ch)
22. Kt takes Kt	22. Q-Kt 6
23. P-K 4	23. Q-R 7 (ch)
24. K-B 2	24. R takes P
25. R-Kt sq	25. R-Kt 3 (ch)
26. R-K 3	26. R-Q B sq
27. Kt-Q B 3	27. B takes B (ch)
28. K takes B	28. R-Q B 3 (b)
29. Q B-K sq	29. R-Q sq
30. K-B 2	30. P-K R 4
31. Kt-K 2	31. Q-K 4
32. Q-Q B 3	32. Q-K B 4 (ch)
33. Q Kt-K B 4	33. B-K 5
34. R takes B	34. Q takes R
35. R to K sq	35. Q-K B 4 (c)
36. R-K 5	36. R-Q 7 (ch)
37. Q takes R	37. Q takes R
38. Q-Q 8 (ch)	38. K-R 2
39. Kt-Kt 5 (ch)	39. K-R 3
40. Kt takes P (ch)	40. K-R 2
41. Q takes R mates	

(a) Cook here gives Kt-Q B 3 as the best play, and the game proceeds 4. Kt-K B 3; 5. $\frac{\text{Q-K 2}}{\text{B-Q 3}}$; 6. $\frac{\text{P-Q 3}}{\text{B-K Kt 5}}$, &c., neither side having the advantage.

(b) If 28. $\frac{}{\text{Q-K Kt 6}}$ 29. $\frac{\text{K takes B}}{\text{R-B 5 (ch)}}$ 30. $\frac{\text{K-Q 5}}{\text{Q-Kt 5}}$ 31. $\frac{\text{Kt-B 4 (best)}}{\text{Q takes Kt}}$ 32. Q takes P, and White has the advantage.

(c) If 35. $\frac{}{\text{Q-Q Kt 2}}$ 36. $\frac{\text{Kt-Kt 5}}{\text{R-Q B sq}}$ 37. $\frac{\text{R-K 7}}{\text{Q-Q Kt 3}}$ 38. $\frac{\text{K-K sq}}{\text{B-K B sq}}$ 39. Kt (B 4) to K 6, &c.

Tests for Coffee Adulteration.—In a work now in course of publication at Breslau, Professor Wittstein gives details of the tests which he regards as effective in the discovery of false colouring on coffee, such a process being, it is explained, resorted to in order to give to inferior and sea-damaged kinds the appearance of superior descriptions. To detect the presence of lead he recommends the placing of the suspected coffee-beans in diluted nitric acid (of 1·10 specific gravity), which is poured off after one hour, and further diluted with three times its bulk of water. By the addition of sulphide of hydrogen the lead is made to form a black precipitate. Another mode of colouring coffee-beans is said to be by the use of a greenish powder, composed of Prussian blue, chromate of lead, clay, and gypsum. In order to discover the presence of this colouring matter, warm distilled water is poured over a quantity of coffee-beans. After a couple of hours they are taken out again, and the water is allowed to become clear. If gypsum has been used, the water is rendered turbid by chloride of barium. If Prussian blue has been used, it can be readily traced by applying potash-lye, which immediately changes its colour into brown. If this change does not take place, it may be inferred that indigo has been used instead of Prussian blue, and in that case nitric acid will destroy the colour. During the treatment with potash-lye the chromate of lead is more or less affected, and is partially or wholly dissolved; while, if turmeric has been used, it only takes a brown colour. As a further test, hydro-sulphuret of ammonia is spoken of as being able to show the presence of chromate of lead if any blackening takes place.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock street, Covent garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the Kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

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Indices for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indices to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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Holloway's Pills should be taken occasionally in moderate doses during the winter season, when the stomach, liver, and lungs are hourly liable to derangement. Holloway's medicine prevents acrid and undigested matters from acting prejudicially on the system, and is therefore highly serviceable when impure foggy atmospheres are prevalent.

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Wanted, a good **Monocular Microscope**, in exchange for a Central fire 12 bore Double Gun, a first-class killer.—J. H., Elysium, Bovey Tracey, Devon.

A **Lamb's Knitting Machine**. Exchange for a Joiner's Foot Lathe.—Buckley Lee, Upper Mill, Holmfirth, near Huddersfield.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 1, 1882.

THE VOSS INDUCTION MACHINE.

By John T. Sprague.

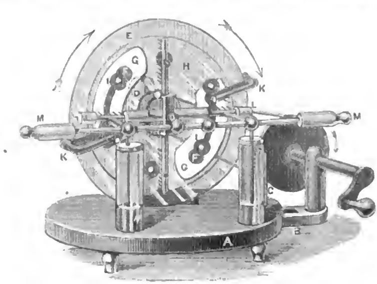
THERE is so much interest at present about this machine, that a more full description than has been hitherto given may be useful to our readers, more especially as this machine will not only furnish a great deal of information in static electricity, but it will conveniently replace induction coils with their trouble and expense of batteries. I will, therefore, give a detailed description of the construction, which it is only justice to the makers to say is very simply and effectively arranged.

The base board A has upon its lower side a groove formed by two strips of wood fitted longitudinally; in this slides a bar of wood B, carrying an upright stem of wood, through the upper part of which there crosses a brass tube, the ends of which contain stout rings of brass to form bearings for an iron axle on the further end of which is clamped a large driving-wheel, while the other is fitted with a handle for working the machine. The tension of the driving cord is controlled by sliding the bar B, which carries the whole system, in its groove, and fixing it by means of C; this, which cannot be clearly seen in the drawing, as it is hidden by other parts, is a handle of wood, carrying a screw, which passes through a longitudinal slot in B, and into a nut upon a strip of iron fixed across the groove, so that when the screw is tightened up it clamps the sliding bar B against the base.

On the further part of the base there is a strong wood pillar D, the end of which is turned down to fit a hole in the base to which it is screwed from the bottom when truly adjusted. From this pillar there projects the axis which carries the working parts; it is formed conically where the moving parts work on it, and reduced beyond this to adapt it to receive the various fittings. A little above this axle there is also a rod of ebonite projecting from D, with a notch close to its end to carry the fixed plate, which is also supported by two notched pegs of ebonite fixed in the base board, but only one of which is seen in the figure.

The fixed disc E (say 12½in. in diameter) has a central opening of 3in. diameter. Let us imagine a circle drawn on this of 7½in. diameter, divided into six equal parts; on two opposite pairs of these points are fixed 1in. discs of tinfoil, and the pair are then connected together by a narrow strip of foil. These pairs are shown FF on each side of the plate. The intermediate points are unoccupied in this fixed plate, and it is not unlikely that the working would be improved by dividing it, and leaving an open space between the two parts in the vertical line. GG are segmental shields of paper pasted over the pairs of foil, and projecting beyond them, half of one division, in the direction of the motion: these are sometimes made larger, but I find a curious disadvantage result, which I shall return to hereafter. Strips of foil also connect opposite discs of the two pairs to brass clamps, which are fixed to the edge of the plate projecting beyond it, and having holes in them to carry the fittings KK. The plate E is to be placed upon its supports, with the foils and shields at the back. Its whole surface (except upon the shields which are required to act as partial conductors) is carefully varnished, as is also the moving plate, in order to prevent deposit of moisture; the glass also must be thin, such as window-glass, but perfectly flat, and of suitable quality, or other materials such as ebonite; or vulcanised fibre may be substituted.

The moving disc H (say 10½in. in diameter) has a central hole for mounting on its axis, and should be divided exactly as the other into six equi-distant points, to be fitted with inch discs of foil, *i i*, upon which are fixed small metal buttons: these are firmly fixed to the glass disc through small holes in the foil, by means of marine glue or other cement, but must make metallic contact with the foil; in rotating, these discs exactly face those of the fixed system. The plate is mounted with its plain side facing the other, and as near to it as is manageable (say one eighth of an inch apart), so that the two glasses and this air-space constitute the induction circuit between the conducting foils, just as in Leyden jars or condensers, which they, in fact, constitute. The plate is now to be mounted on its hub, which is a brass tube fitted internally with a brass bearing at each end, drilled to fit the conical axis. On its further end is fixed an ebonite driving pulley, and on its front end a flanged collar of ebonite to fit the hole in the plate, and a nut of ebonite to screw on it and so firmly grip the plate, and effect its rotation.



The moving system is now passed on to the axis through the opening in the fixed plate, and secured in position by a broad brass nut screwed on the axis, and upon the face of which two steel pins are fixed in the horizontal line, to carry the remaining parts.

LL is the collecting system, composed of a stout rod of ebonite, slipped upon the projecting axis and the two pins just mentioned, which hold it firmly. At each end of the rod are brass T-pieces, fitted with projecting pins nearly touching the glass plate and the metal buttons. At the ends of the combs are blocks of ebonite with projecting pins of ebonite, which reach to the fixed plate and keep it steady and at the proper distance. The other branch of the T-pieces terminates in a ball, drilled to receive a sliding-rod for the conductor, fitted with ebonite handle M at one end and a movable ball at the other.

Leyden jars NN, with foil on their lower parts, support the end of the collecting system by their brass terminal rods entering holes in brass knobs above them: these wires are connected to the inner coatings by wire brushes on their ends. The outer coatings are connected together by means of metal saucers in which the jars stand, and which are screwed on the base and connected together by a wire beneath. It would be better to thoroughly insulate them and provide a shifting means of connection, or ebonite pillars might replace the jars, which could then be suspended from the collecting rods as in the Holtz machine, or a single jar have its coatings connected to the two collectors, so as to be able to vary the conditions. P is a second pair of combs screwed to a brass frame which also fits on the projecting axis, and is held in place by an ebonite ball screwed on the end of the axis; these combs have in their middle a brush of fine wire which just touches the buttons of the disc, and the function of this part is to make contact between and discharge the several parts of the disc of any residual electricity not taken up by the collecting combs. The working position is not vertical, as shown, but just over the end of the paper shield; and the fixed plate itself, though working in different positions, is probably best arranged with its discs equally above and below the collectors.

KK are brushes carried upon bent arms screwed to the clamps on the fixed plates; these brushes are so adjusted that they just touch the buttons as they pass under them, so as to connect together the discs of the fixed and moving plates which are exactly opposite each other.

The action and working results of the machine must be deferred to another occasion.

THE TEXTBOOK OF GEOLOGY.*

IN a volume of nearly 1,000 pages, Dr. A. Geikie has presented us with a work which may appropriately be termed "the Textbook" of Geology, for, both in the facts presented, and in the method of presenting them, it leaves nothing to be desired. The method is that adopted by the author while conducting his class at Edinburgh—a method which he has found to afford the student a good grasp of the general principles of the science, and at the same time a familiarity with details of which he is enabled to see the bearing in the system. The digest given of each subject is accompanied by references to memoirs where fuller statements may be found, and Dr. Geikie has done much to remove the not unmerited reproach that geologists in this country are but vaguely acquainted with types and illustrations other than those drawn from the British Isles. Geology is so progressive a science, and its literature increases so rapidly that between the writing of such a volume as this and its issue, many subjects of interest are brought to the notice of the geological branch of the scientific world, which are of necessity omitted from its pages. That is especially true of the geology of the American Continent—a land which for the simplicity and grandeur of its "examples" is probably unequalled, but which has already yielded a rich harvest by way of promise for the future. Dr. Geikie uses illustrations from all parts (one of Mr. W. H. Holmes's pictures, "The Plateau and Canons of the Colorado," forms an appropriate frontispiece to the book), but in a work intended primarily for use by British students, it is obviously advantageous to use illustrations which can be verified by examples taken from a familiar ground that can be visited on an excursion or during a field day. Geology is not, as some suppose, a dry study of rocks and fossils, for it includes everything which belongs to the history of the earth, and although it may leave the peculiarities of living and fossil species to other branches of science, no geologist can neglect their teachings, nor fail to see the bearings of his special department on the history of both the animal and vegetable world. In treating the subject, then, Dr. Geikie divides it under seven books, some of which contain several chapters. Thus, at the outset, we have the cosmical aspects of geology, which include the relations of the earth as a member of the solar system, the form and size of the earth, and its movements in their geological relations. The question of the stability of the earth's axis is treated in a clear and concise manner, the various arguments pro and con. being noticed. Geologists have maintained that the poles have shifted to different points of the surface as the only possible explanation of the remarkable changes of climate which have occurred—such a change as that indicated by the fact that coal in situ has been found within ten degrees of the North Pole. From the time of Laplace, however, astronomers have strenuously denied the possibility of any sensible change in the earth's axis of rotation, and mathematicians have all but demonstrated that the possible amount of deviation of the pole is quite insufficient to have influenced the climates of the globe within geological history. Changes in the earth's centre of gravity may occur through the accumulation of ice at one pole, and its diminution at the other, producing a rise of the ocean level, which would not, however, account for the presence of coal in Lady Franklin bay. But the "raised beaches" which are found at various parts of North-Western Europe vary so much, that they cannot be adduced as evidences of changes in the earth's centre of gravity, but are due rather to local and irregular subterranean movement. In bygone ages, the earth may have been subjected to greater heat from the sun, and may have been powerfully affected by the greater proximity of the moon; but, so far as the geologist is concerned, no indisputable evidence of a former intensity of superficial change is forthcoming. A consideration of the history of the solar system would itself suggest the inference that the climates of earlier geological periods must have been warmer than the present; and it seems certain, from a review of the vast areas over which Palæozoic molluscs are found, that climate at the time when they lived must have been more uniform than it is now. It also seems certain that there has been a gradual lowering of the general temperature, accompanied by a tendency to greater extremes of climate, and there are proofs that at longer or shorter intervals cold cycles have intervened, one of which, the "glacial period," preceded our own time. For the best working hypothesis in connection with this problem we are indebted to Dr. James Croll, whose views are quoted at length by Dr. Geikie. But for the Gulf Stream, Europe would be in a glacial condition, and the mean annual temperature of London would be 40° lower than it is. The various opinions on these points having been briefly but clearly noticed, Dr. Geikie proceeds to his second book, which is an investigation of the materials of the earth's crust. Viewed in the broad way, the earth consists of two envelopes—an outer one of gas completely surrounding the planet, another of water covering about three-fourths of its surface, and a globe, cool and solid at its surface, but possessing a high internal temperature. Quite one-half of the outer shell of this globe consists of oxygen which once existed in the gaseous envelope, but now appears combined with metals; while the extent to which water has been abstracted by minerals is almost incredible. Already, it is believed one-third of the whole mass of the ocean has been absorbed, and eventually it is probable the earth will resemble the moon and become a globe without air, or water, or life of any kind. Volcanoes, hot springs, and borings for wells and mines give abundant evidence of internal heat, for, although the rate of increment varies slightly, the temperature as we approach the earth's centre, or, to speak more within conceivable limits, as we sink beneath the crust, always increases and never diminishes. The different thermal conductivities of the rocks and surface conditions, such as perennial sheets of ice, sufficiently account for the observed differences in underground temperatures, although Mr. Mallet contends that they are due to local accessions of heat arising from transformation of the mechanical work of compression due to the constant cooling and contraction of the globe. There are, however, only three theories as to the condition of the earth's interior which merit consideration—one which supposes the interior to be molten with a solid crust; another which is based on the supposition that, with the exception of local vesicular spaces, the globe is solid and rigid to the centre; and a third which supposes a liquid substratum between a solid core and the crust. The arguments for and against these suppositions are briefly given by Dr. Geikie, and he concludes with the statement that it is highly probable the substance of the earth's interior is at the melting point proper for the pressure at each depth, and that any relief allows of the liquefaction of the matter so relieved, which is exhibited on the lines of uprise by volcanoes, &c. Having given an account of the composition of the minerals and rocks forming the earth's crust, the author proceeds to Book III., which consists of a discourse on Dynamical Geology divided into hypogene and epigene action, the former relating to the changes in progress beneath the surface, the latter to the effects of air, water, and animal life on the surface. Volcanoes and earthquakes are the signs of internal action, and are probably due to the heat of the interior, which, however, produces effects distinct and separate; so that in a work on geology volcanic action forms a chapter by itself. That it is one of the results of terrestrial contraction, can, says Dr. Geikie, hardly be doubted, though we are still without satisfactory data as to the connection between the cause and the effect. It will be observed that volcanoes occur chiefly in lines along the crests of terrestrial ridges. There is evidently, therefore, a connection between the elevation of these ridges and the extravasation of molten rock at the surface. The formation of continents and mountain-chains is probably consequent on the subsidence and readjustment of the cool outer shell of the planet upon the hotter and more rapidly-contracting nucleus. Every such movement, by relieving pressure on regions below the axis of elevation, will tend to bring up molten rock nearer the surface, and thus to promote the formation and continued activity of volcanoes. Besides the upheavals and sinkings of the surface, produced by the action of volcanoes and earthquakes, there are those of a quiet and uniform character—phenomena known as secular upheaval and depression—which are due to the movement of the land, and not, except in some cases, to a change in the level of the sea. Any stratum of rock containing marine organisms must be evidence of the upheaval of the land, as are also sea-worn caves in cliffs, now separated by a strip of meadow-land from the ocean. Raised beaches also afford one of the most striking proofs of upheaval. It is more difficult to find clear evidence of subsidence, for each successive sea-margin is carried down and washed away; but here and there are submerged forests, giving clear evidence of subsidence, while coral reefs are taken as proving depression of the bed of the Pacific and Indian Oceans, for reef-building corals do not build at greater depths than 20 to 30 fathoms, and yet their reefs rise out of deep water, so that it would appear the rate of building has kept pace with the rate of subsidence. If the effects witnessed on the surface are so great, it is certain that the internal changes must also be very considerable, and this branch of the subject occupies several of the most interesting pages in the book, for Dr. Geikie refers to experiments in fusion, crystallisation, and sublimation, and to the effects of heated water and its action on rocks, to the production of marble from limestone, and the conversion of vegetable substances into coal. The effects of air, water, and life form the subsection of epigene or surface action, and are treated as fully as need be even in a volume of a thousand pages. Book IV. introduces us to what is considered geology proper—i.e., geotectonic geology, or the architecture of the earth's crust, books V. and VI. being respectively devoted to palæontological and stratigraphical geology. Book VII. completes the work with a few pages on physiographical geography. The geotectonic section discusses the mode of arrangement of the various materials composing the crust of the earth. It shows that some have been formed in beds or strata, whilst others have been poured out from subterranean sources in sheets of molten rock or in showers of dust which have been piled up into hills and plateaux. It also shows that beds laid down originally in practically horizontal strata have been distorted, crumpled, and thrust upwards by masses from below, forced up by movements of the inner crust. Palæontological geology deals with the organic forms found preserved in the rocks, and affords the principal evidence of the changes in climate which have occurred in any given region. Stratigraphical geology is really geological history, as it shows the age of the different strata, and places them in their chronological order, and determines the order of succession of the various plants and animals which have in past times lived upon the earth. Physiographical geology embraces an inquiry into the history of the present features of the earth's surface, based on the facts obtained from a study of the strata. All these branches of the subject are freely illustrated with little woodcuts, and numerous notes give ample indication where further particulars may be looked for, or where the statements made can be verified. The work deserves to be considered "the textbook" of geology for another reason than because it gives a complete survey of the facts; for, head of the geologists of Britain as he is by virtue of his office, Dr. Geikie never claims more for his branch of science than it can fairly lay claim to. The geological record, he acknowledges, is, at the best, but an imperfect chronicle of geological history: in no country is it complete. The lacunæ of one region may be supplied from another; but in proportion to the geographical distance between the localities, so is the element of uncertainty in our reading of the record increased. The most desirable method of research, says Dr. Geikie, is to exhaust the evidence for each area or province, and to compare the general order of its succession, as a whole, with that which can be established for other provinces. It is, therefore, only after long and patient observation and comparison, that the geological history of different quarters of the globe can be corrected. In carrying on such work as that this volume will be of great assistance to students; for, as we think we have shown, it covers the whole field, and, while not neglecting the details, impresses the foundation principles of the science upon the memory.

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* Textbook of Geology. By Archibald Geikie, LL.D F.R.S. London: Macmillan and Co.

THE TRANSIT OF VENUS.

WE are indebted to one of our greatest English astronomers for inviting our attention to an absolutely inexplicable omission in our numerical details of the Coming Transit of Venus on p. 266. The times there given of the various phases of the Transit are, it should, of course, have been stated, *Geocentric*—i.e., those at which the contacts, &c., would occur, as seen from the Earth's centre. Quite evidently, in the case of a body so relatively near to us as Venus, a marked displacement must take place in her position as viewed from the surface of the earth; and, in order to reduce the times given on p. 266 to those for any given station, the *Nautical Almanac* furnishes the following formula (four equations are really given, but we need here concern ourselves only with that having reference to External Contact at Ingress):—

Call the radius of the Earth at the given station ρ, the Geocentric North Latitude l, and East Longitude λ; then the Greenwich Mean Time of First external contact may be computed by the formula—

$$\text{Dec. 6th, 1h. 55m. 57s.} + [2{\cdot}5471]\,\rho\ \text{sin.}\ l - [2{\cdot}4789]\,\rho\ \text{cos.}\ (\lambda - 87^\circ\ 53{\cdot}3').$$

The log. of the radius of the Earth and Angle of the Vertical will be found in Table XII. in Loomis's "Practical Astronomy." Employing this formula for Greenwich (Geocentric Latitude 51° 17·4'), we find that 4m. 28s. must be added to the Geocentric time of First Contact, which will hence take place at 1h. 55m. 57s. + 4m. 28s., or 2h. 0m. 25s. p.m. on Dec. 6th, and so on. The Angle from the North Point of the Sun towards the East (as seen with the naked eye) for First Contact at Ingress will vary from about 127° in the East of England to 122° in the West of Ireland.

The Writer of "Astronomical Notes for December."

SIMPLE PROCESSES IN QUANTITATIVE CHEMICAL ANALYSIS.

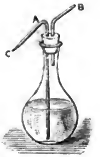
THE following chapters on the above subject are intended principally to be a help to those junior students of chemistry who may not have access to a chemical laboratory, and who wish to acquire a slight knowledge of Quantitative Chemical Analysis by working at home. The processes selected have been simplified as much as possible without interfering with their efficiency, and they give results accurate enough for all practical purposes. They will include processes for the analysis and valuation of most of the commercial products more commonly met with, such as bleaching-powder, soda-ash, pyrites, limestones, iron ores, manures, feeding stuffs, water, &c., and if space permits milk and butter. It is of course expected that the student will have at least an elementary knowledge of chemistry and chemical notation, but as many may not be acquainted with the use of apparatus, I will, before proceeding further, devote a few sentences to the consideration of the subjects, "apparatus" and "manipulation." To perform an analysis satisfactorily, it is absolutely necessary that the operator should possess a certain amount of manipulative skill, to be acquired only by practice. However, by reading over the instructions carefully, and referring to them as occasion requires, and at the same time exercising a due amount of care, I have no doubt but accurate results will be obtained. Regarding apparatus, then, first in importance comes:—

The Balance.—This instrument is indispensable in quantitative analysis, since by its aid alone we are enabled to determine exactly the weight of substances, and on its sensitiveness depends in a great measure the correctness of the results. A first-class balance commands a high price; but one sufficient for the requirements of a beginner may be purchased for a very moderate sum. The balance should be kept in a place where it will not be exposed to acid fumes. A vessel containing strong sulphuric acid, and another a piece of quicklime, may be kept inside the case, if it has one, to absorb moisture and prevent the steel parts from rusting. It should also be observed that the instrument is in a strictly level position and free from vibration.

The Weights.—Those commonly used consist of a set ranging from 50 grammes to ·001 grammes.

The Washing Bottle, is a large flat-bottomed flask about 35 ounces capacity. It must be fitted with a good sound cork in which two holes have been bored by means of a rat-tail file. Into these holes are fitted tightly two pieces of glass tubing, bent at angles corresponding to A and B in Fig. 1. The tube A extends nearly to the bottom of the flask, and has its point of delivery, C, drawn out so as to leave a small aperture for the ejection of the stream. The other tube terminates a very little below the cork. When this flask is nearly filled with water, the cork and tubes inserted tightly, and air from the lungs blown in at B, a fine jet of water issues from C.

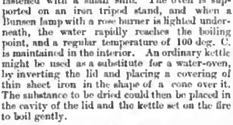
FIG. 1.



Water-oven or Drying-closet.—The best form of this apparatus consists of a copper or tinned metal box, about nine inches square, open in front. The walls are double on the five sides, admitting of its being surrounded with water, which is introduced at an opening in the top. The front is provided with a hinged door and fastened with a small snib. The oven is supported on an iron tripod stand, and when a Bunsen lamp with a rose burner is lighted underneath, the water rapidly reaches the boiling point, and a regular temperature of 100 deg. C. is maintained in the interior. An ordinary kettle might be used as a substitute for a water-oven, by inverting the lid and placing a covering of thin sheet iron in the shape of a cone over it. The substance to be dried could then be placed in the cavity of the lid and the kettle set on the fire to boil gently.

Sand-bath.—This is a sheet-iron tray with the sides turned up about two inches all round, and may be of any convenient size. It is supported on four feet sufficiently high to allow one or more Bunsen lamps to stand underneath (see Fig. 2).

FIG. 2.



The bottom is bedded with sand to a depth of about an inch. When in use, the sand-bath should be placed in a draught or an inclosed space, so that the fumes evolved will be carried away without pervading the apartment.

The rest of the apparatus needs no detailed description. I will therefore simply give a list of what is indispensable at the commencement, and when any special piece of apparatus is required describe it at the time.

Two Berlin porcelain evaporating basins, 10 oz. capacity; also two small ones about 2 oz.; several thin glass beakers of various sizes; two or three glass funnels; a double filtering stand; some test-tubes; watch-glasses; a retort stand with two rings; Bunsen lamps with rose burners, or spirit lamps where gas is not available; a few iron wire triangles; small spatula; pestle and mortar; Swedish filtering paper; platinum foil, two pieces, each about 2in. square; one or two small porcelain crucibles with covers; glass rod for stirring rod; brass forceps, &c.

Reagents.—It will be found convenient to procure the reagents, with the exception of the mineral acids and some others in their dry form, and make up the necessary solutions only when required for use. An accumulation of bottles will thus be prevented.

Manipulation.—Sampling.—In order to obtain concordant results in analysis, great care should be bestwed on the sampling when the substance is soft or friable, such as some guanos or superphosphates; what is considered a fair average sample of the whole should be selected and spread on a clean sheet of paper on the table. It should then be thoroughly mixed with the hands, and the larger portions crushed between the fingers until the sample assumes a uniform consistency throughout. By lifting the corners of the paper, gather into a heap in the centre, and using the spatula again, spread out and divide across into four equal portions; separate one of the portions from the rest, and retain for pounding in the mortar and subsequent analysis. In the case of hard mineral substances, the large masses should be broken up with a hammer on an anvil or steel plate, and reduced to a coarse powder, then thoroughly intermixed and divided as before.

Pulverisation.—After sampling, the substance to be examined is ground to a powder in a porcelain mortar; if very hard or tough in an iron one. Most minerals require to be first reduced to a fine powder in the iron mortar, and a portion taken and further ground to an impalpable powder in an agate mortar. A well-tempered file may be employed to pulverise metals and alloys.

Weighing.—It is convenient in most instances to weigh in a carefully counterpoised watch-glass. A counterpoise can, with a little trouble, be made of lead. No body should be weighed while warm. Nothing must ever be added to, or removed from, the pan of the balance while the beam is free to oscillate, but only when resting on the supports. The weights should be systematically selected, not taken at random, and lifted with the forceps only—never with the fingers. Suppose it is required to know the weight of a crucible which turns to be 6·531 grams; the 10-grams is first tried, and finding it too much, the next in order, 5-grams is substituted—this is too little; so the next lower weight, 2-grams is added—this is too much; it is therefore replaced by 1-gram, making 6-grams, which is too little; the next weight ·5-gram is added, then the ·2-gram, and so on until the balance is ascertained to be in equilibrium by the pointer vibrating to an equal distance on each side of the central mark on the scale. The weight is then noted, and the weights removed from the pan and replaced in the box.

Drying.—Wet substances, and such as are capable of absorbing moisture from the air, must be dried. To accomplish this, the powdered body is exposed from one to two hours to the heat of the water-oven. In the majority of instances this is quite sufficient: but there are cases where a temperature above that of boiling water is necessary: such substances can be dried over the reduced flame of a rose-burner.

Solution.—Digestion.—The common solvents are water, hydrochloric, and nitric acids, singly or together. Solution is facilitated by heat. When the substance under examination is soluble in water, or supposed to be so, it may be heated along with that liquid in a beaker or porcelain basin on a piece of wire gauze, supported over the flame of a rose-burner until solution takes place. If the substance is insoluble in water, it is next treated with acid in a small flask or porcelain basin, and allowed to digest in the sand-bath. If a flask, it should be bedded in the sand nearly to the level of the liquid, in an inclined position, to prevent loss by spurting. To diminish, to a certain extent, the escape of fumes, a small funnel may be placed in the mouth of the flask. It will be found to hasten solution if the vessel and its contents are occasionally shaken or stirred.

Precipitation.—When a dissolved body is suddenly reduced to the solid or insoluble state, it is said to be precipitated. The reagent causing this change is termed the precipitant, and the solid so formed the precipitate. In most cases the precipitant must be added in excess; and to find if such is the case, the precipitate may be allowed to settle a little, and a few drops of the supernatant clear fluid, taken up with a glass rod, placed in a watch-glass, and tested, if any portion of the body still remains in solution, by adding a drop of the precipitant. Beakers and porcelain basins are the most convenient vessels for precipitation. When necessary, adherent particles can be removed from the sides of the dish by means of a feather before transferring the precipitate to the filter. In many cases precipitation is promoted by boiling; in others, complete separation only takes place after standing at rest for some hours.

I hope to be able, in the next article, to give a process for the estimation of lime in chalk.

Esthos.

PRACTICAL NOTES ON PLUMBING.—LIII.[*]

By P. J. DAVIES, H.M.A.S.P., &c.

(Continued from page 267.)

Chemical Works, Valves, and Pumps—Perreau's Rubber Cone Valves.

THESE valves are illustrated at Figs. 283 and 284. They are made of indiarubber, and after the manner of the natural valves of the heart. They are especially suited for certain work executed in chemical works, and stand very well. Fig. 285 is a section of the bucket to match the rubber valve. Of course it will be readily seen that the valve may be screwed between the flanges of an iron or other pump, as at AB, Fig. 286. Of this further explanation will be given later on.

FIG. 283 END VIEW.

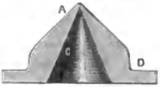


FIG. 284, SIDE VIEW.

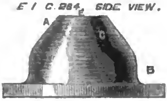
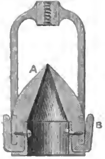


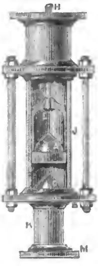
FIG. 285



Chamber, Tail-Pipe, and Relief and Retaining Valves.

The tail-pipe valves, as illustrated at A B C and E, Fig. 287, are valves for fixing on the suction pipe—in fact they answer the same purpose as the sucker valve, and are nothing more nor less than substitutes for the sucker valve or box. The old school of plumbers were very fond of using these valves upon their suction pipes, especially in places where there was a long length of horizontal pipe, say 30 to 50 feet, buried in the ground, &c. In such places it is quite as well to use one. The place for fixing is about 6 feet down the well, but where such valves are fixed the pump will work harder or heavier on account of the weight of the valve, and the extra friction of the water through the additional valve. The reason why these valves are used on the suction is to prevent the top or sucker valve receiving the heavy slam or shock which takes place in long lengths of pipes when the handle of the pump is worked and stopped too quickly from the hand stroke on to the back stroke, or, in other words, from the down stroke to the up stroke. Take notice—the strokes in pumping are known to pump-makers and fixers as "hand" or "back stroke," and also as "forward" or "back" stroke, or as "in" or "out" stroke, whether the rods are working in a horizontal oblique, or vertical position. Some plumbers will say "up stroke" or "down stroke"; this will answer when the rods do not receive a rocking motion, or when fixed in a horizontal position for reciprocating motion; but the regular pump-hand is known to say "hand or back stroke."

FIG. 286



These tail-valves are often fixed upon the rising mains to relieve the valve on the outlet of the barrel, or to keep the constant weight of the water off the stuffing-box. They are then known by the name of retaining valves. D, Fig. 287, is known as the foot-valve. E is a retaining or tail valve, having the plate J for taking out the valve K for repairs, &c. This arrangement often saves a lot of trouble and heavy work in pulling the pipes apart when the valves require to be leathered, &c.

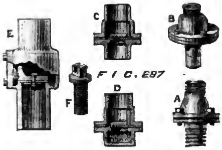


FIG. 287

(To be continued.)

ON THE OIL FROM THE BOTTLE-NOSED WHALE.

By ALFRED H. ALLEN, F.I.C., F.C.S.

I HAVE recently made a very complete examination of the oil from the bottle-nosed whale, and some of the observations are of general interest.

In the first place, I find that the oil has the remarkable chemical constitution hitherto observed only in the oil from the true sperm whale, and which shows it to be allied more to the waxes than to the majority of liquid oils. Thus, all the ordinary fatty oils of animal and vegetable origin yield, on treatment with an alkali, a "soap," or compound of the alkali used with the fatty acids of the oil, together with the familiar body known as glycerine. The waxes, on the other hand, including spermaceti, yield a soap like the oils and fats, but instead of glycerine, they furnish peculiar waxy solids, varying in nature with their origin. Thus, the product of the saponification of beeswax is "myricyl alcohol," Chinese wax yields "cerotyl alcohol"; while spermaceti furnishes "cetyl alcohol." On similarly saponifying sperm oil, I found it to yield a soap (as usual), but instead of glycerine I obtained a new solid body, which I propose to call *Spermyl alcohol*, and which I have as yet only incompletely examined. The analysis of sperm oil from different sources shows that the proportion of spermyl alcohol yielded on saponification was remarkably constant, lying, according to present experience, between 38 and 42 per cent. Thus, on saponifying ordinary animal or vegetable oil, there is obtained about 95 per cent. of fatty acids, and 10 per cent. of glycerine, but on saponifying *sperm oil* there results about 60 to 64 per cent. of fatty acids and 10 per cent. of *spermyl alcohol*—a white, crystalline, readily-fusible solid. The bottle-nose oil has yielded me analytical results showing that it is chemically identical with sperm oil. Thus I have obtained from bottle-nose oil 64 per cent of fatty acids, and 39 to 40 per cent of spermyl alcohol—numbers which are practically concordant with those yielded by the oil from the true sperm whale. Up to the present time the peculiar composition first noticed by me in the case of sperm oil is not known to be common to any other oil than that from the bottle-nosed whale, so that the latter oil stands alone in its right to be considered as a perfect substitute for true sperm oil. Porpoise oil, and the oils from the various species of whalebone whale are quite different in chemical nature from the oils of the sperm and bottle-nosed whales. The striking similarity in constitution, amounting in fact to chemical identity, between the oils from the sperm and the bottle-nosed whale suggested the probable close relationship of the two animals. On inquiry, I found this suspicion confirmed in the strongest manner. The food of the two animals is very similar, and quite different from that of the Greenland and other whalebone-whales; both animals have a back-fin, which is not present in whale-bone whales; and last, but not least, they both possess large cavities in the head, which are filled with oil.

Whether the oils of the narwhal, dugong, and other *cetacea* may not possess characters similar to those of the sperm and bottle-nosed whales, is an interesting question which I should like to have the opportunity of practically testing.

The oils from the bottle-nosed and sperm whales being identical in chemical nature, and sharply distinguished from all other known oils, it is not surprising that their physical characters should have proved to be very similar. Thus, I find their viscosity or flowing power, their density, their flashing points, and all other physical characters to be practically identical with each other, and different from those of ordinary oils.

These characters sufficiently indicate the bottle-nose oil as a suitable substitute for sperm oil, and I have in addition found it as free from tendency to gum or thicken as could possibly be desired.

If further proof be needed of the identity in nature of the oils from the sperm and bottle-nosed whales, it is to be found in the fact that they each deposit spermaceti when cooled to a low temperature. This property of sperm oil is well known, though it is often erroneously supposed to be limited to the oil from the head-cavities of the animal, whereas it is in fact true of the oil from all parts of the body. The spermaceti yielded by the bottle-nosed whale appears to be fully equal in quality to that furnished by the true sperm whale; but the quantity obtained is smaller.

From the method of its treatment, some of the bottle-nose oil at present in the market has a somewhat strong smell, and possesses an objectionable tendency to become green in contact with copper or brass.

These properties render such lots of oil as possess them unsuitable for some of the most valued uses of sperm oil. I have attempted to remedy these defects, and have succeeded in producing a refined oil of a very pale yellowish colour, having but little smell, and possessing absolutely no tendency to act on brass or other metals. In other respects it is unchanged.

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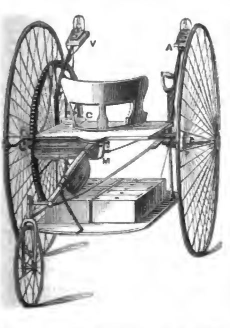
The amount of bottle-nose introduced into commerce during the last two-years has been considerable, and is rapidly increasing. In some cases it has been sold under the not inappropriate name of "Arctic Sperm oil"; but in other instances it has been mixed with, or substituted for real sperm oil, without any acknowledgment of its true nature. From the fact that dissatisfaction has not resulted when the oil has been thus surreptitiously substituted, as well as from the considerations already mentioned, I believe further experience will prove the refined product to be equal to the finest sperm oil, and capable of being used for every purpose to which the latter has hitherto been applied.

AYRTON AND PERRY'S ELECTRIC TRICYCLE.

THE annexed engraving is an illustration of Ayrton and Perry's Electric Tricycle—an open-fronted machine of ordinary pattern, with the treadles and driving gear removed. The driving-wheel is 44in. in diameter, and close to it will be seen a large spur-wheel containing 248 teeth. The motor M is slung from the seat platform, and the armature spindle carries a pinion of 12 teeth, gearing into the spur-wheel—the machine being thus speeded down 20 to 1. Taking 460 revolutions of the driving-wheel to cover one mile, it will be found that the motor must make about 1,200 revolutions per minute to reach a speed of eight miles an hour. The battery, composed sometimes of Faure cells, sometimes of Sellon-Volckmar, and at times of combinations of the two, is slung from the backbone and axle, and, when fully charged, contains a store of energy equal to about two horse-power-hours. The motor, which is rather too large, weighs 45lb., and with the battery there is altogether a weight of 150lb., sufficient to give a speed of six miles an hour. With an increased weight of accumulators a speed of eight miles has been maintained. The steering-handle and brake are shown in their usual positions; but on either side of the rider brackets extend, each carrying a small four-candle incandescent lamp to serve as "lights," and also to illuminate the ammeter (A) and the voltmeter (V), by which the rider can see at any moment the amount of the current and the E.M.F. between the terminals of the motor, and thus calculate the horse-power which is being expended in propelling the machine. At the left side of the seat is a commutator C, by which the number of accumulators in circuit can be varied, and by which the current can be altogether cut off from the motor. The full power can be obtained only by turning the switch of the commutator through the intermediate powers, so that shocks are avoided on starting the machine. The tricycle is, as mentioned above, an ordinary one converted; but Profs. Ayrton and Perry have, we believe, designed a machine specially adapted for being propelled electrically, which will have the advantage of carrying the rider and the accumulator on springs, and probably treadles to assist in driving the machine up steep hills.



THE ACHROMATIC OBJECT-GLASS.—XII.

By W. Bradbury.

(Continued from page 220.)

Art. LIX*.—*The Colour Correction of Certain Achromatic Object Glasses.* By Prof. C. A. Young, Princeton, New Jersey.

THE recent discussions in this journal upon the theory of achromatism will, perhaps, give interest to a brief statement of the results actually obtained in practice. I accordingly present the results of my measurements upon two excellent object-glasses which have come under my observation.

The first is that of the Dartmouth College Equatorial, made by the Clarks in 1871. It has an aperture of 9·36in., and a focal length of 12ft. It is considered by the makers a little under-corrected, but suits my own eye very well, in pleasant contrast to the violent over-correction of a 6in. Munich glass, which I had used for several years previous. The spherical aberration is very perfectly corrected. The curves are essentially those of Littrow ("Mem. Roy. Astron. Soc.," Vol. III.),† a nearly equi-convex lens of crown, and a nearly plano-concave flint.

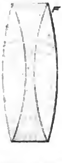


FIG. 6.

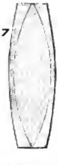


FIG. 7

The other lens is that of the equatorial belonging to the observatory of the John C. Green School of Science at Princeton. It has an aperture of 9·5in., and a focal length of 138. It is constructed substantially upon the curves proposed by Gauss ("Gauss's Werke," Vol. V., p. 207, Gottingen ed.),† the radii and constants of the objectives being as follows, viz.:—

Crown-lens, meniscus, convex side outward.	Inches.
Radius of convex surface	16·572
Radius of concave surface	57·425
Thickness at centre	0·620
Interval between lenses	0·312
Flint-lens, concavo-convex, convex-side next crown.	
Radius of convex surface	20·684
Radius of concave surface	13·871
Thickness at centre	0·305

The radii were determined by a delicate spherometer.

The telescope is remarkably excellent in every respect, especially in the darkness of the field and the power of exhibiting faint objects, like the satellites of Mars and Uranus.

The observations on the Dartmouth telescope were made by myself in 1872, those on the Princeton instrument in 1879, partly by myself and partly by my assistant, Mr. McNeill. The number of observations on the Princeton telescope was from ten to twenty for each line of the spectrum examined; the figures for the Dartmouth instrument depend upon only five measurements each, and are, of course, somewhat less reliable.

The method of observation was in all cases substantially the same. The spectroscope, arranged as for observation of solar prominences, is attached to the telescope, which is first pointed at the centre of the sun. The portion of the spectrum to be examined is then brought to the middle of the field of view, and one of the longitudinal dust lines (caused by particles between the jaws of the slit, always far more abundant than one would like) is made perfectly distinct by the focussing screw of the spectroscope. If the parts of the spectroscope all happen to be in exact adjustment, the true dark lines of the spectrum and these dust lines will, of course, both be perfectly sharp for the same focal adjustment; but this is seldom the case for a fastidious eye.

This adjustment of focus having been accurately made, the telescope is then so directed that the edge of the sun's image shall cross the slit perpendicularly, and by sliding the whole spectroscope along its supporting bar a position is sought where the edge of the solar spectrum shall be perfectly defined as seen in the eyepiece of the spectroscope. When this has been accomplished, the slit will evidently be exactly in the focal plane of those rays of the spectrum which occupy the field of view.

Of course, if the object-glass is poor, or the air unsteady, no point of absolute sharpness can be found, and we have to be content with finding a minimum of indistinctness. But with good seeing and an object-glass well corrected for spherical aberrations, the observation admits a really surprising degree of accuracy, successive determinations of the same point seldom differing under such circumstances as much as half a millimeter.

In this way the differences of focal length for different parts of the spectrum may be obtained with satisfactory precision. I say *differences*, because the absolute focal length is all the time charging with the temperature, and that by a considerable amount, so that it is necessary to recur to and redetermine the zero point continually. This zero, in my observations, was the focal plane of the D lines.

Ray of Spectrum.		Gauss.		Littrow.	Fraunhofer.
Designation.	λ.	dF	$\frac{dF}{F}$	$\frac{dF}{F}$	$\frac{dF}{F}$
		in.			
A	7600	0·199	·00145	·00172	—
B	6866	·097	69	97	·00064
C	6561	·052	37	49	52
D	5890	·002	1	0	2
1235K	5500	·000	0	—	—
1474K	5316	·004	3	35	—
E	5269	—	—	—	15
b	5183	·011	8	—	25
c	4956	·035	25	—	—
F	4860	·060	42	129 ?	72
2500K	4530	·197	143	—	—
f	4471	—	—	—	214
2796K	4340	—	—	294	271
G	4307	·370	262	—	280
h	4101	·626	437	441 ?	452
H	3968	·810	·00575	·00650 ?	·00582

A (?) is appended in the table to a few of the numbers which do not seem to fall in well with the general course of the curve to which they ought to conform.

In the table, the first column contains the designation of the spectrum lines observed, either by letters, or by their position on Kirchoff's map; the second gives the wave-length, according to Angström. The remaining columns explain themselves, except that *d* F denotes the difference expressed in thousandths of an inch, between the minimum focal length and that for the particular ray of the spectrum in question, while the columns headed *d* F / F contain the same quantity expressed in hundred thousandths of the focal length. I have added, for comparison in the sixth column, the results of Lorenzoni for a Fraunhofer object-glass of 1·750m. focal length, published in the *Astronomische Nachrichten*, Vol. LXXVIII., p. 289 (1871). His numbers were obtained by calculation, and not by direct measurement, the computation being based upon Fraunhofer's determination of the indices of refraction for specimens of glass, like that used in the lens. A glance at the table shows that, as to the extreme rays, there is very little difference between the three objectives, but that for the middle rays the Gauss lens is decidedly the best, and the Littrow the worst. The same thing is still better shown by the diagrams of the colour-curves. The ordinates of these curves are taken from the columns $\left(\frac{dF}{F}\right)$ of the table; for abscissas I have used the values of $1/\lambda$—i.e., the number of wavelengths to the millimeter. If we take the wavelengths themselves as abscissas, the left-hand portion of the curve is so flattened and extended, and the right-hand portion becomes so steep, as to make the figure very inconvenient.

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* From the *American Journal of Science*, Vol. XIX., June, 1880. I am indebted to the kindness of Mr. J. A. Brashear, of Pittsburg, for this and another communication which will appear in subsequent articles.

† Can any correspondent furnish an account of the formulæ of Littrow and of Gauss? Gauss' theory gives a very different arrangement of curves from any that I am acquainted with.—W. B.

Princeton, N.J., April 14, 1880.

If it be possible to alter the composition of optical glass, so as to destroy the outstanding colour, there is evidently required either a crown-glass having less, or a flint-glass having more, dispersive power over the interior or intensely luminous rays, in proportion to the length of its spectrum.

There are now manufactured very many kinds of flint-glass of excellent quality, varying greatly in their refractive and dispersive power; and it does not seem improbable that such a composition for crown-glass will be found as will remove the secondary spectrum. The following is a list of some of Fraunhofer's glasses; it is succeeded by others relating to modern English, and French optical glass.

Refractive Indices of Seven of Fraunhofer's Glasses.

Kind of Glass.	Specific Gravity.	Refractive Indices for the Seven Colour Lines.						
		B	C	D	E	F	G	H
Crown-glass, No. 13	—	1·5243	1·5253	1·5280	1·5314	1·5343	1·5399	1·5447
Crown-glass, No. 9	2·535	1·5258	1·5268	1·5296	1·5330	1·5360	1·5416	1·5465
Crown-glass, M	2·756	1·5548	1·5559	1·5591	1·5632	1·5667	1·5736	1·5794
Flint-glass, No. 3	3·512	1·6020	1·6038	1·6085	1·6145	1·6200	1·6308	1·6404
Flint-glass, No. 30	—	1·6236	1·6255	1·6306	1·6374	1·6435	1·6554	1·6660
Flint-glass, No. 23	—	1·6266	1·6284	1·6336	1·6405	1·6468	1·6588	1·6697
Flint-glass, No. 13	3·723	1·6277	1·6297	1·6350	1·6420	1·6482	1·6603	1·6710

Glass Manufactured by Messrs. Chance Brothers and Co., Birmingham.

Description.	Density.	Indices.			
		C	D	F	G
Hard Crown	2·485	1·5146	1·5172	1·5232	1·5280
Soft Crown	2·55	1·5119	1·5146	1·5210	1·5263
Light Flint	3·21	1·5700	1·5740	1·5839	1·5922
Dense Flint	3·66	1·6175	1·6221	1·6348	1·6453
Extra D Flint	3·85	1·645	1·6504	1·6643	1·6761
Double Extra Dense Flint	4·45	1·7036	1·7103	1·7273	

Glass Manufactured by M. Feil, 30, Rue Lebrun, Paris.

Index for the D line only.

Crown Glass.

Density.	Index. Raie D.
2·45	1·5031
2·49	1·5160
2·52	1·5190
2·51	1·5221
2·80	1·5329

Flint Glass.

Density.	Index. Raie D.
3·58	1·6135
3·64	1·6214
3·70	1·6412

Flint Glass for Photographic Objective.

Density.	Index. Raie D.
3·56	1·6109
3·54	1·6047
3·50	1·5999
3·21	1·5622
3·20	1·5630
3·16	1·5542
3·00	1·5147

Extra Dense Flint Glass.

5·500	1·8240
5·000	1·7920
4·700	1·7632
4·250	1·7471
4·000	1·7020

Chance's table is more complete than Feil's, as the indices of the four chief colour-lines are stated, from which the approximate dispersive power can be ascertained.

(*To be continued.*)

IMPROVEMENTS IN ELECTRO-DEPOSITION OF BRASS AND BRONZE.

SOME further improvements in the electro-deposition of brass, bronze, and other metals have been recently patented by Mr. W. H. Walenn, of the Caledonian-road, N. According to the present invention absolute adhesion of the coating to the metal, together with constancy of the solution and softness and ductility of the deposited metal, are the results of the methods used. The first part of the present invention relates to electro-depositing copper upon iron and similar metals, so that the coating may be adherent and in a soft condition. Preferably, the solution used is compounded of thirty-two ounces avoirdupois of cyanide of potassium (70 per cent. real cyanide) and one ounce of neutral tartrate of ammonium per gallon of liquid, and it is charged with copper by electrolytic means; the solution is then made complete by the addition of cupric ammonide. The solution is used at a boiling heat, or near thereto, namely from 150° Fahrenheit to the boiling point of the solution, whether the solution be under pressure or not under pressure. The effect of heat upon these solutions is to soften the coating of copper, and to increase the rate of deposition very materially. The following example of the application of this process produces a result which, as far as the inventor is aware, has never been attained by any process up to the present time. Thin sheet-iron plates, treated in this manner, have the coating so adherent that repoussé work may be executed on them without interfering with the continuity of metal, or without exposing the underneath or coated metal. If a plate be hammered to destruction, the copper coating will be simply extended over the iron where it is cracked or broken. The second part of the invention relates to a method of preventing the too great evaporation of a solution which is heated during deposition. The conducting wires from the source of electricity are passed through the depositing tank, but are insulated therefrom, and all rods or wires for suspending anodes or cathodes have their bearings upon inside shelves mounted with slabs of non-conducting material. Over the whole, and dipping into a water seal, is a counterbalanced cover, that is removable by means of pulleys and slinging chains. To an aperture in the cover is adjusted a long condensing worm tube opening into an upper vessel or box that contains materials which are capable of condensing, or absorbing, or combining with the gases that escape. The liquids flow back down the tube into the tank. This improvement applies to cyanide coppering, brassing and bronzing solutions, to gilding solutions, and to all electro-depositing solutions that are heated. The third part of the invention relates to working copper, brass, bronze, gold, and other electro-depositing solutions, in a closed vessel under a known pressure, the pressure being applied by heating the solution or otherwise. This plan has the great advantage of preserving the purity and stability of the solution, and of preventing its waste by evaporation; it enables the electro-deposit to be uniform over the surface of the cathode, and to be of compact and uniform quality throughout. A high pressure is not recommended, a single atmosphere is in general more than sufficient. The closed vessel may be used for solutions in which there is free ammonia, or where it is essential to keep the solution free from dust, or where other conditions arise in which it is necessary to inclose the solution, although neither appreciable increase of pressure arises, nor is heat applied. If there be much gas or vapour coming off, the condensing worm tube opening into a vessel may be employed. Another improvement consists in adding to the charged and finished solution in the cold cupric ammonide, until the solution is slightly green in colour. In a solution treated in this manner it is exceedingly difficult to isolate the combination containing ammonia so as to obtain its formula, but, from the constancy, persistency, and stability of a solution treated with cupric ammonide, as above described, it seems most probable that a definite ammoniacal salt is formed which is not decomposable (or is difficult of decomposition) at a high temperature.

OBSERVATIONS OF VARIABLE STARS.

PROF. E. C. PICKERING, Director of the Harvard College Observatory, has sent us a copy of a pamphlet he has just written on "A Plan for Securing Observations of the Variable Stars" (Cambridge, Mass.; the University Press), and in the letter accompanying it he writes: "The object of the work is to call the attention of astronomical amateurs to a class of useful observations, which could be undertaken with instruments of any size, and even in some cases with the naked eye. By the plan proposed, the observations would lead to definite results, instead of being desultory, as those of amateurs too often are." Prof. Pickering points out that useful observations may be made by unskilled observers; and as the work is quantitative, the observer has a continual test of the increased accuracy he has acquired by practice. The aid of the professional astronomer is "earnestly requested" for the scheme; but it is on the amateur and student of astronomy that Prof. Pickering depends largely for the success of his plan, and he is careful to point out that "much valuable assistance" might be rendered by ladies. We quote the following passages from the pamphlet, copies of which, and further information, will be supplied on application to Prof. Pickering:—

"Variable stars may be defined as those which exhibit a varying degree of brightness at different times. The following classification of them is believed to be a natural one. (Proc. Amer. Acad. xvi., 1, 257.)

"I. Temporary stars, or those which shine out suddenly, sometimes with great brilliancy, and gradually fade away. Examples, Tycho Brahe's star of 1572, new star in Corona, 1866.

"II. Long period variables, or those undergoing great variations of light, the changes recurring in periods of several months. Examples, *o* Ceti and χ Ceti.

"III. Stars undergoing slight changes according to laws as yet unknown. Examples, *α* Orionis and *α* Cassiopeiæ.

"IV. Short period variables, or stars whose light is continually varying, but the changes are repeated with great regularity in a period not exceeding a few days. Examples, β Lyræ and δ Cephei.

"V. Algol stars, or stars which, for the greater portion of the time, undergo no change in light, but every few days suffer a remarkable diminution in light for a few hours. This phenomenon recurs with such regularity that the interval between successive minima may be determined in some cases within a fraction of a second. Examples, β Persei (Algol) and S Cancri.

"Stars belonging to the first of these classes are seen so rarely that the apparent discovery of one is to be received with the utmost caution. On the other hand, the importance of early observations of such an object is so great that no pains should be spared to secure an early announcement if one is really found. On the best star charts many stars are omitted of the brightest of the faintest objects given. But any star much brighter than these should be measured by the method given below, and a watch kept to see if any change takes place. If it proves to be a temporary star, an immediate announcement should be made. If a telegram is sent to this Observatory [Harvard College] the object will be at once examined, and, if verified, notification will be made in this country, and in Europe, with the name of the discoverer or sender of the telegram. A similar notification may be sent of any suspected objects, which will be examined in the same way, and announced at once if they prove to be of interest. It is essential that the position of the object should be given with all the precision practicable, and that a letter should be sent by the next mail, giving the observations in detail. This often proves of the greatest value in case the object is not readily found. It also serves to establish the claims of the first discoverer.

"Nearly three-quarters of the known variables belong to the second class. Most of them undergo very large changes of light, and may therefore be observed with comparative ease. Our knowledge of their variations is, however, very defective. Hitherto the attention of observers has been directed principally to determining the times at which they attain their maximum light, while their light at intermediate times has been neglected. It is now proposed to secure observations of these objects once or twice in every month, so that their light curves or variations throughout their entire periods may be determined. Again, many observers are accustomed to state their brightness in magnitudes, without giving any clue to the scale which they employ. In most cases such observations have little value, owing to the uncertainty of the scale of the fainter magnitudes.

"According to Dr. Gould, and some other observers, most of the visible stars undergo slight changes of light, and should therefore be assigned to the third class of variables. . . . .

"The stars of the fourth class, as compared with the second, are relatively few in number, and the changes in light small. While many of them need observation, especially to determine their light curves more precisely, it is advised that this work be left to those who have acquired a high degree of skill in these observations. . . . .

"The phenomena of the Algol stars are in many respects the most striking of any. The rapidity of the changes, their surprising regularity, and the comparative rarity of these objects, combine to render the discovery of each new one a matter of unusual interest. As in the case of stars of the fourth class, however, the study of their light curves should be left to those who have acquired especial skill in this work. This is particularly desirable when, as in this case, the unaided eye enters into competition with photometric apparatus, by which, as some think, it should properly be altogether replaced.

"An elaborate bibliographical work on the variable stars has been undertaken at this Observatory by Mr. Chandler. It will include the collection of all available published observations of known or suspected variables. A catalogue of suspected variables has thus been prepared, doubtless containing many stars, which are really important variables. But it is also likely that many objects have been introduced in the list by errors in the original observations. Such stars often appear in one catalogue after another of suspected variables, and it is difficult to prevent the continued circulation of such an error. Of course, if an experienced observer at any time estimates a star as above or below its normal brightness, it is impossible to prove that the observation was not correct, and the star really variable. No amount of subsequent observing could prove that it had not then, and then only, an abnormal brightness. We can, however, prove that in all probability it does not belong to one or more of the above classes, and thus make it more and more probable that the observation is due to an error.

"To prove that a star does not belong to the fifth class is a matter of much greater difficulty. In fact, it is almost impossible to prove that it may not be an Algol star with a long period between the minima. Since these stars may have their full brightness for nine-tenths of the time, it is obvious that they may be examined again and again without happening to be seen at the time of a minimum.

"On the other hand, during a considerable portion of the time when it is varying, the light will be so much less than usual that a careful measurement is not needed to detect the change. Moreover, it will be useless to look for an increase of light, and the observation may be so planned as to detect a diminution only.

"The problems to be undertaken may be defined as follows:—

"1. To observe all the long period variables once or twice every month throughout their variations, according to such a system that all the observations may be reduced to the same absolute scale of magnitudes.

"2. To observe the stars whose variability is suspected, and prove either that they are really variable, or that in all probability they do not belong to the first, second, or fourth class. If any are thought to belong to the fifth class, to watch them until such a variation is proved, or is shown to be improbable.

"Any persons who desire to take part in these observations are requested to communicate with the writer, and send answers to the questions given below:—

"1. What is the location of your point of observations? In the city, or in the country, on the ground, from a roof, or from a window? Is any part of your horizon obstructed, or can you observe in all parts of the sky?

"2. What is the aperture, focal length, and name of maker of your telescope? Also the lowest magnifying power, and largest field of view you can obtain with it? Have you a field-glass or opera-glass?

"3. Can you identify bright and faint stars from their designations, or right ascensions and declinations? Have you Heis' Atlas Cœlestis Novus, the Uranometria Argentina, the Durchmusterung, or other maps and catalogues of the stars?

"4. Would you prefer to observe the known or the suspected variables, or to divide your time between them?

"To attain success, it is particularly important that the plan should not be local or national. Observers in the southern hemisphere are much needed, and for some purposes, those in various longitudes. It is hoped that among the many amateurs of Europe, and especially of England, may be found some ready to participate in this work. No restriction regarding the observations or publication is intended; but it is hoped that a large addition to our present knowledge of the variable stars may be secured, without interfering with what would otherwise be obtained."

NEW RESEARCHES ON ELECTRIC CURRENTS.

THE remarkable property possessed by nitrates in fusion, of producing currents by their reaction with incandescent carbon, was first indicated in 1855 by A. C. Becquerel, who had observed a considerable deflection of the galvanometer on plunging a piece of red-hot retort-carbon in a bath of melted nitrate of potash. This experiment, repeated more recently by M. Jablochkoff, who sought to apply the principle in a new battery, which he called *electromotive*, has been made by M. Brard the starting-point for an experimental study of the behaviour of nitrates. The following are his results, as communicated to the Paris Academy:—

1. *If any piece of carbon, made red-hot, be immersed in a capsule containing a bath of nitrate infusion, a strong current is obtained, flowing from the bath to the carbon in the exterior circuit.*

This experiment is that of Becquerel, only M. Brard has observed that it equally succeeds with all carbons. Further, when one uses, as Becquerel did, hard carbon, of slow combustion, retort-carbon, graphite, plumbago, &c., the current weakens very rapidly, and this weakening is due to a deposit on the part of carbon immersed, of a very adherent and very compact crust of salts, which, being interposed between the nitrate and the carbon, arrests the chemical action.

2. *Nitrates in fusion become very fluid, and acquire the property of moistening extensively* (au loin) *the heated objects with which they are in contact.*

One drop of these salts, let fall on a heated plate of cast iron, spreads rapidly, and soon covers a large surface of it; and by virtue of this property the liquid rises in such bodies by capillarity 0·01m., 0·02m., or even 0·03m. (say 1·2in.), according to their size and the greater or less rugosity of their surface.

One of the consequences of this property is the possibility of modifying Becquerel's fundamental experiment by not immersing the carbon by its incandescent end in the bath of nitrate. By making red-hot merely the end of the crayon opposite to that which is immersed, one may, in fact, still obtain a current, provided the crayon is not too long.

3. *To obtain a current it is not necessary to immerse the carbon in the bath of nitrate.* It is sufficient, indeed, to place on burning carbon a metal capsule containing a few grammes of nitrate in fusion, and to let it stand a few minutes, for a current to be produced, flowing from the bath to the carbons in the exterior circuit. The current, which can be proved by placing a galvanometer in the circuit of which one end is immersed in the bath while the other consists of a metallic rod, which one may introduce and move about in the burning carbon, persists with sensibly constant intensity so long as the carbons on which the capsule rests are red, and the capsule contains traces of nitrate.

The explanation of this singular fact is found in the property of nitrates already indicated—viz., their tendency to soak heated bodies with which they are in contact.

It may be shown, indeed, in a few seconds, when this experiment is made, that the interior wall of the capsule, situated above the level of the liquid, is gradually moistened, and that this imbibition, after reaching the upper border of the vessel, then descends on the outer wall, which is at length completely moistened. Thus a thin, continuous, and nearly always equal layer of nitrate is brought into contact with the red-hot carbons on which the capsule rests, and there keeps the chemical reaction sensibly constant, generating a current, and insuring its regularity. This current, formed at the point of contact of the capsule with the carbons, then traverses the incandescent hearth with a facility which is greater the higher the temperature, so that the red carbons here themselves fulfil the office of conductors, and close the circuit through the metallic rod introduced among them.

4. *It is not necessary, in order to obtain a current, to put the nitrate in contact with the carbons of a fire.*

A metallic capsule, containing salt in fusion, and freely suspended over a burning hearth, which it does not touch, still gives a current, flowing from the bath of nitrate to the outer surface of the capsule.

These currents are weaker than the preceding ones; but their intensity may be increased by coating the outer surface of the capsule with a layer of plumbago or lampblack, and covering all with wire-gauze. A maximum effect was obtained by placing on the outer wall of the capsule a sheet of asbestos-paper, and covering this with plumbago, and then with large-meshed wire-gauze. In this form, the wire-gauze becomes the negative pole of the element, and the metal of the capsule the positive pole.

A couple thus formed, and placed over a Bunsen burner, gives, when the nitrate becomes fused, a continuous current of six to seven milliampères, of very remarkable constancy. For this battery to act well it is advisable to place it as near as possible to the source of heat near the point of the gas-flame. Now it is precisely at this point that there is the largest proportion of incandescent carbonaceous particles liberated from the flame. It is, in fact, these red-hot carbon molecules, which, meeting in their passage the melted nitrate that soaks the asbestos, generate the current. And as, on the other hand, with a well-regulated Bunsen burner, the proportion of these carbonaceous particles and the degree of temperature remain sensibly constant in a given length of time, we can readily understand the constancy of the current itself.

5. *Nitrates kept in the state of fusion have a great fixity.*

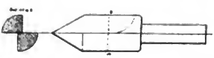
These salts, which melt about 200° C., are only decomposed, indeed, about 1,000° or 2,000°. Up to this point, not only do they not attack the vessels of metal which contain them; but they appear, on the contrary, to have the singular property of preventing their oxidation in fire; or, at least, of retarding it considerably.

PHYSICAL EXERCISE.

A LECTURE under the auspices of the Edinburgh Health Society was delivered on Saturday last by Dr. Charles Cathcart, Lecturer on Anatomy in the Edinburgh School of Medicine, on "Physical Exercises: their Place and Function." Dr. Cathcart, after defining physical exercise as the "action and use of our bones and muscles," went on to explain the anatomy of the muscles, the manner of their attachment to the bones, and their great capacity of contraction—it being stated that the body was arranged into about 400 separate muscles of various sizes and shapes. No muscle could contract unless stimulated by a nervous impulse coming from the brain or spinal cord. Each muscle had its own particular action, but no muscle ever contracted by itself. They could thus see that the exercise of one part of the body indirectly told upon many others which they did not suspect. Hence the value of vigorous walking, for instance, with the swing of the arms, the balance of the body, and the action of the legs; but hence, also, the danger of movements which were one-sided and often repeated, producing the constant and associated action of certain groups of muscles, which might bring about changes in the bones and alterations in form which no one would suspect. Going on to consider the effect of muscular exercise on the various functions of the body, Dr. Cathcart first noted the changes it caused in the respiration. They were all familiar with the fact that exercise not only made the heart beat quicker, but caused them to breathe more rapidly and freely, and at the same time the amounts of carbonic acid and watery vapour exhaled were much increased. Under ordinary circumstances it had been found that a man drew in 480 cubic inches of air per minute; if he walked four miles an hour he drew in 2,400 cubic inches, and if six miles an hour 3,360 cubic inches. The muscles, in contraction, used more oxygen and gave out more carbonic acid, consequently a greater demand was made on the lungs. More air was required, and the blood must be driven the faster through them; and that accounted for the shortness of breath and beating of the heart which accompanied any muscular action. If they looked at the demands made upon the air while a person was taking exercise, they would see how very important it was that the air should be not only large in amount, but also exceedingly pure in quality. Let them take, as an example, an ordinary dancing party. There were more people in the room than it was intended for; the whole company exerted themselves violently—certainly as much as would be equal to walking four miles an hour—and what was the consequence? Not only did they now require five times as much air as they did before, but they were using up the oxygen, and giving out the carbonic acid at a relatively much increased proportion—while people were afraid to open the windows in case of draughts. When they remembered that that was almost always carried on in a blaze of gaslight, every burner of which used as much air as four or five men, they could see that those entertainments required serious attention and careful management if they were to be conducted on sound principles of health. Emphasising the point that during exercise the lungs should have the freest possible play, the lecturer said he had been furnished from good authority with an illustration of the effects of custom *versus* humanity and sense in the late Egyptian war. A body of soldiers and another of marines had to make a march of three miles under the burning sun. The soldiers had their tight-fitting jackets, the marines their loose and free costume. Before the march was ended 130 of the soldiers had fallen out, while every man of the sailors continued in his place. He knew of no other difference between the two sets of men but the costume. The effects of physical exercise on the circulation and on the nervous system were next in turn considered. As to the first, as any unwonted strain must act injuriously on the heart, necessity existed for beginning gradually and systemically any exercise which involved unusual exertion. On the latter point, the reasonableness of relaxation and rest to the brain was insisted on, and muscular exertion commended as one of the best cures of mental overwork. That brain and muscle could be developed at the same time, was illustrated by a reference to the oarsmen of Oxford and Cambridge; and the intelligence of the working classes was also cited as a proof that hard and constant physical labour in no way tended to depreciate the quality and strength of brain power. As to the effects of exercise in expanding the chest some striking facts were given, not the least interesting of which related to a school where physical exercises had been systematically caried out. The effect of regular exercise was shown as follows:—New boys, aged 14, average chest measurement 29·3, at 15—30·6, at 16—32·0, at 17—32·6 and at 18—32·5: while former boys measured respectively 30·6, 32·1, 34·2, 35·8, and 36·8. In conclusion Dr. Cathcart laid down some rules for the regulation of physical exercise:—1. It should be conducted in an abundance of fresh air, and in costumes allowing free play to the lungs, and of a material which will absorb the moisture, and which, therefore, should be afterwards changed—flannel. 2. There should always be a pleasant variety in the exercise, and an active mental stimulus to give interest at the same time. 3. The exercises should as far as possible involve all parts of the body and both sides equally. 4. When severe in character the exercises should be begun gradually and pursued systematically, leaving off at first as soon as fatigue is felt. 5. For young people the times of physical and mental work should alternate, and for the former the best part of the day should be selected. 6. Active exertion should be neither immediately before nor immediately after a full meal.

A NEW CENTRE REAMER.

A CORRESPONDENT of the *American Machinist* sends the following sketch of a centre-reamer, which he thinks better than any yet published. In the first place, it has plenty of room for the chips to escape; next, after being once made right, it is easy to keep at the right angle by grinding, and if ground properly it will not chatter. If it should get broken it is easily ground to shape. The sketch will explain itself.



BOILER TREATMENT AND ENGINE MANAGEMENT.*

THERE being so many engines in use where first-class engineers cannot be employed, it may be of service to such persons to give a few simple rules to be observed in the management of boilers and engines. As new boilers have more or less oil in them, it is best to blow out the first filling of water at the end of a day's run. This need only be done where there is a tendency to foam. A small amount of oil will prevent incrustation. The supply of feed-water should be regular. In no case should the feed-pump be required to lift water more than 5 or 10ft., and where the water is fed hot, it should come from a tank situated above the pump. If from the high temperature of the water the pump refuses to work, a remedy may be found in allowing a slight leakage around the plunger, thus allowing the accumulation of vapour to escape. A very small air-cock may serve the same purpose. Never fire when the water is below the lowest gauge. The safety-valve should receive daily attention, and if not raised by the steam, should be raised by hand. Frequent firing is most economical. Sudden cooling is injurious to a boiler. Portable boilers in particular should not be blown off entirely when steam is above ten pounds; the doors should be kept shut while cooling. The efficiency and durability of a boiler are greatly increased by keeping it clean. Where water contains sediment, cleaning should be frequent. New engines that have been exposed in shipping should be thoroughly cleaned before starting, and oil of *a good quality* freely used during the first few days' run. A priming tendency will sometimes be obviated by opening the throttle valve slowly. Cylinder-cocks should always be open on starting the engine. All leaky joints should be stopped at once, and loose boxes taken up as soon as discovered. The governor belt should be kept tight, to insure sensitive action of the governor. To lubricate the cylinder and valve, either cylinder-oil or tallow should be used. Lard-oil is not good for this. Belts, when new, frequently slip or require to be unusually tight. An application of equal parts of neat's-foot-oil and tallow will be found very good on leather belts. and on rubber, either linseed-oil or castor-oil—the latter preferred; but a small amount at a time will be needed. Animal-oil should never be applied to rubber belts. By observing the above, and exercising good judgment, but little trouble may be apprehended in the management of an engine.

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* By "Dynamicus," in *American Machinist.*

PICRATE OF POTASH AND CAUSTIC POTASH AS A TEST FOR GRAPE SUGAR.

AS a test for grape sugar, Dr. G. Johnson has recently found picrate of potash to be very delicate, and the following is extracted from a chemical paper on the subject by his son, Mr. G.S. Johnson, which appears in the *Lancet*.

Several precautions are necessary in the use of this test. First, care must be taken not to employ too strong a solution of caustic potash, for picric acid is decomposed by concentrated potash on boiling, ammonia being evolved in abundance, and a dark-brown colour being produced. The liquor potassæ of the British Pharmacopœia does not decompose picric acid when boiled with the crystals. A solution of potassic hydrate, containing 20 grammes KHO to 1 litre of water (nearly 2 per cent.) produces no decomposition when boiled for many minutes with crystals of picric acid; whilst the full effect of Moore's test for grape sugar may be obtained with a solution of this strength. In testing the limit of delicacy of the potash and picrate test, a 2 per cent. solution of caustic potash was therefore uniformly employed. Secondly, it is necessary to avoid the presence of an excess of picrate, on account of the strong colouring effects exhibited by this substance when boiled with excess even of dilute (2 per cent.) potash solution. It was found impossible to detect less than 50 parts of grape sugar in 100,000 parts of water, when a saturated cold solution of picrate of potash in 2 per cent. caustic potash was boiled with the grape sugar, and the colour produced compared with that obtained by boiling an equal volume of water devoid of grape sugar, mixed with the same volume of the alkaline picrate. The deep colour of the alkaline picrate itself interfered with the delicacy of the test.

By adopting the following method it is possible to detect three parts of grape sugar in 100,000 parts. 0·8 c.c. grape sugar solution (containing 0·0006776 gramme grape sugar) was mixed with 20 c.c. of 2 per cent. potash solution and 0·5 c.c. of a cold saturated solution of picrate of potash. This liquid was boiled for about thirty seconds in a flask. 20 c.c of 2 per cent. potash solution + 0·5 c.c. of the same picrate of potash solution was boiled for an equal length in another glass flask. The two liquids were then transferred to two colourless test-tubes, held vertically over a white porcelain plate in a good light, when that containing the grape sugar was seen to be very slightly, but distinctly, darker than the other. This experiment, by which the limit of delicacy of the test was fixed, will give a sufficient illustration of the general method to be employed, and the precautions necessary in applying this delicate test.

CONCAVE DIFFRACTION GRATINGS.

AT a recent meeting of the Physical Society, Prof. Rowland, of Baltimore, exhibited a number of his new concave gratings for giving a diffraction spectrum. He was led to construct these gratings on seeing the machine for constructing large gratings of Prof. Rodgers, of Cambridge, Massachusetts, some two years ago. He set himself to design a machine on what he considered a better principle, and as it can be shown theoretically that gratings can be ruled on any surface if the lines are at a proper distance apart and of the proper form, he chose a concave surface as being that most convenient in practice. The best surface is given by a hollow cylinder, or a sphere of large radius. Prof. Rowland did not describe his machine because he intends to publish an illustrated description of it shortly, such a description as will enable astronomers anywhere to get one made. The gratings shown were solid slabs of speculum metal about half an inch thick and several inches square; but smaller or larger ones can of course be made. On the polished surface of the metal a belt parallel and equidistant had been ruled, and the furred surface reflected a series of spectra when exposed to the light of the sun or an electric lamp. The spectra exhibited by Mr. Rowland in this way were very beautiful, and they show, in a manner hitherto unrivalled, the dark lines with great distinction. Some showed the E lines doubled, and the large B group was analysed in a striking manner. Dark lines are split up by these gratings which have never been divided before; and the work of photographing the spectra takes a mere fraction of the time required by the older methods. One great advantage of the gratings is that the relative wave-lengths of the spectra can be measured by the micrometer with great accuracy. Morever, the photographic plates can be kept in focus by an an ingenious and simple device of the author's invention. A photographic plate, sensitive throughout its length, is obtained by using a mixture of eosine, iodised collodion, and bromised collodion. Prof. Rowland and Captain Abney are, we believe, at present engaged in preparing a new map of the solar spectrum, using a focus of 18ft. Profs. Dewar and Liveing have for the last three years been preparing a map of the ultra-violet spectrum; but had they been able to employ Prof. Rowland's gratings they might, in Prof. Dewar's opinion, have finished it in three months. This map will soon be published by the Royal Society. In short, the new gratings will make a great advance in spectroscopic investigations, and we may expect new light on the constitution of the elements from their revelations. The average number of lines ruled on the metal is about 14,000 to the lineal inch, but Prof. Rowland has ruled 42,000, and might have ruled more had he required to do so. A diamond point is employed for the purpose. Some doubts having been expressed as to the durability of the gratings in a bad climate, Mr. Warren de la Rue testified to the continued brightness of a speculum plate which he had used at Oxford for thirty-seven years; and Prof. Rowland remarked that if proper speculum metal made after the direction of Lord Rosse be employed, he believed that the surfaces would be very durable. If too much copper were put into the alloy he would not, however, expect them to last so well.—*Engineering.*

USEFUL AND SCIENTIFIC NOTES.

Wear Wool in Winter.—Half the colds and small ailments from which English men, women, and children suffer in winter might be avoided if woollen goods were more frequently worn. Flannel should always be worn next the skin all the year round. The feet should be protected in winter by good home-knitted socks or stockings. They wear longer, and are infinitely more comfortable than the shop goods sold as "home-knitted." The worst of it is, in these days of fashionable accomplishments, few girls and women are left, comparatively, who *can* knit a comfortable, well-fitting stocking. The best way is to find up some country family of children, or some old dame, and keep them going with a standing order. Our supply comes alternately from Wales and Cornwall, where stocking-knitting is not yet obsolete. Woollen waistcoats are very beneficial substitutes in winter for the ordinary cloth ones. Here, again, discouragement usually steps in in the shape of the cumbrous and ugly things sold by the hosiers and drapers. If slipper-making curate-hunters, and other charitably-minded spinsters, would turn their attention to the chests of those whose hearts they are seeking to captivate, good would probably result all round. The best woollen chest-protectors we have seen lately are the woollen vests advertised elsewhere by Mr. Jenour. They are strong, cosy, neat, cheap, and well-fitting—well worth buying, wearing, and imitating.

Another Great American Bridge.—A great iron bridge on the Atlantic and Pacific Railroad over the Canon Diablo, in Arizona, has recently been completed. It is 500ft. long, the canon being some 250ft. deep. The height of the bridge is 240ft. The weight of the bridge amounts to something like 800,000lb., and the cost of construction was over 40,000dol.

Kelway's Electric Log.—During some recent trials of Kelway's electric log on board the steam-tug *Pixie*, a number of runs gave a mean of 7·2724 knots, while the same distance by actual measurement was 7·2768; the difference is thus 0·0044, which is probably the nearest approach to accuracy obtained by any log.

Red River, a great tributary of the Mississippi, rises in North-West Texas, and enters the Mississippi 341 miles above its mouth. Its length is 1,200 miles, and its basin 97,000 square miles in extent, 2,450ft. above the sea. Eight miles below its source it is 2,700ft. wide. Its sources are in a barren plain, the Llano Estacado, in Texas. Steamers of 4ft. draught can ascend to Shreveport, 330 miles from the mouth of the river.

SCIENTIFIC NEWS.

THERE seems to be no longer any doubt that Dr. Gould, of Cordoba, was the first to discover the great comet known as *b*, 1882.

The reported death of Prof. Palmieri was an error. His son died recently, but the eminent director of the observatory on Vesuvius is alive and well.

Dr. Von Kobell, professor of mineralogy at Munich, and well known by his numerous publications, died the other week, aged seventy-nine.

Mr. A. G. Vernon Harcourt, M.A., F.R.S., has been appointed general secretary of the British Association, in the room of the late Prof. F. M. Balfour.

The Canadians are determined to do what they can to induce the British Association to visit Montreal in 1884. The committee has issued a circular, pointing out that Montreal has twice entertained the American Association, and that the buildings of McGill University offer ample accommodation. Montreal is about six hours from Quebec, which is reached in eight or nine days, and it is within a day's ride of Niagara, New York, Boston, and New Haven, Conn., where the American Association will meet at such a time as to give the visitors an opportunity of being present. It is stated that the Government of the Dominion will make a liberal grant to defray the expenses of members of the British Association in crossing the Atlantic !

A revised edition of the "Rules, Regulations, and Orders for the Passing of Letters Patent for Inventions" has been issued. Those who take out their own patents should procure a copy.

A preliminary trial of the Giant's Causeway and Portrush Electric Railway took place last week. Several runs of over a mile were made, the rate of speed being at times ten miles an hour.

Prof. Fleeming Jenkin has patented an electrical system of transporting goods, which he calls "Telpherage." It resembles the wire-rope system, in so far that the vehicles are supported on strained conductors, which suspend the load and at the same time convey the electric energy. There can be no collisions, as if one train gets on to a section occupied by another, it is deprived of motive power and brought to a standstill until the section is clear. The patent is No. 1830 of 1882.

Mr. Edison has also obtained another patent for details in connection with electric railways, the most important of which appear to be the means of preventing leakage of the current. The ends of the rails and the fish-plates are of nickel, copper strips being used between rails and fish-plates at each joint. The rails are japanned, except at the top, and the ties are covered with an insulating compound. The patent is No. 1862, of 1882.

The Charing Cross and Waterloo Electric Railway Co. will apply next session for an Act authorising them to extend their projected line to the Royal Exchange. The scheme will involve another tunnel, as the proposed line passes along the Southern side of the Thames until near Southwark Bridge.

The elevated railways of New York are developing traffic in an extraordinary manner. During the twelve months for which the statistics have recently been made up, more than eighty-six millions of passengers have been carried, an increase of twenty-six millons in two years. It is expected that the next annual return will show a traffic of over a hundred millions.

Messrs. Piette and Krizik, the inventors of the Pilsen lamp, have been driving a threshing machine by electricity at an agricultural show in Lundenburg.

Mr. N. Stevenson uses a small Swan incandescent lamp to illuminate the cavity of the mouth in dental operations. It is fitted into a vulcanite cup which acts as a prop to keep the jaws apart.

A committee was formed last week at the Society of Arts for the purpose of commemorating next year the fiftieth anniversary of the death of Richard Trevithick, "the inventor of the high-pressure engine," by means of some permanent memorial. Capt. John Davis was appointed hon. sec.

The Board of Trade have issued a new or revised scale for the wire gauges, and plainly intimate that unless very great opposition is offered, the Board will advise its adoption. The new scale is a compromise; it makes concessions to the thick-wire manufacturers, and takes an average of the Birmingham and Yorkshire gauges for the thinner sizes. No. 19 will be ·042in., 1·07mm.; No. 20, ·036in., ·91mm.

On the 6th of May, next year, Southern Seas will witness the rare phenomenon of a total eclipse of the sun of very long duration, about *six minutes* for totality. Considering the rapid advance of solar physics in recent years, and the important problems regarding the sun, and the regions about him, still awaiting solution, it will be readily understood that astronomers are looking forward to this eclipse with much eagerness. In a recent report M. Janssen urges the importance of the opportunity, and he indicates Caroline and Flint Islands as the most suitable for observations. Both are in the zone of longest totality. The observers will have to study specially the immense appendices of the corona, in order to decide if they are really lineaments of the solar surface, or consist of meteoric streams circulating in space. The zodiacal light, too, will claim attention; and a careful examination will have to be made of the intra-Mercurial regions, with the view of settling the question as to the presence of planets (to which Le Verrier's analysis pointed).

In several of the hothouses in Holland, a myriapod is frequently met with which (according to Herr Weber, of Utrecht,) is a foreign species of the genus *Fontaria*, and has the remarkable property of producing prussic acid (HCy). Attention was called to this on finding that the animal, when excited, gave out a strong smell of oil of bitter almonds. The phenomenon is still more pronounced on bruising. Some specimens having been distilled with water, prussic acid was found in the distillate. Herr Egeling has lately made a series of experiments to test the view that this myriapod prepares a substance which, under certain conditions, is decomposed, giving prussic acid as one of the products of decomposition. This was fully confirmed. By action of various reagents, a substance was detected, which is split up by water, yielding HCy. It further seemed probable that, besides this substance, the animals possess one which acts as a ferment, and which the author hopes to be able to separate.

M. Fredericq, of Liege, lately put several aquatic coleoptera (including the great water-beetle) in aqueous solutions of curare and strychnine in poisonous quantity. A few drops of these liquors sufficed to poison a frog in a few minutes. The insects, however, lived in them, some more than a fortnight, others nearly a month (when the experiment was concluded). These coleoptera are certainly sensible to the action of curare and strychnine, and the absence of symptoms of poisoning in the present case, must be (the author says) because the absorption by the surface of the body and the mouth was nil. M. Plateau has previously observed that aquatic coleoptera kept in sea-water do not absorb its salts.

While air inclosed in a horizontal tube has throughout the same tension, corresponding to the outer state of the atmosphere, it must, on the tube being raised to the vertical position, present differences of tension due to pressure of the air-column. Herr Hopfgarten recently experimented in this way with an iron pipe, about 38ft. long, and ½in. internal diameter. It was screwed into a short tube of ⊥ shape, the horizontal part of which could be rotated in a bed; this piece was connected by caoutchouc tubing with a petroleum manometer, which revealed a difference of pressure when the long tube, which was surrounded with a bad heat conductor, was turned up to the vertical. The average increase of pressure at the base was found about 25mm. petroleum, and this corresponds to about half the weight of the column.

Wiedemann's *Beiblätter* contains a brief account of an incandescent electric lamp, devised by Herr Böhm, the parts of which are easily separated. It consists of a bell jar, with a glass stopper passed into wood. This stopper holds the conducting wires, and has also a passage, into which a small tube can be easily inserted. By simply turning it (after evacuation) the lamp is lit. A fresh carbon can easily be inserted when required. For rapid and convenient evacuation, the author has constructed an air-pump, which is a combination of those of Geissler and Sprengel. The former is first used, and when a certain degree of rarefaction has been reached, the Sprengel comes automatically into action.

A Committee of the Franklin Institute appointed to test the Rapplaye Rheometric Governor Burner, in comparison with a number of other burners, have stated that, in consideration of the uniformity of gas consumption maintained by the burner under varying pressure, and its high photogenic qualities, they recommend it with confidence as affording a better light, at less expense, than any other practical appliance with which they are acquainted. This burner meets a long-felt want in that it allows a maximum light at a slight increase of pressure above that required for an open burner, and maintains a uniform flow and light at any pressure in excess that is liable to be encountered.

A great many automatic regulators of heating by gas, for keeping a constant temperature in a hothouse, stove, room, &c., have been invented, but few are so simple, perhaps, as one recently described by M. Saignol to the French Society of Mineral Industry. It is composed of a tube of Y shape, through the forked part of which the gas passes to the heating apparatus. In the stem mercury moves by reason of dilatations and contractions caused by variations of temperature. The mercury touches the bottom of the fork at a fixed temperature, 10° *e.g.*, and closes the passage. If the temperature falls, the mercury contracts, the gass begins to pass, and the more so, the more the contraction. The temperature then rises again to 10°, and the gas is stopped. A small jet is kept constantly lit in the heating apparatus, and ignites the heating-gas whenever this is liberated. In one modification a spherical glass vessel, holding concentrated alcohol, is fitted into one end of a U tube containing mercury, the other end having an arrangement which acts on the principle that has been indicated. (The system is illustrated in *La Nature*, No. 492.)

We recently referred to the interesting researches of MM. Deherain and Maquenne on the reduction of nitrates in the ground. The effects of heating and chloroform, &c., seemed to point to a fixed ferment as the cause of the reduction, and the authors have found reason for believing that the ferment in question is the agent of butyric fermentation, discovered by M. Pasteur, and described by M. von Tieghem under the name of *Bacillus amylobacter*. This was found in a fermenting liquid which had been composed of some earth and a solution of sugar and nitrates, and was heated at about 35° C. (The gases given off were sometimes carbonic acid and hydrogen, sometimes CO_2 with nitrogen and nitric protoxide, and the liquid smelt strongly of butyric acid; the nitrates disappeared). The *Bacillus* named is very widely distributed, and may be easily observed (as oblong particles in groups of two and three) in the liquor formed by beans, peas, or leaves, rotting in water. It is supposed that the nitrates in the soil are reduced by the hydrogen generated in the butyric fermentation caused by this small organism, when it meets with abundant organic matter, and oxygen is absent. This ferment is not represented as the only one capable of this curious action. MM. Gayon and Dupetit have lately shown that sewage-water, withdrawn from the action of air, reduces nitrates, and as no hydrogen was observed, it is probable that the active ferment in this case is different from *Bacillus amylobacter*.

This month, a century ago (that is in 1782), the art of aërostation practically began, when Stephen Montgolfier, at Avignon, first succeeded in causing a silk parallelopiped, of about 50 cubic feet, to rise to the roof a room. Encouraged by this success, the brothers made experiments on a larger scale at Annonay, with equally happy results; and finally, in June, 1783, in presence of the States of Vivarais, and an immense crowd, they raised a balloon, 35ft. in diameter, to a height of 1,500ft. (In 1782, Cavallo had succeeded in raising soap-bubbles, inflated with hydrogen gas.) In recording the centenary, M. Tissandier gives, in his paper (*La Nature*) a representation of the medal that was struck in 1782, in honour of the Brothers Montgolfier.

The Persian Government has arranged with a syndicate of French capitalists for the construction of a railway between Teheran and Resht.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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THE GREAT COMET.

[20777.]—Through the kindness of a gentleman whom I am unable to identify, as he has added no signature to his letter bearing the Liverpool postmark, but to whom, with the Editor's permission, I am anxious to return in this way my very sincere acknowledgments, I am in possession of some particulars respecting the comet, which may interest your astronomical readers. It appears, from a Melbourne newspaper, quoted in the Otago *Daily Times*, that at noon on Sep. 17 it was plainly seen with the naked eye as a very bright object within 4° of the sun; and that an orbit, roughly computed from that and previous observations, showed that it had swept half round the sun in less than two hours, and would return over nearly the same part of the heavens in which it had at first appeared. Continuous clouds, however, prevented its visibility till Sunday, Sept. 24 (or Oct. 1?), when it presented a grand spectacle, exceeding, it was thought, even that of 1861 in brightness. The elements of the orbit referred to gave it a perihelion distance of only about 23,000 miles from the photosphere—a "somewhat alarming proximity," as the newspaper expresses it. This, I believe, has been modified by subsequent observation; but there is still much justice in the striking remark that it was "certainly within range of the enormous volcanic jets of incandescent hydrogen ejected from the sun in the vicinity of sun-spots, which often extend 100,000 miles from its surface." I do not know whether it may have been noticed that not merely orbital disturbance, but even chemical change, may have been possible under such circumstances, and that the alteration which has been recorded in the spectrum may have been induced by some influence independent of calorific action. **T. W. Webb.**

Hardwick Vicarage, Nov. 23.

THE TRANSIT OF VENUS.

[20778.]—Just allow me to anticipate a mistake into which amateur observers are likely to fall, in consequence of your having quoted the times of ingress as seen from the *centre of the Earth* (which are those given in the *Nautical Almanac*), instead of the times as seen from its surface, which last have to be computed from the central times, and are nearly five minutes earlier.

I send you the times of ingress as calculated for London, Edinburgh, and Dublin.

	London.	Edinburgh.	Dublin.
	h. m. s.	h. m. s.	h. m. s.
First external contact	2 0 24	2 0 46	2 0 39
First internal contact	2 21 4	2 21 31	2 21 35

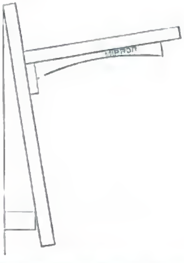
The sun sets shortly before four o'clock.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage Nov. 25.

THE TRANSIT OF VENUS—SUNSPOTS —A BIG TELESCOPE.

[20779.]—Since getting our "Astronomical Notes for December," and seeing it there stated that the transit of Venus can be seen by the naked eye screened with coloured or smoked glass, it has occurred to me that some of your readers may be interested to hear of two other simple ways of seeing the Transit, not indeed without optical aid, but by means of an unsilvered mirror: 1st, without an eyepiece; 2nd, with an eyepiece and coloured glass. First of all, mount the mirror on two pieces of board, nailed together thus (see figure); take it to any convenient spot where the sun can fall fully on it, and arrange it by tilting, as shown in figure, so that the shadow of a small piece of cardboard (white) held in its focus will fall on the centre of the mirror; now focus the sun properly on the card, and look for Venus. I have this morning (Nov. 27), seen three groups of sunspots and some single ones in this way. My second plan is to get the lowest power eyepiece with sun-screen of coloured glass, and again arrange the mirror so that one half of it is covered with the shadow of the head, and so that the eye comes in a straight line with the centre of the mirror and the sun; now if the eyepiece be used at a proper distance from the mirror, the sun can soon be found, and proper focus obtained; by this simple means a good view of the Transit may be obtained. I have this morning seen not only sunspots, but the willow-leaf markings, very distinctly in this way. The longer the focus of the mirror the better for the first plan, as it gives a larger image of the sun on the white card. The one I used this morning is 12¼in. diameter, and over 9ft. focus, giving an image nearly 1¼in. in diameter. Having no proper appliances for viewing the sun with a large silver surface, I always view it in the way described above, as, with a low power and a little practice it can soon be done, taking care to keep the centre of the mirror, the eyepiece, and the sun nearly in a straight line with each other. When viewing the sun in this way, it has often struck me that a "big" telescope on this principle could be constructed, even more perfect than the Newtonian or any other form of reflecting telescope. This is my idea (if it is worth printing): grind, polish, and figure to a parabola, a silver-on-glass mirror, of, say, 11ft. in diameter, and 50ft. or 60ft. focus; mount it in an iron or steel tube, and, instead of a flat or small reflector of any kind, fix a box 6ft. high, and only just wide enough to admit one person (the observer); at 5ft. 6in. fix the eyepiece so as to look straight toward the centre of mirror, and then you are complete, except a light ladder inside of the tube by which the observer could reach his nest. Yes! One thing more—a door at bottom of tube, as well as the usual arrangements for moving the telescope.



The Optical Bricklayer.

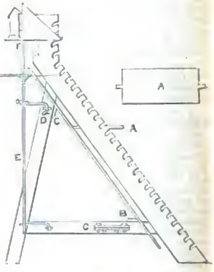
OBSERVING SEAT AND LAMP— AURCRA—JUPITER.

[20780.]—I have an impression that a request was made some few weeks ago for a sketch of an observing-chair suitable for a telescope of about 3in. aperture. I send a sketch of one I had made, and have found convenient in use. The frame is made just like an ordinary pair of steps, the seat A being carried in notches, and prevented from falling back by a piece of wood 4in. wide, which is carried on two cross pieces (ends shown at B, &c.), and serves for a back. In the straight part at the top small round pegs are let in for the seat to rest on. The small lamp-stand and table were adapted from a sketch given some time ago (letter 20030), by Mr. F. G. Dupont. The lantern used is an ordinary bull's-eye. The small desk has a piece of frosted glass let in, on which to lay paper for sketching, and the under part of the box being cut out, a piece of tin laid over the glass reflects the light on to the round table below.

This arrangement is carried by two iron brackets made to swing round, a thumb-screw at D clamping them in any position, the rod E also moving up and down in the brackets. Mr. Dupont's sketch showed the same arrangement as a detached affair, but it is much more convenient to have it attached to the seat. The lamp and desk turn on a pivot at F, so as to cast the light on any part of the table. At G is a rack with four holes to take the eyepieces, fitted with a flat cover to prevent dewing of the eye-lenses.

I have used this seat for many months with my 3in., and am now also using it with a 6in. reflector, with a Berthon equatorial mount, and find it equally convenient.

On Friday night there was a grand aurora, which, doubtless, many of your readers observed. As seen from here it presented at first (about 5.30), the appearance of a lurid red tint overspreading the whole northern half of the sky, but deepest over the north-western horizon. Later on, the colour changed to a bright silver-grey, and sharp prominences shot out as far as the zenith, up and down which the light flickered and, at times, almost flashed. At 12 o'clock there was only left a single rainbow-like arch of bright grey, low down towards the north. I noticed that the air was steadier and definition better than it has been for weeks past, especially about midnight. With a 6in. mirror of Mr. Calver's make, which I have just got into working order, the details of Saturn were as distinct as if drawn in pen and ink. On Jupiter I noticed a curious phenomenon. On the preceding half of the great deep south equatorial belt (which showed a glorious brown-red tint) there was a large, long oval light spot. When I first observed it a deep-coloured small spot was first joined to the dark belt on the north shore of this lagoon, if I may so term it, just connected as it were by a narrow isthmus. Whilst I was looking the small spot seemed to be obviously detaching itself. I took off the 250 power I was using, and put on the 300, and in the few seconds which this took to do the spot had entirely separated itself, and when I looked at it with the higher power it was very slowly floating like a moving island toward the centre of the light spot. This was about 1 a.m., and within ten minutes the sky became clouded, and I lost the opportunity of seeing what became of the little spot. It was slightly oval shaped, and about the size of the disc of a satellite, with which, however, there was no confounding it, for it was only slightly darker than the belt, and moved from N. to S. Besides which, I think all the satellites were visible well off the disc; but of this I will not be sure. I was so occupied with the spot that I scarcely noticed them at all. Now, I should like to ask, first, whether any of your more experienced astronomical contributors saw anything of this; and if so what it means; and how is it reconcilable with the general opinion that the *dark* belts are what we see of the planet itself? Was this an opening in the vaporous envelope which moved in this way, and in this direction?



If the definition had not been simply superb, I should never have seen this; but as it was I am sure of my facts—viz., that when first noticed it was distinctly attached on the N. side of the oval light spot, and that 10 minutes afterwards, and seen with a higher power, it was as distinctly detached, and moving slowly out.

N.B.—I have a rough sketch (*very rough*) made at the telescope, which is not clear enough for publication, but which I will gladly send to any contributor who would like to compare.

Warminster, Nov. 20. **E. S. Beaven.**

MIRRORS OF REFLECTING TELESCOPES—TO "A. N. H." AND "ORDERIC VITAL."

[20781.]—I was very glad to see the letters of these two correspondents on this interesting but difficult subject, and I can but regret "O. V.'s" announcement that his communication must be considered his final one.

Before seeing either of the letters I had posted my "notes," taken from Edward's paper on grinding mirrors, in which I casually quoted Mudge's remark, that the curve of the small mirror was always a spherical one. What Mudge and Tulley experienced in *their* day proves to be also the experience of "A. N. H.,"—viz., that the hyperbolic convex can't be obtained, and I believe "A. J. S."

has made the same remark; while, from the failure of one of our principal opticians to grind me a correct ellipse for a Gregorian, it is evident that this latter curve is, *on the small scale*, equally as impossible as the hyperbola.

As far as I know, the most modern Gregorian is the one constructed by the late Mr. Lassell, which is now in the possession of Mr. Valance; and the most modern Cassegrain is the great Melbourne instrument constructed by Mr. Calver. These may doubtless be accepted as the most perfect representatives of each, and it would be extremely interesting if the owner of the former, and the maker of the latter, would give us information as to the curves employed.

It may be a useful hint to "A. N. H." if I mention that I was told by an old and experienced grinder that it was scarcely possible to figure one of these small mirrors by itself, and that the way he had adopted was to imbed it in a disc of the same substance, and grind and figure the whole as one piece.

I presume a still more exact way would be to grind and figure a larger mirror, and then cut out the required central portion—unless, perhaps, strains might be introduced by so doing.

Our lost (and regretted) correspondent "Hyperion" once gave a capital account of how he had cut a hole in a Newtonian mirror, in order to use it for a Cassegrain; but he told us nothing about his final success (or otherwise) in the attempted conversion.

By the bye, is it not a fact that the theory of the Gregorian and Cassegrain is only true when the focal image has no appreciable magnitude, and that, *even with true curves*, aberration must always result in practice? **L. L. L.**

REFLECTORS VERSUS REFRACTORS.

[20782.]—A remark by "Prismatique" in the "E.M." this week induces me to trouble you. I have for some time had possession of a 3in., by Wray, with which, for its size, I am well satisfied, but have lately been thinking of changing for a reflecting telescope.

Our optical friend, differing from Mr. Holmes, prefers a refractor. I see he says he would rather have a 4in. refractor than a 6in. reflector. This has a little checked me, because, if the difference is so great as that, it appears to me probable that a 6in. mirror would have no advantage over my present Wray. May I ask him if this would be so, and also to state on what grounds he bases his preference? Will Mr. Holmes say if he has had any experience of a 3in. Wray as well as a 6in. reflector, and, if so, with what result? I think it would be very interesting to your readers if a practical optician like "Prismatique," with such excellent opportunities for judging, were to state why he so greatly prefers the refracting form.

While writing, may I ask a question on another matter? Mr. Proctor states in his "Half Hours" that 2in. will show the division in the Ring of Saturn, and it is said that Cassini discovered the division with a non-achromatic and a power of 90, and that he saw the division all round. I, however, with a 3in., have only on rare occasions glimpsed it, and certainly only in the ends, and no one of my friends can do any more. Ought it to be always visible? Ought it to be steadily visible? Ought it to be black and sharp? What power ought I to use?—I find anything beyond 150 deficient in light; I consider it very hard work to see it. Should I see it any better with a 6in. reflector? My telescope experiences differ so greatly from what I read of others, that I am often much confounded. After "Prismatique's" decided statement, I shall certainly wait for his further explanation of why he would prefer a 4in. refractor to a 6in. reflector before I move in the direction of change.

Thomas Jobson.

23, Canonbury Villas, Islington.

CONTINUOUS BRAKES.

[20783.]—Since the publication of my letter, p. 253, I have received communications from many of your correspondents relating to the Clayton vacuum brake used upon the Midland Railway.

Those gentlemen who advocate this system of brake object to my statement that "plenty of vacuum may be shown upon the gauge, and yet there may be no available brake-power"; but I maintain that this remark is perfectly correct, as it is based upon the result of my own experiments.

When the brake is applied the vacuum in the cylinders is destroyed, and the brake-blocks cease to press upon the tires in from a minute to a minute and a half (*whether the driver wishes it or not*). A driver, finding that the brake is leaking-off, and that the train is still running, has to open the large ejector, take the brakes fully off, and create another vacuum before he can have any available brake-power. When he sees ten or fifteen inches of vacuum shown upon his gauge, he naturally thinks that he has that power for use, and this idea has caused many trains to run past stations. All drivers who work this brake should be specially warned that they cannot obtain a second supply of stopping power until they have drawn the air out of the top sides of the cylinders through the small leak-holes in the pistons. Now a driver is not provided with any means of knowing how long it will take to re-create the vacuum in the cylinders; but it will be seen from actual practice that to obtain power to stop a train, even when running into a station at a low speed, takes a very considerable time, probably a minute, and during the whole of the time the vacuum is being re-created the brake must be fully off; suppose for a moment that an emergency arises, or that the driver finds he is likely to run past a station, or into buffer-stops, *what is he to do!* Simply wait till the large ejector has re-created the vacuum, which will again, in its turn, leak away in a minute or so.

Some of the letters which I have received express the opinion that this brake "cannot be as dangerous as I consider it, because no cases of failure to act are recorded in the returns." This latter argument brings under our notice a very important fact. The Midland Railway Company's returns, so far as they refer to the Clayton two-minute modification of the Sanders-Bolitho vacuum brake, are perfectly incorrect and unreliable.

I have been a passenger in trains when the brake has failed to stop at platforms, have witnessed "failures," "delays," and the breaking of draw-bars and couplings, and yet when I turn to the Board of Trade returns, I find that the Midland Company has not mentioned any one of the cases in question. If the "Returns" contained a true record they would be most valuable, but at present they are rendered perfectly useless for purposes of comparison in consequence of the incorrectness of the information furnished by this company.

I trust that by calling public attention to the present unsatisfactory "Returns," the subject may receive the consideration which it requires, and that the Board of Trade will take the necessary steps to enforce obedience to the requirements of the Railway Continuous Brakes Act of 1878.

Clement E. Stretton.

Saxe Coburg-street, Leicester.

JERK IN RAILWAY TRAINS.

[20784.]—I did not think it worth while to occupy your space with a reply to the letter of Mr. Stretton, p. 253, as I felt sure it would be readily seen that he had not answered the objection of Mr. Molison, p. 230, that the action would vary on different parts of a carriage; nor my own, that the carriage righting itself would jerk the passengers towards the engine, whereas "S. J.'s" jerk is in the other direction.

On reading Mr. Molison's letter, it struck me as being a singularly well-written, explicit, and courteous communication, and I, therefore, enter a protest against that of "Nun. Dor.," p. 273, from which all these qualities, especially the last, seem conspicuously absent. Criticism is here almost out of place, but I may just remark: (1) That Mr. Molison did *not* state that the jerk would be unfelt by a sitting passenger, but inferred quite the contrary. (2) The buffer recoil would jerk the passengers *towards*, and not *from*, the engine. (3) The buffer recoil does not account for the jerk in a tram-car which has no buffers; and (4) I shall try to conclude without calling anybody names or making any personal remarks whatever.

Belfast. **J. Brown.**

[20785.]—I did not intend to write anything further in this matter after the reply of Mr. Stretton; we simply differed in opinion. I was, however, pleased to see that my views were shared with your able correspondent, J. Brown (letter 20701). Our friend, "Nun. Dor.," now rushes at me with reference to this matter, and treats me with more rudeness than reason. I fear it would be vain for me to try to point out to him where he errs. He has evidently made up his mind, and intends to stick to it; argument with him would be out of the question, and the only one which might have the chance of reaching him is that which he suggests at the end of his polite epistle. This style, however forcible and striking, has not the convincing power *I* respect, and therefore, he may keep his name, age, and weight a profound mystery; but may it be remarked in passing that the loudness of the crow of such as "Nun. Dor." is always directly as the square of the distance, multiplied by the cube of the pluck, which latter factor may be neglected, and considered a vanishing quantity, especially when the distance is small.

My further remarks are, therefore, not meant for "Nun. Dor." Oh, no; but simply to point out to any who may care to read these letters that there are false teachers abroad; men—independent men—who claim to despise textbooks, perhaps for the good reason that they are unable to understand them.

The jerk referred to by "S. J.," the original querist, was the jerk that tended to throw the traveller in a direction away from the train. The rebound of the buffer, as "Nun. Dor." would have to be the cause, would have exactly the opposite effect. Indeed, "S. J." distinctly points out the fact that it is not due to this cause, and mentions also that a similar jerk may be experienced in a tramcar, where it evidently cannot be the effect of the buffers. I think "S. J." will bear me out when I say that his question was, What is the cause of that unexpected jerk, or tendency to fall away from the engine, immediately on the stopping of the train? I take it neither "S. J.," nor most of the readers of the "E. M.," need to have explained to them that a sudden jerk from the engine, the sudden application of the brake, nor, indeed, that any sudden change of motion, will produce an unpleasant jerking sensation to the rider; and I think they will, if they have not despised "the usual textbooks," have no difficulty in saying in which direction the body will tend to fall; but *the* particular jerk which certainly does occur, and which I have myself experienced, is not so clear as to its cause. Mr. Brown gave the true explanation, and had his letter been published before I had sent mine, mine would not have appeared. Curiously enough, "Nun. Dor." distinctly differs from Mr. Stretton, whom he wishes to uphold. He ("N. D.") refers it to the buffer-springs, Mr. Stretton to an unequal pressure on the carriage-springs—both equally wrong. May I also remark, in closing, that "Nun. Dor." attempts to prove *too, too* much? Surely I was safe in saying that the way to prevent the unpleasant consequences of the jerk is "not to rise from your seat till the train has stopped." But no; "Nun. Dor." says, "if the passenger follows Mr. Molison's advice, and does not rise from his seat till the train has stopped, he will most decidedly experience the jerk." Perhaps "Nun. Dor." will tell us next that it is safest to get into the carriage and take our seats *before* the train has stopped. Is this ignorance, or—has "Nun. Dor." corns?

Swansea. **A. R. Molison,** Science Teacher.

NOVEL VIOLIN — EXTRAORDINARY VIOLIN—SOUNDPOST.

[20786.]—Referring to "Fiddler's" remarks (letter 20771, p. 275), the reason I said there was some hope for the tone of the novel pattern was that all the parts found to act well were retained, the shape only being altered. "Fiddler" thinks, with some reason, that the rounded form of sound-board would not give good effect; but I think, if made sufficiently thin, the resonant quality would be sufficient.

But extraordinary violins are a mistake. Attracted by the exceptionally fine tone of the violin, the inventor seeks to improve it by a totally different arrangement, discarding parts that work well together, and, of course, failure ensues. Under the head "extraordinary" I would class the "Berliner," the "Fiddler," and some crude styles recently advocated or suggested in these pages. As to the specimen "Fiddler" describes, I cannot see why he winds up with such eulogy of it as "this invention was the result of a lifetime of thought, always battling against the stupid conditions imposed by the soundpost," &c. Now, if this invention had come to the front with acknowledged superiority, one might well understand discarding the soundpost; but when it is found that it has been allowed to die a natural death, the reasoning appears less cogent. I, for one, am satisfied to remain amongst the stupid who still believe in the soundpost, considering it one of those simple additions often seen in great inventions which steps in unobtrusively and perfects what otherwise would be crude; for suppose it were possible to make the violin equally resonant as at present by some fixed contrivance replacing the soundpost, the chances of having equality of tone over the four strings would be greatly reduced. I don't know whether "Fiddler" disputes the comparative regulating properties of the soundpost; but when he applauds himself for having discarded it in his own invention, he leaves it to be inferred that the superiority of his is established. However, when he mounts his hobby it must not surprise that he should be a little inclined to draw a long bow.

Nov. 27. **Captain Cuttle.**

[20787.]—After reading the letter 20738, which appeared under the above heading in your issue of Nov. 17, it occurred to me that an account of the guitar-shaped violin, invented in 1817 by M. Chanot, might be of interest to some of your readers.

The peculiarities of these violins were as follows:—1. The corners of the inner blocks were rejected, and the violins assumed the outline of a guitar having the sides similarly bent. 2. The edges, instead of projecting beyond the sides, were finished off square, with an inlaying of hard wood all round, like a guitar. 3. Instead of sound-holes of the ordinary form, the new violin had openings of about the same length as usual, parallel to the sides and as near the bendings as possible; their shape was consequently that of a segment of a circle. 4. The brass bar was placed in the middle of the belly just upon the joint. 5. A screw was placed in the end of the tail-piece so as to prevent the strings causing too much pressure on the belly. 6. Beneath the soundpost, and passing out through the back of violin, was a screw, by means of which the pressure of the soundpost against the belly could be adjusted. In 1819, M. Chanot introduced some further modification; he discarded the tail-piece and button, and attached the strings to the belly of the violin between the outer edge and bridge. The bar was shaped in the form of an arch. It passed under the left foot bridge near the G string, and approached the middle at the extremities, and the soundpost was placed in front of the bridge. Some of these instruments are still extant, and possess a good tone, being sold at from £8 to £12. In the year 1832, C. A. Galbusera also manufactured guitar-shaped violins and tenors. **War.**

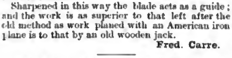
SAW-SHARPENING.

[20788.]—In sharpening his tool is where the amateur most generally fails; and the saw is no exception to this. Without a good saw, the labour of much of the amateur's work is greatly increased; and if the saw, in addition, be blunt or badly set, the difficulties are still greater.

Though some letters have appeared on the subject, I have not seen the method I am about to describe referred to. Not that there is anything new in it; but it is not, I think, very generally known. It will be seen that the form of tooth is only suited for cross-cutting; and as it is possibly desirable to keep a special saw for this and another for long cutting, the sooner the change is made from the "mungal" tooth to the regular cross-cut tooth the better; and as a hand-saw sharpened as I shall endeavour to describe will do better work than the most carefully-set tenon saw, the cost of the latter may be saved, or else spent in buying a rip or long-cutting saw.

If the saw has been in use before, lay it on a smooth anvil, and very carefully *take all the set* out of the teeth; then bring to the saw-vice, and bring top of all teeth to level by running a fine-cut file along their top. This will leave a little bright facet on top of each tooth.

Now take the file, and apply it to a tooth; file lying at an angle of about 60° *to the plane of the blade*, and also *pointing at about the same angle* towards the *point* of the saw—i.e., supposing the saw-blade to be perpendicular, and lying east and west, the hand will be lowered 30° from perpendicular, leaving 60° below file and saw-plate, and point of file will be 30° to E. of N. Work the file in this position till you have produced a chisel edge on the *front* of each tooth, being careful only to file off what is necessary to produce it. When all the front edges of every second tooth on one side of the saw are thus sharpened, the facet on top of each tooth will be probably altered from the square shape it had at first to a triangular one, but the front must never be filed so much as entirely to remove the facet. Let the file be now applied to the back of the tooth *in exactly the same way, and at same angle both ways*, and every second tooth filed *till the whole* of the facet remaining is just removed. Turn the saw, and treat the other side just in the same way, and you will have a tooth of



this form, which will be found to cut most delightfully without *the least need for any set.* It will cut off a thin slip $\frac{1}{16}$in. thick from end of a 9in. board without breaking it, and will leave a surface almost as smooth as if it had been planed.

Let anyone try this, and I venture to say they will never go back to the old method of sharpening or setting, and their tenon saw will have very little to do in future.

Sharpened in this way the blade acts as a guide; and the work is as superior to that left after the old method as work planed with an American iron plane is to that by an old wooden jack.

Fred. Carre.

HYDRO-DYNAMIC PARADOX AND PARADOXES IN GENERAL.

[20789.]—I see a correspondent, signing himself "Little," has actually been constructing an apparatus which I remember to have seen illustrated in a book at least a century old, and that he attributes its failure to insufficiency of the weights employed. May I state that it is absolutely impossible that *any* amount of weighting could have produced rotation? It is axiomatic that if any course of reasoning would inferentially lead to proving self-motion possible, in the case of any machine whatever, such reasoning must, *ipso facto*, be false; and the only use of introducing such matters into our columns is to give opportunities for showing *where the fallacy lies.* Such was my intention in sending the original paradox of the lever and weights from which I deduced the fallacy of the hydro-dynamic wheel. In the form of the latter that I devised, there is much difference from that sketched by "Little," as I provide for raising the water direct from its lowest (and so to speak) neutral point to that of greatest effective leverage. But that the apparatus could by any possibility make a single revolution is not to be supposed for a moment.

By the way, perhaps "Little" will tell us *at what point* his apparatus found for itself a condition of equilibrium?

As to his second sketch, so far from the machine being "correct in theory," it is obvious that the wheel would *tend* to revolve in the other direction, owing to the pressure of water in the cistern acting against the divisions. **A. S. L.**

DIE-ENGRAVING.

[20790.]—There is no need to recommend "Gamma" (letter 20762) to read Montaigne. I cannot sufficiently thank him for his most excellent letter; it is, indeed, a far more complete answer to my query than I had allowed myself to expect, even from the English Mechanic; and while we have such willing, free, and practical writers to counterbalance the few wordy, empty talkers, we need not fear for the reputation of our paper.

There are one or two things I would like to have "Gamma" explain a little more fully. He says *hand-gravers* may be had at Buck's of sort used by copper engravers. Are these similar to the ones used for *wood* engraving? Are they to have mushroom handles? What length and what dimensions should they be of? Are Figs. 3 and 4 full-size sections? Next, as to the *punches*. I have never seen a skittle, so am in doubt as to what their shape is.

All the work I purpose doing would be light, such as monogram crests with motto, address for head of letter-paper, and envelopes. I suppose for motto and address I must buy letter punches, as apparently they are too difficult to be made satisfactorily by an amateur, but the other I can easily accomplish.

I do not quite understand the description of punches *a*, *b*, *c*, Fig. 6, as to be "deep at the outline and softening off to nothing close to the nose"; could "Gamma," please, explain. Again, he says "make a punch like a rosebud." This is, I presume, merely to the outline of a rosebud, and that the punch is *quite flat* on the face, the folded leaves in centre being the after-work entirely of punches and chisels. May I hope that this is only "Gamma's" *first* letter, and that it will be followed by a second, third, and fourth, giving us a few *more examples* from which so much is to be learned?—that he will, too, take up the mounting of the die when finished, what its thickness should be, to what it should be tempered, and all other points about it which he has shown himself so well qualified to speak on. **Fred. Carre.**

"LOOPED FIGURES BY GEARING."—NORTHCOTT'S LATHE

[20791.]—Your engraver has succeeded perfectly in reproducing the figures I sent you before, and, thinking you may be interested to see some more of them, I inclose tracings, which you will probably not have space to engrave.

I was delighted to see Mr. Northcott's letter; but as I have the first edition of his work, I cannot refer to the figures. Will he kindly tell us whether he has made any improvements in his lathe since we last heard of it? **F. A. M.**

COLOUR.

[20792.]—Owing to various reasons, I have not been able to send this letter earlier. I am sorry not to have sufficient power of language to express myself as clearly as I can see this subject in my own mind. But the great study of my life has been to get a thorough knowledge of colour, and to be able to express my thoughts and interpret my views of nature with a brush or pencil.

The sweeping statement that scientific and artistic practice cannot agree is simply a claim by a theorist, whose views have proved to be quite unpractical, that he is correct, and that the practice is therefore unscientific.

"Sigma" finds fault with my definition of pure blue (probably because it is incomprehensible to him), and gives the scientific definition; but may not both be correct? This letter has been delayed, partly on account of the absence of sunshine lately, as I have waited to try some experiments with spectrum colours, using prisms from ¾in. to 3½in. diameter.

I find the spectrum colours depend upon the distance the rays have to travel from the prism to the surface upon which the spectrum is seen, and also upon the size of the prism.

If we hold a white surface near to the prism, we get red, orange, and yellow, divided by a clear space from the blue, these hues being the only ones visible. Upon moving the screen further off the rays spread, until the blue and yellow slightly overlap one another, and we get the invariable result of a mixture of these two colours—viz., green. The red and yellow also overlap; and we consequently get what appears to be commonly recognised as the spectrum—viz., red, orange, yellow, green, blue, and purple. Upon moving the screen still further away from the prism, we find the blue, red, and yellow rays overlap more and more, until the primitive colours are lost, or almost lost, and we get varieties of orange, purple, and green, covering nearly the whole of the spectrum.

Another experiment is to hold coloured surfaces in the spectrum rays, and we find that a yellow surface gives a green line where the blue of the prism falls upon it. To get this fairly, it is best to catch the blue rays close to the prism before they have overlapped the yellow.

A similar experiment is to hold a blue surface in the yellow rays, when green will again be the result.

The following is a simple experiment for those who have not the time or opportunity to arrange the ordinary spectrum experiment:—Hold a prism close to the eye, and note the strong colours bordering the window frames, &c.; the edges being bright red and yellow, opposite bright blue. Upon revolving the prism slowly, the blue and yellow may be made to overlap, with the invariable result of a vivid green. The same result may be seen upon pulling down the blind until it nearly meets the window frame, when we again get vivid green.

These experiments all show us that green is simply a combination of blue and yellow, no matter how the hue is obtained; that combinations of spectrum colours give the same results as mixtures of pigments of the same hue, *and that there is no green in the spectrum until the blue and yellow are combined by the rays overlapping.*

From the experiments I have tried, I conclude that if the spectrum rays were allowed to travel far enough, the pure blue, red, and yellow would be entirely lost by the rays overlapping. The room I devoted to the experiments is rather small; but after travelling about 15ft. from a ¾in. prism, the general effect of the spectrum was orange, green, and purple; there being no pure yellow, and very little pure red or blue. With my large prism, I got scarcely any orange, green, or purple, owing to the confined space; while the blue, red, and yellow were very vivid at the full range.

The "scientific monopolists" declare that the results produced, upon combining pigment colours, differ from the results obtained by combining the same colours in the spectrum, on account of their impurity. They talk of the spectrum, as if it was invariable, and as if the names, or signs, of the colours were produced by the prism alongside their respective hues; instead of which, the same spectrum appears extremely different to different people, and if a number of scientists were practically examined, not by the sample tests for potted knowledge, but if they marked the spaces they imagined were the pure blue, red and yellow, and which they considered the dark and bright parts, we should find the most extraordinary discrepancies.

For instance, take "Sigma's" statement that "there are a number of different hues of pure blue and yellow." This is quite unscientific, and entirely at variance with the strict meaning of the words "blue" and "yellow." He might just as reasonably say there were a number of different kinds of pure gold.

What he calls a range of blues and a range of yellows, would be more scientifically described as varieties of blue-purple, blue, and blue-green; and yellow-green, yellow, and yellow-orange, &c.

If his view is universally accepted by the scientists (I trust it is not), it would account for their many errors. I have been endeavouring all along to show that their statements amounted to this, but did not expect they would make the admission. You can make yellow with red and green glasses, if you believe in a number of reds, and choose the most suitable, which an artist would call orange from the quantity of yellow in it.

Theoretically, it is impossible to have absolute purity in anything, and in that sense, all pigment colours are impure; but although not so pure as could be wished, they can be obtained in a very fair state of purity, quite sufficiently so for experiments in the simple mixtures, and as we find that the three first compound colours—viz., green, purple, and orange—are invariably more intense the purer the primitives, it is only common-sense to argue that if the latter were quite pure, the results would be slightly more intense.

"Sigma" writes, "glasses that cut off all but the blue and yellow light are scarcely obtainable." Those who believe in a variety of blues and yellows must certainly find these glasses difficult to obtain; but if you happen to know what pure blue and yellow mean to start with, I should say it is a comparatively simple matter to get tolerably pure blue or yellow lights, although, I must say, that in the limited time I have been able to devote to these experiments, I have not succeeded in getting a transparent blue, free from red.

"Sigma" states "the fact is unquestionable that blue and yellow lights do not produce green." This is simply an assertion, which I have not the least doubt is incorrect in the sense in which he puts it; and I take it as a proof of the very imperfect knowledge of colour of the gentleman making it. He goes on to say that they only try their experiments in the dark, because a coloured light is scarcely visible in open daylight. No doubt; but can be not see in this an argument in favour of the theory, that the colour is part of the darkness?—for if you drive away all shadow, the colour must also disappear.

"Sigma" is certainly wrong in calling any combination of coloured lights white, without it has due equivalents of blue, red, and yellow.

Again "Sigma" writes: "We can produce white light by a number of combinations," "but these several whites, although optically and artistically alike,"—he is evidently as easily satisfied with his white, as with his blue and yellow (green he has an especial aversion to). I have taken great trouble to explain that it is quite impossible to form a judgment of any isolated colour, and any hue, especially if it is rather faint, might be mistaken for a white, under these circumstances; but if he tests his "several whites" carefully, by comparing them with a fair standard white, perhaps he will again admit "a greenish tinge" or "excess of green" or some other hue; and if he is still unable to recognise the impurity of his white, let him get the advice of some (non-æsthetic) artist friend.

Let us take a number of different materials, such as paper, silk, cloth, &c., anyone of which, seen by itself upon a black ground, would be accepted as white. We now lay them alongside with a standard white, and probably find that no two of them match, and that there is not one fairly pure white amongst them.

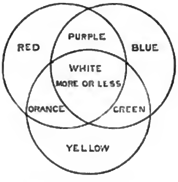
Certainly a neutral tint may be obtained by several combinations, provided they contain between them the due equivalents of red, blue, and yellow. For instance, blue, green, and red-orange may form a neutral tint; so may yellow-green and red-purple; or blue-purple and yellow orange; but there is no mystery about this to one who is in the habit of using colour all day long, every day of his life; and the same neutral tint is obtained by corresponding mixtures of pigments.

In the generally-accepted theory of light being composed of colour, along with a great deal of which I am ready to agree, I see much that is altogether contradictory and untrue. I think that, with a few modifications, the theory at present accepted by the scientists would be rendered more complete, and, at the same time, much more simple; but no theory can be sound that does not recognise the fact that mixtures of pigments, properly illuminated, must necessarily produce the same results as mixtures of spectrum colours of the same hue; and any statement to the contrary only serves to show the imperfect knowledge of colour of those who make it. The statements that the blue and yellow of the spectrum combine to form white, or a neutral tint, is only an instance of this; and certainly arises from their accepting what an artist calls purple and orange for blue and yellow, and then again being satisfied with a very questionable white. For instance, if one is experimenting with a spectrum in which the rays overlap, so as to show scarcely any colours but varieties of orange, green, and purple, he may easily go astray in endeavouring to combine the pure blue and yellow portions of it.

I am glad to see Mr. Walter Hardie's letter (20588), because I think his third diagram will serve as a very forcible illustration of the erroneous conclusions that may be drawn when experimenting with coloured lights with the idea of mixing colour—and I also consider his diagram a good illustration of my theory, that the colours exist in the shadow. For instance, Mr. Hardie makes green and purple lights overlap, and, naturally, the result is blue, which he erroneously calls the compound colour produced by the mixture. "Green + violet (or purple) = blue." Now, as blue happens to be a primary colour, it is evident that it cannot be *made* by mixing other hues, any more than gold can be *made* from other metals; but, taking my theory, that a coloured light is one which disperses its equivalent of complementary colour from shadow, we find that the green light disperses its equivalent of red, and the purple its equivalent of yellow, therefore, as the shadow originally contained equal equivalents of red, blue, and yellow, it is evident that most blue will remain; and when the green, purple, and orange all overlap, the light is more or less neutral or white; but this white light is not any more a combination of *colour* than the blue is a combination of purple and green. Altogether, I consider Mr. Hardie's diagram a capital illustration of my theory—viz., that white light is composed of various rays or vibrations which render the colours in shadow visible, by dispersing their equivalents of complementary colour.

When we have produced a brilliant white light by the so-called mixing of coloured lights, we find that any coloured light, however intense the colour, now thrown upon the spot, will be scarcely visible—showing clearly to my mind, that in driving away the shadow we have driven away the colour of which it was composed. I should like to know if Mr. Hardie agrees with me as to the result of mixing blue and yellow. I quite agree with his diagram, although I differ with his explanation, or rather deductions from it. I strongly object to red (or pink), blue, and yellow being called "binary compounds." I wish Mr. Hardie would kindly try a similar experiment using glass or gelatine of the three primary colours, instead of using the three compound hues, and let us know the result.

If his colours are sufficiently pure this diagram shows the result he will have. But if the blue is rather inclined to purple, and the yellow to orange, the green may be almost neutral, and if the centre is stopped out dark, the green may be *mis*-called white.



The scientists say in effect, that their theory must not be judged by the ordinary rules of common-sense, and any practical tests that differ with their dogmas, must be wrong and misleading, and "are sure to confuse." In fact, they would require the rest of the world to accept their doctrines in blind obedience, and call anyone a paradoxer who happens to have the courage to assert his own opinions. Now I maintain that my theory will stand any test, scientific or practical, and really combines science with practical experience.

I have no doubt some people will call this an arrogant assumption upon my part; but I write strongly, because I feel the importance of the subject, and if I knew any way to make my statements more palatable I would do so. "Calorimeter" quotes some of my remarks, but does not attempt to explain why he considers them incorrect, and proceeds to quote several contradictory *scientific* theories without saying which he agrees with. He states that "according to the Young-Helmholtz theory, the eye has three sets of sensitive fibres, sensitive respectively to red, green, and orange. When all sets are equally excited, the impression of white light results." This is claiming green and orange as primary colours. The eye that is only sensitive to these three hues will not be able to see blue, or purple (or violet, as they like to call it). No combination of red, green, and orange will make purple or blue; but as they contain the three primaries between them, they may produce a neutral tint, if the green contains sufficient blue to neutralise the red and yellow. But these hues cannot be accepted as primaries by anyone with a practical knowledge of colour. If they had said that the nerves were sensitive to red, blue and yellow, the theory might work very well. "Calorimeter" asks, what is meant by the terms red, green, blue—is vermilion red or orange?" The artistic test is exact and invariable.

The purity of a red is tested by its capability of forming purple, if mixed with blue, or orange if mixed with yellow; the purity of a blue by its capability of forming purple with red, or green with yellow; and the purity of yellow by its forming a good green or orange with blue or red respectively. Vermilion will not form a good purple with any blue, proving (if proof were needed), that it contains yellow, and is really orange-red, although it is commonly accepted as a red.

The practised eye should be able to judge of the purity of a colour at a glance, unless it is seen isolated, in the *scientific* style. I have already given the definition of green, as the result of any mixture of colours in which blue and yellow predominate. "Sigma," differs with me, and says, "A green can be fixed as definitely as a blue." This is a vague statement; but, as green covers a practically unlimited number of hues, from yellow with a tinge of blue, to blue with a tinge of yellow, it can hardly be called a fixed colour.

"X. N. X." made one statement which I was too busy to take sufficient note of at the time. It was that while blue and yellow light combine to form white, blue and yellow pigments would, if pure, make black. Now, this is, I consider, a very important statement, or rather, admission, and I agree with him as far as this: That any two hues which, as light, combine to form a neutral tint which may be called white, are complementary colours, and in pigments will also form a neutral tint, which will be called black, or white, according to the circumstances under which it is seen. Here "X. N. X." and I agree that a combination of certain hues, no matter whether they are pigment colours or are seen by the aid of a prism, will produce a neutral tint. This really amounts to the admission that mixtures of spectrum colours and mixtures of pigments of the same hue agree. But it rather, I think, tells against blue and yellow being complementary colours, for "X. N. X." must admit that, in experimenting with the purest blue and yellow pigments obtainable, we get a vivid green; it is, therefore, only reasonable to suppose that, if the primaries were slightly purer, the green would also be slightly more intense.

"X. N. X." states that the pure yellow light of sodium, if thrown upon a blue surface (or rather, a surface that would be blue if exposed to white light), does not give a green effect, the yellow only being visible. Now, I will take his word that this is correct; but it follows that a red surface, lit by this pure yellow flame, would only be yellow, and not orange, as in a combination of red and yellow. Will "X. N. X." kindly say if this is the case? Therefore, it is no argument against yellow and blue making green.

One of our correspondents lately took the trouble to rebuke artists for painting good reflections of rainbows; and then concluded his letter by saying, "Since writing the above, I have seen a perfect reflection." Perhaps, a landscape artist, who is continually in the open air, wet or dry, sees them more frequently. **S. Calton.**

"J. L.'s" PLANER.

[20793.]—If F. Carre is a cricketer, he knows that a man may be got rid of in two ways—either by hitting his stumps or hitting himself, and some bowlers appear to prefer the latter course, or, at any rate unwittingly practise it. Bowl at my wicket, and though my middle stump may suffer, I will bear it like a man; bowl at me, and I shoulder my bat and walk off in silence. With regard to this planer, which I distinctly and more than once placed second to a separate and properly fitted one, I do *not* see the objection, because I do not see the difficulty of fitting it up, unless it be that the bridge form of head is objectionable. This may be so, and no doubt would be far more difficult to arrange than the other. "F. C." has criticised the affair so severely that I have hunted up Northcott's book, from which I quoted from memory. I see that he proposes to use the saddle of self-acting lathe as the moving table, and that the only real difference is that I have used the small slide-rest adapted for the purpose, and he has one permanently attached, which means £3 to £4 extra cost. Experiments are even now in progress at a lathe-maker's, and with such a dreadfully unorthodox planer-head as that of a large sewing-machine, and the only drawback at present is the weakness of the small rack, which it is easy to remedy. Whether such a "small, insignificant, and generally useless" planer is worth attention I will not pretend to decide. A three inch screw-cutting lathe may be so considered by some. They have, at any rate, sold freely, I believe, and those who need larger and more orthodox tools can get them. I freely allow their superiority, as I allow that of a set of proper planing machine castings; but I do not by any means allow that to fit them up would be easier than to fit a planing head which has but two faces to be fitted at all. As to cost, it will be the cost of the planer-head, possibly 10s., probably 5s., and less still if they are introduced and made for sale.

Surely, again, as regards difficulty of fittings, an amateur who could not fit the tenon of a small slide-rest into a slot in the face of the planer-head would hardly be competent to fit up all the castings and details of an orthodox planing machine. I should regret exceedingly leading any amateur wrongly; but if letters received privately go for anything, I have reason to think that I have little to blame myself for in that respect. I do not intend to continue this discussion; but I hope shortly for a favourable report of the arrangement from the manufacturer to whom I alluded, and who certainly, at present, seems to regard the design hopefully. **O. J. L.**

DRILLS AND CHAMFERS.

[20794.]—"Tubal Cain's" method of manufacturing drills is certainly unique and extraordinary. I cannot imagine any man, who is in the habit of working in metal for either profit or amusement, being unable to perform the simple operation of making a small drill after he has been once told or shown how to do it; and to say that hardening and tempering a drill is an "insuperable obstacle" to an amateur mechanic is, to say the least of it, "bosh." "Tubal's Cain's" chemistry, also, is about on a par with his mechanical genius. The idea of mixing washing soda with aquafortis to make it act quicker is rather "rich," and I should hardly like to insult the readers of the English Mechanic by explaining why.

Perhaps he is a science teacher, and that is Brompton chemistry. I don't object to make small drills from needles if nothing else is to be had; but the proper size steel wire is preferable. "Alfojoe's" is, I believe, the method usually followed by watchmakers, and is very well when the drills have to be particularly small or minute; but drills which have no bearing except at the point are always liable to wobble about, and it is perfectly possible to make a drill which shall be for its whole effective length much the same size as the hole to be drilled, and at the same time to have sufficient clearance for chips and turnings. If a lathe is available, they should always be turned up the proper size in the drill-chuck, and then filed off perfectly flat from two opposite sides, getting, of course, gradually thinner towards the point. I have no difficulty in using or making these drills; they do not stick fast, and seldom or never break. In drilling a deep or long hole they require to be withdrawn once or twice, as, indeed, any drill will, and as the whole drill fits the hole perfectly, it cannot deviate much. If nicely made, they are quite as good as fluted or twist drills. Minute drills can be hardened and tempered at one operation by heating the point in a flame, and plunging it into a piece of wax or candle end. The body of the drill can be left soft; but anything which will bear a stronger heat without being injured can be put in a coke fire, and when about the same temperature as the red-hot coke, take out quickly and plunge into cold water; apply the two flat surfaces of the drill to a grindstone and temper. This I sometimes do by placing the drill on a piece of red-hot iron, and when the right colour is reached roll off into water, or it can be done very well in a gas-flame. I make small drills to use with a bow or a small Archimedean drill-stock, or for use in the lathe. I make all in the manner described above. I don't put small ones in the fire—I heat them on charcoal with the blowpipe, and if they are too small for the lathe I use a file; but it would only be for a very minute drill, such as watchmakers only use that I would hammer out the point. When the hammered point is used up, or ground away, the tool is done for; but my drills will wear away to a stump. I file the drill on two opposite sides for the whole of its *effective* length. I cut steel, iron, or brass with equal facility, and with the same drill. When doing a piece of woodwork, I much prefer these drills to gimlets—that is, if the work can be held up to the drill in the lathe. It is an immense saving of time, and there is no danger of splitting the wood.

Before seeing "Tubal Cain's" letter I had thoughts of supplementing that of "Alfojoe," as I find my drills so very useful and easily made. They are not so liable to twist off as the ordinary round drill with hammered point. **Os.**

"MINNESOTA AND THE NORTH-WEST."

[23795.]—In the English Mechanic for Oct. 13, I wrote a letter on "Minnesota and the North-West," stating a few of the advantages offered to emigrants in this region. I repeat to-day what I stated in my former article—I have no interest in this city or State in the sense that emigration agents have, and all that I say concerning it may be relied upon. I am aware of the fact that my fellow-countrymen have a considerable difficulty in obtaining reliable information about this country. It affords me great pleasure to find that so many Englishmen have written me—no less than thirty letters now lying on my desk.

My chief and, I think, sufficient reason for answering the letters that I have received through the columns of the "E. M." is that by this means I shall reach hundreds of working men who will be as glad to get the information as those who have written me. What I have to say concerning work for mechanics will do as well for one as for another of the many whose letters are before me.

To the many mechanics who have addressed me, I would say:—I have just paid a visit to one of the leading machine shops in Minneapolis, and had a talk with the foreman. Here are his words: "No skilled mechanic need go begging for work in this city. He will find here that the highest wages are paid. If we could get hold of skilled non-union men in this shop, we would set to work four or five more moulders than we have, and eight or ten machinists. The trouble has been that we have not been able to get hold of all the really first-class men we need. When I do get a good man I hold on to him. I have now with me an English pattern-maker who is a good worker. He started when 13 years old in the old country, attended night schools and paid strict attention to his trade, and I commenced with him at 2dols. 25cents. (9s. 5d.) a day. I found I could rely on him, and now he is at the head of my pattern shop. Good machinists are getting 2dols. 75cents. (11s. 5d.) a day, and good moulders the same money. First-class bricklayers are getting 4dols. (16s. 8d.) a day, and enough men cannot be secured at this price. There would seem to be no reason why a bricklayer or plasterer should earn more than a good machinist. House joiners and carpenters have been getting 3dols. (12s. 6d.) a day. We get a good many good German and Swiss mechanics, but they must be here a year and a half before we can make ourselves understood when talking to them. We like Englishmen, for they can understand us at once."

Of painting and plumbing I have learned the following:—Sign painters earn from 3dols. 50cents. to 5dols. (14s. 6d. to 20s. 10d.) a day, and house painters from 2dols. 50cents. to 3dols. (10s. 5d. to 12s. 6d.). First-class men are in demand, especially from the 1st of May to the 1st of July, and from September to December. A Minneapolis plumber said:—"We have to go East to get our plumbers. The best man we ever had was an Englishman. He learned his trade in London, and was 12 years learning it. The average pay for good men is 3dols. to 3dols. 50cents. (12s. 6d. to 14s. 6d.) per day. Our very best workers get 4dols. (16s. 8d.) or even more than that. They earn from 50cents. to 75cents. a day less in the East than they do here. Steam fitters get a shade less pay than plumbers, but our best men receive from 3dols. 50cents. to 4dols. (14s. 6d. to 16s. 8d.). A gas-fitter also is paid somewhat less. The demand for good men is greater than the supply. If a thoroughly competent man comes along here in search of work we should engage him at once."

Several salesmen have written me asking what field there is for them in the North-west. A Minneapolis dry goods (Manchester goods) merchant states as follows: "For an Englishman that has got money the chances are good. Then he might be able to go into business on his own account. But a man has little chance of getting a situation out here that would pay him much better than the one he might leave in England. It is very desirable that our assistants in this store, for example, should be acquainted with the manners of the people. They must be able to entertain our customers. The fact that a salesman having a thorough knowledge of the people and only a fair knowledge of the goods he has to sell would, as a rule, be of more use to us than a man well acquainted with the goods but ignorant of the people. Our business differs exceedingly in this respect from that of a machine shop. The worker has no customers to please and persuade. You see that man who now came in at the door? Three years ago he started in business with 1,000dols., and now he is doing a trade of 40,000dols. a year. All do not get on as he has done, but many do exceedingly well."

Thus, those salesmen who have written to me see what is before them. This country is full of men having no special knowledge of any one thing. What it needs is specialities. A man who knows a little of carpentering, a little of machinery, and as much of mason work cuts a comparatively poor figure here. If he could concentrate his knowledge into one department, its pecuniary value to him would be far more than it is ever likely to be spread over so much ground.

Locomotive men have written me. I took a ride on an engine of the Chicago, Milwaukee, and St. Paul railroad yesterday and talked with the driver. I learned the following:—The demand for competent drivers and firemen has been great during the past twelvemonth. If you are well acquainted with your work, you need not fear that you will fail to find employment. Engineers on locomotives receive 3.70dols. (15s. 6d.) for a day's work. They usually work about twelve hours. Firemen receive 2.10dols. (8s. 9d.) for the same period of time. These wages are paid to both freight and passenger men. Engineers on switching engines get somewhat lower pay. If the coming winter is a severe one, the demand for men will be greater than if it is mild.

Several compositors have written me. In reply to them, I would say that they can find an abundance of work at their own trade at wages ranging from 20 dols. (£4 3s.) to 24 dols. (£5) per week. No good man need be long out of employment.

Some of my correspondents appear to think that this part of the world is adapted to nothing else but farming. A compositor, for instance, seems to be of opinion that there is no demand for printers out here, but that agriculture is king, queen, and subject, too. He could not entertain a more fallacious idea. Following closely on the heels of agriculture there will always be found manufactures. The richer the soil farmed, and the more advantageous the terms under which it is held by the men who till it, the more varied and extensive the manufactures will be. And then, too, what a place this is for newspapers!

And now I will reply to some questions not covered in the above. I give initials of my correspondents only. "F. W. B.," a compositor, thinks £100 insufficient capital. If he is going to work at his trade it is enough, and there is no need for him to spend more than £20 to get here. With so good a trade at command, let him not think of going into agriculture.

To Robert Henry M., I would say that the climate is decidedly favourable to the sufferer from chest-complaints, asthma, bronchitis, &c. To this correspondent and all others who have asked concerning route and cost of journey, I would state: Take steamer from London or Liverpoool to New York. Cabin passage costs from 10 to 21 guineas. A daily paper will give facts concerning the White Star, Inman, Cunard, Guion, Anchor, and National lines. Their prices vary, the highest-priced ones being named first in my list. All are safe and able. When you get to New York, if you want to stop a night, you cannot do better than take a room at, say, the Cosmopolitan Hotel—a central and good place, where a room costs a dollar. I say briefly, but emphatically, beware of cheaper hotels recommended by fellow-travellers. They are dangerous for strangers; I speak of what I know. Buy your ticket (*via* Chicago, of course) to Minneapolis or St. Paul. You can come first or second class. First-class fare is from two to three cents. per mile (1d. to 1½d.). Holders of first-class tickets can ride in Pullman sleeping cars by paying about 10s. a day extra. Persons having money in their possession may find this an advantage, as they will thus be protected from robbery. The journey from New York to Chicago by ordinary trains takes about 36 hours; from Chicago to St. Paul or Minneapolis 20 to 24 hours. The fare all the way through from New York varies from 25dol. (£5 4s.) to 30dol. (£6 5s.) first-class, to 20dol. to 25dol. second-class. Railroad wars often bring the figures down. There are several roads by which the traveller may come—the Pennsylvania, the New York Central, the Baltimore and Ohio, and the Erie. As a rule, he can come cheaper by the B. and O. or the Erie than by the two first-named roads.

Another hint on this railroad business. A few dollars may often be saved by purchasing tickets of what are called "scalpers"—a genus you don't have in England. There are, in New York, a tribe of scalpers. Let me refer you to Frank. His office is in the Astor House. I have no interest in Frank, only that I have purchased tickets of him a good many times. If the traveller goes to him and asks the price of a ticket to any point in the North-west, he will generally find he can save some little money by purchasing of him. There are other scalpers equally reliable, but none more so. If the emigrant does not care to trouble about Frank, let him buy his ticket to St. Paul or Minneapolis in England with his steamboat ticket. In doing this however, he will be likely to pay a sovereign or two more than if he bought his railroad passage in New York.

Let me return to Robt. Hy. M.'s letter. "What time of the year is best to come"? I should advise April or May. "Are there any agencies to assist people out"? There are none to assist you to Minnesota or Dakota. "Would you advise me to come and get settled first, or bring my wife and family with me"? Come alone first, by all means. To other questions in this letter I would say—It is of no use for you to advertise in papers here while you are in England. The cold weather begins about now and lasts till April. The thermometer reaches 80 to 90 in the summer, and goes down to from 10 to 20 degrees below zero in the winter. But these extremes are easily borne because of the dryness of the atmosphere. We have no fogs. This region has no high hills and no swamps. It is pleasantly undulating. The fruits grown are apples and small garden fruit, but we get a good deal from the southern states. We let them have our wheat, which is the best in the world, for their fruit. Bring both light and warm clothing. You cannot bring too much. Clothes cost twice as much here as in England.

To "J. D.," a currier, I would say that there is not much work in this city for him. A new tannery is just being started. In Chicago you would probably get work easily enough at from 18 to 25 dols. a week—£4 11s. to £5 4s. Or you might do well in New York or Philadelphia. If you are a good workman you will find employment. "What does it cost to live?" All the way from £1 to £2 a week for a single man. It depends on your tastes. I would add that money goes much faster here than in England; but the fact remains that a great many mechanics in this city own the houses in which they live. Your other questions are answered in other replies.

"P. W. P.," a warehouseman, asks a few questions. I dare not take the responsibilty of advising him to come out here.

"L. M.," a stoker and cleaner on the M. S. and L. railway for six years, I would refer to remarks above, and would say that he cannot possibly secure a position before coming out.

"J. B.," a mechanic, is referred to previous answers. I would add that house-rent costs about four times what it does in England. A family's expenses for food would not necessarily be greater than in England.

To "J. J." I would say that children under 14 travel for half-fare on this Continent and across the ocean.

"J. S. F." is informed that the growth of flax is being promoted in this region. There are no mills for the manufacture of flax in this city. It is a growing industry, and "J. S. F." should have no difficulty in getting on if he has capital.

"J. W. H.," a grocer's assistant, with a taste for the fine arts and mechanics, appears to be vigorous, and might do well here. He is informed that it is 1,200 miles from here to Ottawa. His good habits—non-smoking and total abstinence—would be greatly in his favour. But he had better not leave a good situation. This is not Paradise.

"E. M." is informed that electrical work is largely done in Chicago, Cincinnati, and other more Eastern cities. But if he comes out with a little capital he will readily find work if he understands his business.

"J. C." has set his mind on going into farming in Canada. I regret that I never was in Canada, and, therefore, cannot possibly give him any information.

I must refer "F. W. P." to the remarks above of a dry goods merchant. I fear I cannot advise him to come out.

I have before me a number of other letters, but all the questions in them are covered by the above remarks. A few final words: If a man has a good position in England let him keep it, especially if he is married or has no capital. There is a danger lest people who live over 4,000 miles from this State should, when reading the facts concerning it, picture to their minds a veritable El Dorado. There is as much of the prosaic and humdrum element in life here as anywhere. Men work longer hours, and with more energy than in England. A man who wants work is not always pounced upon by employers as though he was the only worker they had seen for a generation. There is no land on earth that seems more cruel to the man out of work and money than the United States; although it is fair to say that we have few such men in Minneapolis.

I have simply stated facts. I take no responsibility whatever. I advise no one to come out. They read what I have to say, and please themselves. I thank the editor for giving me so much of his valuable space. **R. M. Tuttle.**

P.O. Box 206, Minneapolis, Minn., U.S.A.

THE DATE OF THE COMMENCEMENT OF THE CHRISTIAN ERA.

[20796.]—As the period of the year arrives at which new almanacks, without number, are being put into circulation, it may not be inappropriate to examine the foundation on which is reared the superstructure of our modern chronology, and to give a recapitulation of the means by which it is ascertained that 1883 represents a fixed epoch, differing by only four years from the interval which has elapsed since the birth of Christ.

The ancient Romans excelled all other nations of that period in the exactness of their chronology, and they measured their years from the date of the foundation of Rome. In old records, therefore, our Saviour's birth is mentioned in connection with this mode of computation. If, then, we can find in what year of Rome this event took place, we can connect the two eras by a very simple process, since Jan. 1, A.D. 1, is the same as Jan. 1, A.U.C. 754.

Now, I. Eusebius, the well-known historian of the early Christian Church, tells us that Christ was born in the 42nd year of the reign of Augustus Cæsar; and according to another statement which he makes elsewhere, the first year of Augustus's reign is that in which Hirtius and Pansa were consuls at Rome, and this is known to have been in A.U.C. 709. Hence 709, added to 41, gives A.U.C. 750, which is the date we require to know.

II. The same Eusebius says that from Christ's nativity to the demolition of the churches in the 19th year of the reign of the Roman Emperor Diocletian, is 305 years. Now, Diocletian became Emperor on Sep. 17, A.U.C. 1037.

Hence 1037, added to 18, with 305 subtracted, gives A.U.C. 750, as before.

III. St. Luke tells us that in the 15th year of the reign of Tiberius Cæsar, Jesus began to be about 30 years of age. Now, Tiberius succeeded Augustus on August 19, A.U.C. 767.

Hence 767, added to 14, with 31 subtracted, gives A.U.C. 750, as before.

IV. Josephus, the celebrated Jewish historian, states that the "taxings" were made in the 37th year after Augustus Cæsar gained his victory at Actium. Now, this battle took place in A.U.C. 723, and it is assumed that the "taxings" began 9 years before.

Hence, 723, added to 36, with 9 subtracted, gives A.U.C. 750, as before.

V. The same Josephus says that the 37th year of the reign of Herod-Philip (which began on the death of Herod the Great) was the 20th year of the reign of Tiberius Cæsar.

Hence 767, added to 19, with 36 subtracted, gives A.U.C. 750, as before.

VI. The same Josephus informs us that Herod reigned 37 years, and elsewhere that the 28th year of his reign was the 192nd Olympiad. Now, the Olympiads are a Greek mode of measuring years, and the 192nd corresponds to A.U.C. 741. Herod, therefore, had nine years to reign. Hence, 741 added to 9 gives A.U.C. 750, as before.

VII. The same Josephus records that Herod reigned 34 years after Antigonus was slain at the siege of Jerusalem, which siege took place in the 185th Olympiad. Now the 185th Olympiad corresponds to A.U.C. 717, and Herod's death is a connecting link. Hence, 717 added to 34 gives A.U.C. 751 as before (nearly).

VIII. The same Josephus informs us that Archelaus was banished from his throne in the eighth year of his reign; and another historian, Dio Cassius, says that banishment occurred A.U.C. 759, with 9 subtracted, gives A.U.C. 750, as before.

IX. Lastly, the same Josephus notices that a lunar eclipse took place shortly before Herod's death, and we know that Christ's birth took place a short time before that event. Now the Moon was half-eclipsed on the night of March 13, A.U.C. 750; and, again, it was totally eclipsed Jan. 9, A.U.C. 753. Taking the first as the eclipse referred to, we have an exact correspondence. The second eclipse, though more important astronomically, was not connected with any historical event.

Dionysius Exiguus, a learned monk, when he attempted the above computation in the 6th century, made A.U.C. 753 the year of Christ's birth. Subsequent research has proved that Christ's birthday took place near the end of A.U.C. 750, which corresponds to B.C. 4.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Nov. 18.

ELECTRICAL UNITS—AMPERE VERSUS COULOMB.

[20797.]—It may be an advantage to many readers, that I am unable to follow the deep abstractions of Messrs. Sprague and Moberly. I only regard these units in a *practical* or concrete sense, much as butchers or grocers do with their pounds or ounces. Cheap manuals abound, but I do not find one that appreciates this important distinction.

The electrical editor of a contemporary, writing from a pulpit admitting of no discussion, at p. 403, devotes two columns to the common-place demonstration that batteries should be so joined up as to render the internal and external resistances about equal; thus affording a maximum current, expressed in ampères per second.

It is not usual, or necessary, to be always repeating the term "per second," but *it is always implied*; and necessarily so, because an "ampère current" apart from time, would be an undefinable quantity and a gross absurdity; yet such seems to be the authoritative sense implied, because, in column 3 he goes on to say, "The next unit for consideration is the coulomb, which is a current of one ampère flowing for one second. There is very little to be said on this head: an ampère is strength independent of time; the coulomb is strength enduring for a stipulated time, and *is therefore a measure of quantity*."

I have emphasised this latter conclusion, as perfectly sound and logical in itself; but it is a delectable parody on all the *measurements* of the context; because they were ampères, and properly so called, but not coulombs:

As I was probably the first to publicly denounce the coulomb, I am vastly glad to find Mr. Sprague stating: "It is not a necessity at all, for it is simply of the value of one ampère of current—that is, a current of 10 ampères would transmit, in one second, 10 coulombs of electric quantity; the coulomb is, therefore, C.G.S. 10^{-1}, and represents, in grains of hydrogen, ·000158, or such chemical values as have just been described for ampères."

In the *Electrician* of July 15, 1882, after showing that volts × ampères = "one volt ampères," which by suitable coefficients could be expressed in English or French heat units, in foot-pounds, or kilogrammetres, &c., &c.; in other words, that energy, E.M.F., potential, or force × by quantity were adequate for all purposes, and could be expressed in any desired terms, I then remarked:—

"Why have we deferred all mention hitherto of the French coulomb? Because it seems an unnecessary complication. We speak of a current of so many gallons of water per second, and this × by the time in seconds must give any desired totality of gallons.

"If we similarly × the ampères by the time in seconds, the result must be ampères; but these are now called coulombs.

"In our illustrations of the lamp experiments, we similarly × the volts by the ampères, which gave us a total of 'volt-ampères'; nor would it help matters to call these by a new-fangled name. Any equation must be valuable or appropriate in proportion as it enables a student to understand the essential *rationale* of the process. Gallons × must be gallons, just as ampères × must be ampères; but call either of these by a quite different name, and the student is diverted to think of the unmeaning term rather than the essential reality. Every derivable value or useful application derived from coulombs must necessarily spring from, or arise out of, ampères. An ampère liberates ·000158 grain of hydrogen per second, &c., &c., and in every particular does precisely what a coulomb does.

"It may be, and, indeed, is, alleged that an ampère, per second, and a coulomb is an abstract ampère, apart from time (the very opposite of the before-alluded-to editor); but the definition is equivocal, and proceeds from a mistaken basis. Gallons per second, as applied to current, are none the less gallons: and ampères per second, as applied to current, are none the less ampères. The time function is a necessary adjunct, but not a necessary or invariable constituent.

Eclecticus.

PETROLEUM HEATING AND COOKING-STOVES.

[20798.]—Though I remember to have seen a stray query or complaint about them, I don't think we have ever had any actual discussion on the merits and defects of these much-used appliances, though there would seem to be ample room for experiment and comparison as to their efficiency and cost. Of the enormous numbers in use some idea may be formed from the fact that one company alone professes to have sent out nearly a quarter of a million in ten years.

If, then, we could collect particulars of the actual heating power, as compared to the consumption of paraffin oil, under various circumstances—such as heating rooms, warming conservatories, cooking, and so on—the facts obtained would be valuable as such, and more trustworthy than makers' advertisements, and dealers' recommendations.

Let us begin with heating stoves. Of these the smallest seems to be about 10in. high by 8 or 9 diameter, and fitted with one 1½in. burner. Suppose we introduce this into a small room, how many degrees will it raise a thermometer with its normal rate of oil consumption? Then take another, say 25 by 12in., with two 1½in. burners; and a third, say 28 by 18, with three 1½in. burners. Evidently, we here get twice and thrice the consumption of oil, and a radiating area increasing some six-fold; but do we get three times the heating effect as tested by the thermometer?

In my own experience, I have found these smaller sizes far from effective. The internal arrangement does not give sufficient height of chimney to allow the wicks to be properly turned up without smoking, and the consequence is that the heating power is less than it might be.

A correspondent in one of the gardening journals says he used a stove with 2in. wick in a small greenhouse, 6ft. by 4ft. (the height is not given), and the result seems to have been a difference of only 8 deg. between the outside and inside temperatures. One maker refers to their suitability for hothouses, and speaks of a stove with one 4½in. wick as "very powerful"; but I must confess that the idea of maintaining the high temperature required in a hothouse, with such a "very powerful" stove as this, borders on the incredible.

Of course, it is impossible to refer to the legion of different patterns; but I see one novelty is described as the "Dual wick." This, I suppose, is much like the ordinary Duplex lighting lamp; but whether a double wick is better than two entirely distinct wicks is questionable, as it seems that the amount of radiating surface of heated metal would be greater with the separate wicks.

Of the cooking stoves one can but select two or three typical examples. There is first the simple square box, containing the single-wick lamp, over which is placed a kettle, &c. Of these I find that the usual result is to boil a quart of water in 15 minutes, with one lamp of 4½in. length of wick; while two wicks will boil double the quantity in about the same time. If, however, we employ a large boiler containing a considerable quantity of water, I have found the proportionate effect to be decidedly less.

Perhaps the most ingenious of all the cooking-stoves is the one designed, I believe, by a London maker, in which the heat radiated laterally from the flat-sided chimney of the lamp, or lamps, is used to heat an oven (through which these chimneys pass), while the kettle, saucepan, &c., is placed *above* the flame, as usual. It is, however, advisable to accept the illustrations in the advertisements with a good many grains of salt. For instance, one sees sirloins of beef, legs of mutton, large pies, and so on, cooking in the ovens, while the boiling utensils are emitting clouds of steam galore! In point of fact, the available oven space, in even the largest size, is only about a foot long and 8in. high, and is thus obviously insufficient for more than a moderate-sized piece of meat, even allowing the latter to touch the chimneys, which it ought not to be allowed to do.

I have also found a difficulty in obtaining sufficient roasting-heat when boiling is also being carried on, owing to the escape of heat round the kettles or saucepans. These latter do not closely fit the openings in which they rest, but leave an annular space of some ⅜in., through which a great deal of heat creeps and is wasted. I once presumed to mention this to the gentleman who does the public the honour to stand behind the counter at the London depôt; but, of course, I was the only one who complained; and, in fact, I did but show my ignorance by the observation. Notwithstanding this, I have since seen the illustrations of other stoves in which this objection was, to a great extent, obviated. With two 4½in. wicks a small joint can be cooked; but it is well to stop up the annular openings if the joint is to be cooked in a reasonable time.

In another pattern the oven is *above* the flame, the whole products of combustion passing *through* the oven; while in another the oven casing is double, and the heat passes between the two.

Doubtless, other correspondents can now take up this subject and give us plenty of *practical* experience. **Calorio.**

MEDICAL REPLIES.

[20799.]—Night Sweats (48423).—Not eligible for useful reply. If your wife is losing weight get your doctor to examine her lungs. Put her on a diet of oatmeal-porridge and milk and fat bacon, before described.

Scrofula and Emigration (48658).—Foreign countries differ so vastly that a precise answer cannot be given to your query. But you would probably gain much if you could get a situation on board a good sailing-ship, or go to Australia or Auckland. Mere change of scene, and of work and climate, often is very helpful to the health. But if your disease seriously cripples you, and impairs your power for rough labour, going abroad is doubtful policy. The conditions of life abroad to those unaccustomed to them are often at first very hard. Consult some competent local doctor who can examine you personally, and advise you as to your prospects of success as a colonial worker. The climate to which you go should be dry and bracing, and warm rather than cold. The "Far West" is a vast territory, in which swamps, dust tracts, rocky mountains, and fertile healthy countries are all to be found.

Sick Child (48661).—If you live in a marshy or damp district, your child probably has intermittent fever, for which quinine, and removal to a high, dry, and healthy dwelling, are the remedies.

Quinine and Iron Tonics (48691).—Iron and quinine are an everyday combination, and very useful. The citrate of iron and quinine may be bought at any druggist's, and of it six grains may be taken in water twice or thrice a day. What you suppose to have been told you by a medical man must be due to some misunderstanding. A druggist will make you a syrup of citrate of quinine and iron, of which each teaspoonful will contain the dose of six grains. Take it in water.

Flat Feet (48716).—This is a very common complaint, and is practically an incurable infirmity. In severity, it ranges from a mere trifling weakness to a marked deformity, and a cause of permanent lameness. It is due to relaxation, not of the muscles, but of the ligaments that support the arch of the foot. There is a boot made containing a spring under the arch of the foot, which is, I believe, the subject of a patent. My own expectation is that such a contrivance would help but little. But a steel spring of such strength and curvature as to keep the boot in shape might be inserted between the leather in the waist of the boot and tried. The under part of the arch of the foot, however, is not calculated to sustain pressure, which in the foot is borne by the heel and the ball of the great toe and of the little toe, these three points forming a tripod. Upon this tripod the foot is built up as a double arch, and the arches are prevented from spreading by very strong ligaments which pass, girder-like, from point to point, and by strong tendons belonging to the muscles of the leg. If these ligaments once give way their failure cannot be remedied. "F. S." will probably find that he must *rest* his feet by taking to a sedentary occupation, rather than attempt to bring his feet up to the capacity of bearing the weight of his body for long periods. If "F. S." carries redundant weight, starve down gradually, so as to take off as much weight as possible. In walking, the method of using the feet is of great importance, and especially so to persons with weak feet. The habit of turning out the toes is altogether bad, and gives a tendency to inbending of the knees and to sinking in of the ankles. The feet should be turned out only so very little as to make the inner sides of the feet parallel to each other. Each toe should be turned out equally, so that the boot heels wear away equally, both in amount of wear and in angle of wear. The inner edge of the sole should be cut parallel to the axis of the foot. The heel low and square.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

The Government have decided not to complete the Sibi and Quetta Railway, but to construct instead a new road through the Lower Bolan Pass.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48132.]—**Bacteria in Beer.**—I am not surprised to find that Mr. Thoms has never actually seen a yeast-cell developing into a bacterium; but although he has never seen such a phenomenon, he distinctly leads one to infer that under certain conditions a yeast-cell does develop into a bacterium, and vice versâ. If such a thing were possible, many proofs of it would have been adduced long ere this; but none are to be found—that "the development of linear bacteria first into micrococci, and after, in a suitable medium, into torula" (if such were possible), is within the powers of human observation, is, I think, clearly shown in the classical researches of Drs. Drysdale and Dallinger. It is the duty of every seeker after truth to observe things with a perfectly unbiased mind; but it is also his duty to believe in facts, not in fancies. Personally, it is certainly not my wish to insult Mr. Thoms, who is a perfect stranger to me. Indeed, I should much prefer to have kept silence; but seeing so many statements of a misleading character made from time to time on this subject by Mr. Thoms, I felt it my duty to science to contradict them. I have repeated the most important experiments of Tyndall, Roberts, Pasteur, and others, as well as many others of a similar character, and all tend to refute the statements of Mr. Thoms. No matter what the medium may be in which it is sown, a yeast-cell will always remain a yeast-cell, and no matter how much disaggregated or disintegrated the protoplasm of that yeast-cell may become, it will never produce bacteria. Under like circumstances, a bacterium will always remain a bacterium. The only way in which I can account for Mr. Thoms' results is that in which the mistakes of many other experimenters may be accounted for—namely, want of carefulness in manipulation.—John Heron.

[48229.]—**Locomotives.**—The East and West Junction Railway have got five locomotives, and they are all hired. The dimensions are as follows: No. 1, saddle tank, six-coupled wheels, 4ft. 3in. cylinders, 16 by 22, built 1879 by B. and P.; No. 2, six-coupled tender engine, built 1880 by B. and P., cylinders 16½ by 24, wheels, 4ft. 6in.; No. 3, same as No. 2, only 5ft. wheels, built 1881. Beyer-Peacock are makers and owners of these engines; No. 4 is a four-coupled tender engine, wheels 5ft. 6in., cylinders 17 by 24. This engine is worked at a reduced pressure of 80lb. per square inch; No. 5, a six-coupled saddle tank, wheel 4ft. 9in., cylinders 17 by 24. These two engines have outside cylinders, and were built by Buddicom and Co., Rouen (France). I cannot tell you when they were built, but they are very old.—Camomile.

[48236.]—**Iron.**—Experiments have been made upon iron plates, &c., for tenacity, &c., with the following results:—

Temperature F.	Iron Plates.			Rivet Iron.
	Exp. 1.	Exp. 2.	Exp. 3.	Tenacity, tons per sq. in.
	Tenacity, tons per sq. in.			
−30	—	—	—	28·26
0	21·8	—	—	—
60	22·4	26·	22·4	28·05
212	19·96	28·2	—	35·39
320 to 340	22 31	34·3	—	37·52
500	—	35·4	27·15	—
600	—	—	27·6	—
800 to 900	15·3	—	19·3	15·62

It would appear as if no definite rule could be laid down; but the harder irons appear to increase in strength faster than the softer ones, and this increase appears to be maintained up to 600°.—Shipwright.

[48255.]—**Breaking Weight of Rolled Joist.**—It is usual to add ⅙ area of web, calculated on total depth, to the area of bottom flange. If "G. F. B." does this he will have a reliable rule, as far as such can be had. Most joists give way by buckling sidewise under their load, and so much depends on the quality of the iron in the flanges that the rule is only approximate. The rule of "G. F. B.'s," corrected as above, applied to a rolled beam of 27lb. per foot of length, gives 16·8 tons as the breaking load. This beam has been tested with the following result:—With 16 tons it took a permanent set of ⅜in., and with 18 tons it bent sideways.—Shipwright.

[48284.]—**Brass-Casting.**—You will find a series of articles on pattern-making in one of the back vols.—XXV., I think—and many replies about brass-casting. You should get the "Brassfounder's Manual."—Nux. Dor.

[48285.]—**Fan.**—About 3 or 4in. Can test it, I suppose, by placing a gauge on the supply pipe; but most people would test it by the practical way—if it is sufficient to blow the fire bright.—Essar.

[48287.]—**Weight of Steam and Electric Engines.**—Supposing you require the motor for something more than an hour, a steam-engine would be lightest. Mr. Moy wrote a reply to a similar question, some few weeks ago, and he could probably tell you the cost of the lightest 2 h.-p. engine.—Essar.

[47288.]—**Hartz Mountain Bread.**—This is, I believe, made from a sweet biscuit ground to powder. There may be something else in it, to make the birds sing; but if so, it is not detected by tasting. Birds seem very fond of it.—H. H.

[48292.].—**B. Sc.**—No way, except those specified by "Degree."—J. M.

[48279.]—**Spirit Varnish.**—Perhaps you did not paper down after the coat of glue; perhaps the work was cold; perhaps—several things; but you ought to have no difficulty. Use the glue very thin; when dry, paper down with fine (O) paper; another coat of glue (thin glue—properly size—and thin coat); then have the work warm and apply the varnish in a warm room. Use a soft brush, and don't go twice over same part; better put another coat on when dry. If not satisfactory, paper down again, and apply another coat of varnish. Papering down the first coat of varnish, ought to insure the second coat being perfectly satisfactory.—T. P.

[48301.]—**Consumption of Gas.**—I observe "Reksat's" reply on p. 277, and would say that if some other burner than that specified is used, the difference may be still more marked. For instance, if the burner, besides checking the flow, also provides a chamber in which the gas is heated by proximity to the flame, the amount passing will obviously be less than when the gas is not lit. The query specified a "tap," not a burner.—Nux. Dor.

[48311.]—**Cleaning Drawing Instruments.**—Get some watchmaker's rouge and a toothbrush; afterwards polish with a piece of chamois leather, and keep them clean with it by giving an occasional rub.—T. P.

[48325.]—**Antique Knife-Handles.**—Xylonite or celluloid is suitable, I suppose.—Nux. Dor.

[48332.]—**Wire Sheaf-Binder.**—"**Querist's**" best plan would, I think, be to get the specifications of the inventions to which he refers.—T. P.

[48337.]—**Telephone Magnets.**—Yes, it is sufficient if a telephone magnet will just lift one of the same size. Coils for transmitters are very small affairs, and a solid core will *do*; but soft iron wires are always best, and cost very little.—E. T. B.

[48352.]—**Leclanche Battery.**—Agglomerate plates are made of carbon, manganese, and resin, and subjected to pressure. Full particulars for making Leclanchés in many back Nos.—E. T. B.

[48354.]—**Power of Steel Coil.**—The questions asked in this query are to be answered only by experiment. The idea of driving tricycles by means of springs is a favourite one, but it is doubtful if they give out more than half the power put into them, and if the machine were geared up there would be a further loss. It can be done, but no one would be bothered with them, as they would make the machine heavy.—A. M. M.

[48370.]—**Threshing-Machine.**—I quite agree with "Labor Omnia Vincit" that throwing out the gearing would not increase the power; but I think that a change of gearing would help considerably. I would, therefore, to make as little alteration as possible, gear it as follows:—

Wheels.		Pinions.
(Segment) 210 teeth	....	54 teeth.
88 "	....	33 "
4ft.	....	1ft.

Drive water-wheel about 9 revols. a minute, and this will give you the required speed. The great loss of power is occasioned, I think, by the speed being too suddenly brought up.—Mack.

[48429.]—**Garden Bed.**—To describe a curve parallel to an ellipse take any number of points upon the periphery, and through them draw lines perpendicular to the periphery by bisecting the angle contained between lines drawn from the foci through the points. Make these perpendiculars the same length, and draw the curve by hand through their outer ends. The long and short axes produced are also perpendicular to the ellipse. If "Jardin" were not so very particular, he might take his two-foot rule and a handful of small pegs, measure outside his ellipse as nearly as he could in a direction perpendicular to the curve, and stick his pegs in as he goes on. If not quite correct, the irregular growth of the edging might put it right, while it would soon spoil the true curve if never so accurately drawn at first.—Robinson Crusoe.

[48429.]—**Garden Bed.**—As "Jardin" is so anxious to have the equation to the parallel to the ellipse, referred to the principal axes of the ellipse, I give it in full. If equation to ellipse is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and $c^2 - a^2 = b^2$, equation to parallel is:—$c^4 r^8 - 2c^2 r^6 [c^2 (a^2 + b^2) + (a^2 - 2b^2) x^2 + (2a^2 - b^2) y^2] + r^4 [c^4 (a^4 + 4 a^2 b^2 + b^4) - 2c^2 (a^4 - a^2 b^2 + 3b^4) x^2 + 2c^2 (3a^4 - a^2 b^2 + b^4) y^2 + (a^4 - 6a^2 b^2 + 6b^4) x^4 + (6a^4 - 6a^2 b^2 + b^4) y^4 + (6a^4 - 10a^2 b^2 + 6b^4) x^2 y^2] + r^2 [- 2a^2 b^2 c^4 (a^2 + b^2) + 2c^2 x^2 b^2 (3a^4 - a^2 b^2 + b^4) - 2c^2 y^2 a^2 (a^4 - a^2 b^2 + 3b^4) - b^2 x^4 (6a^4 - 10a^2 b^2 + 6b^4) - a^2 y^4 (6a^4 - 10a^2 b^2 + 6b^4) + x^2 y^2 (4a^6 - 6a^4 b^2 - 6a^2 b^4 + 4b^6) + 2b^2 (a^2 - 2b^2) x^6 - 2 (a^4 - a^2 b^2 + 3b^4) x^4 y^2 - 2 (3a^4 - a^2 b^2 + b^4) x^2 y^4 + 2a^2 (b^2 - 2a^2) y^6] + (b^2 x^2 + a^2 y^2 - a^2 b^2)^2 [(x - c)^2 + y^2] [(x + c)^2 + y^2] = 0$, where r is the width of the path. If this does not assist him in making his path uniformly wide, I should suggest some homelier method, such as marking off the desired width in as many places as he thinks necessary, and thus describing the curve approximately.—Hemisus.

[48453.]—**Softening Tone of Harmonium.**—As no one has answered this query I may suggest that there are various means employed to subdue the power and tone from the different reeds. The querist complains that the flute and bourdon are "fuller" than he cares for in a drawing-room where soft music is desired. Now, I think that it is purely a matter of taste more than anything else, but as the bourdon and flute are evidently too harsh in tone for "W. E. B.," he may try the effect of reducing the size of pallet apertures of the bourdon reeds. This may be done by glueing a piece of stiff brown paper with holes for the pallets, somewhat smaller in proportion, over the pallet holes. To perform this operation, it will be necessary to remove the levers and pallets from the action-rail. I do not approve of smothering the sounds from the reeds with wadding, &c. On the other hand, it is too delicate a job for any one to attempt to voice the heavy bourdon reeds. Such a proceeding would require great care, and should not be attempted by the inexperienced. If "W. E. B." has had some experience in voicing reeds (or rather bending them) he may try the effect of bending the tips of the flute a slight bit inwards—that is, towards the aperture in reed block. The bend should not be very great, otherwise it will waste wind. The tips of the free ends of the flute reeds, after they are bent, should be so situated as to just enter the apertures in the reed blocks. In the American organ the power of tone is subdued by a swell or shutter which is actuated by the knee, generally, and is called a knee-swell.—G. Feyer.

[48181.]—**Rigging Boat — Yawl.**—I offer "S. S." the following suggestions, premising that the simplest rig is the best and safest for cruising. Racing is another thing, and should "S. S.'s" boat turn out a fast sailer, it will be time enough to provide a duplicate set of spars and sails for regatta purposes. For a boat of 25ft. keel I should fit a main-mast of 16ft. or 18ft., 6ft. abaft the stem, to carry a sprit sail of about 150 sq. ft. area, and a foresail of about 35ft. area. If the mast is made of good spruce or ricca, stepped on the kelson, and passing tightly through a hole in a broad thwart fixed to the gunwale, and properly strengthened with knees, neither shrouds nor stays will be wanted. But if the mast has to be lowered often, it must be either hinged at the heel or fitted in a socket or "tabernacle." It will want a single pair of shrouds set up by lanyards rove through heart-shaped thimbles, in preference to any kind of screw apparatus, and a stay to the stem with a tackle to set it up. I should also fit a mizen-mast 4ft. from the stern, with a small sprit-sail of about same area as the foresail. A light boom must be laced to the foot of the mizen, to enable the mizen-sheet to reeve through a small block or a thimble attached to the stern. Sprit sails are handier than standing lugs, as they can be brailed up in a moment if a squall comes suddenly down. They also lie closer to the wind. In boats with pointed sterns the rudder is so far off that they must be steered with a yoke and lines. If one of the yoke lines is made long enough to lead forward through a block on the gunwale on its own side, then to one on the opposite side and aft, to meet and to be made fast to the other yoke line, the boat can be steered on either tack with one hand, leaving a hand free, when cruising single-handed, to hold the main sheet, which should never be made fast in an open boat. No ballast is better than clean shingle sewn up in strong canvas bags, with loops of rope at each end to lift and shift them by. If "S. S." prefers water ballast, it should be carried in small ankers or casks with chocks fitted under them to prevent their rolling about. A triangular topsail of very light cloth may be set above the mainsail, the head or fore leach being bent to a light yard (nothing better than bamboo) hoisted parallel to mast, the sheet being rove through an eye or thimble at the top end of the sprit, or spleet, led down alongside of it, and make fast anywhere.—Robinson Crusoe.

[48485.] — **Stockbroking.** — Get Cramp's "Theory of Stock Exchange Speculation," 1 vol., an admirable work, and one that would much enlighten the querist as to the usages of Capel-court. For any about to speculate, it offers the most admirable cautions. The author is, I have heard, the writer of the money article in the London *Times*.—Devonshire Squire.

[48513.]—**Geometrical.**—In my reply to this query I gave the equation $R = (l \sin. \alpha . \cos. \theta) / (\sin. \theta + \sin. \alpha)$, which gives the position of the focus or foci of any conic section made by a plane in any position, but the formula fails when the plane is parallel to the axis of the cone, as in that case l, or the distance of origin from vertex, becomes infinite, so that both sides of the equation become infinite; we must, therefore, have recourse to the method of "limits." Suppose we wish to find the foci of the hyperbolas formed by the section of a plane parallel to the axis at a distance y from the axis; draw a perpendicular from the focus F_1 to the axis (see page 279), and call the point where it meets the axis P, $PF_1 = y$, and we will call $VP = x$, required to find a relation between x and y from the above equation. As the origin O is made to recede lower and lower, l, the distance from O to vertex, increases, and θ becomes smaller; also, R will become greater, but never so great as l by a quantity equal to VO or x. When θ is very small, $\cos. \theta$ tends to 1 as its limit, and $\sin. \theta$ will always be y / r: substituting these in the equation we get, after some reduction, $L - R = y / \sin. \alpha$; that is x that amount, or $\sin. \alpha = y / x$. This shows that the locus of the foci is in a straight line, which makes an angle with the axis of the cone at its vertex, whose tangent is y / x. If we call this angle ϕ, $\tan. \phi = \sin. \alpha$, so all we have to do is to look up $\sin. \alpha$ in the tables, then refer to a table of tangents, and find the angle which has that quantity for its tangent. If a line be then drawn making this angle with the axis, all the foci will be in that line.—M.I.C.E.

[48516.]—**Dividing Circles.**—In trying to find some proof of this curious theorem (for it is more a theorem than a problem), I came across something that seems so mysterious that I must beg for a small space to explain the difficulty in hopes of some solution. Turning to p. 279, where the diagram will be found, call the centre of the circle O; at the end of the horizontal diameter to the right put D, from X above D drop a perpendicular on O D, and call the point where it meets O D, E; also at the point where C X cuts A O, put F; join O X. Now if we can prove that the arc X D bears the same proportion to the length of the semicircle A D B, as O F bears to the diam. A B, the desired result will be obtained. Suppose the dotted circle at C (at least the one which passes through A) to be completed; then taking the radius O A as unity, the diam. of the larger circle will be 4, and it can be shown that the line $OC = \sqrt{3}$; X E and O E are respectively the sine and cosine of the arc X D Then, by similar triangle, we get $(FO) / (OC) = (XE) / (EC)$, or $FO = (\sqrt{3} \sin. XD) / (\sqrt{3} + \cos. XD)$. Now suppose the arc X D is the nth part of 180°, or of π when the radius is 1, and that F O is the mth part of the diameter, the arc X D will be represented by π / n, and the line F O by $2 / m$. Substituting these, and simplifying, we get $m = 2 (\sqrt{3} + \cos. \pi / n) / (\sqrt{3} \sin. \pi / n)$. The object now is to show that whatever value we give to n on the right-hand side, m will always be equal to that value. A few trials will satisfy some people that this is nearly the case: still it is not mathematical proof; and the difficulty that I find is that it does not seem to hold for very minute angles. Thus, supposing $m = n$, and that π / n is a very minute angle, such as one minute, the sine of this angle may be taken as the arc, and the cosine as = 1. Making these substitutions, we find that $\sqrt{3} . n \pi / n = 2 (\sqrt{3} + 1)$, or $\pi = 2 + 2 / \sqrt{3} = 3{\cdot}1547$. Now π is 3·1415 +; so that there is some hitch. If the equation holds good for some values of n, how is it that it fails for very minute angles? The sine and cosine may be expanded in terms of $\pi / 2$, and the numerator divided by the denominator in the above equation; but I do not see that this solves the difficulty. When testing the equation with the ordinary tables of natural sines and cosines, it will be necessary to substitute 180° for π in the equation. After all, perhaps the theorem is only approximately true.—M. I. C. E.

[48533.]—**Angles of Pyramid.**—In the reply of "Scotch Working Mechanic," the sine of an angle appears to have been mistaken for its tangent, perhaps owing to the introduction of the radius, which complicates matters. The sine of half the angle at the apex of one of the faces will be half the base divided by the length of the sloping edge.—M.I.C.E.

[48542.]—**L. & N.W.R. Locos.**—The distribution of weight given by "Prometheus" is that of the "Precursors"; the "Precedents" ranging, I believe, from 32¾ to 35 tons. In express running, in and ex Euston, at any rate, the "Precedents" have now almost entirely, if not quite, superseded other classes. Till a short time ago, the Eunomia or Napoleon (both "Lady of the Lake" class), brought the 12.30 up, and returned in the afternoon with the 4 p.m. down Manchester expresses, running over the North Staffordshire Co.'s line from Colwich to Macclesfield. These trains are now worked by 955, Charles Dickens, a "Precedent" turned out in February of this year, and stationed at Manchester (Longsight, 16). Again, the 4.10 p.m. Birmingham express is now worked by "Precedents," as 506, Sir Alexander Cockburn, instead of by Bloomers, as formerly. This train averages 50$\frac{9}{11}$ miles per hour between Willesden and Northampton. The down night Irish mail is worked by 477, Caractacus, with the vacuum brake, and the "up" by the Experiment. These trains were a short time back run by the "Lady" class.—Tittesworth.

[48561.]—**Induction.**—Three layers of primary wire, lead the ends through the stand, and bring them to the end of the reel where the iron wire core is fastened; attach one end of wire to stud which carries the contact-screw, and the other to the vibrating hammer. Cover the primary wire, when all wound, with two layers of note-paper steeped in paraffin wax: wind on secondary same as primary, and insulate every layer with paraffined paper. Just so. As long as the current is running the hammer sticks to the core, but falls off when the circuit is broken. Connect as described, and you will have constant vibration of hammer, or a contact-breaker as it is called. Glue is bad as an insulator, besides rendering it impossible to unwind wire again. Plenty of directions to make induction coils in back numbers. Directions for electric dial in number which contained your query.—Scotus.

[48569.]—**Millstone Fixing.**—The most improved method of doing this is by means of four screws. Fig. 1 is the plan of the frame, the dotted circle representing the millstone. Fig. 2 is the shape of nut used, and Fig. 3 is a side elevation of frame; *a a* being the stone, *b b* the frame, C the screw, and *d* the nut, which is sunk into frame and held by two screw-nails. The screws used should be about 1¼in. diam., and the point should be let into stone about 1in. This plan is far before wedging, as the stone can be raised or lowered, and adjusted to a nicety by simply turning the screws.—Mack.

FIG. 1.

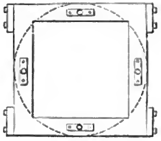
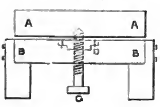


FIG. 2.

FIG. 3.



[48574.]—**Mending Fishing-Rods.**—Take a piece of inch plank, make a square two inches on side, cut it into two pieces diagonally with a fine saw, take one of the pieces, fasten it in vice, or nail it temporarily to a table, take the broken top, and dress ragged ends; lay end of one piece along edge of prepared wood, and plane it to same angle. Do the same with the other piece. Now take two pins, cut off points with nippers, and fix one on heel of each splice; make small hole in point of each splice to fit pins; put fine glue on splices, fit pins into holes, and tie together with a string till dry. When dry, smooth with glass and sand-paper, then take some good linen thread, wax it with cobbler's wax, take another piece of strong thread, and dampit with oil, double the oiled thread so as to have a loop and two ends, lay oiled thread on splice, and wind on waxed thread on top of it, turning in the end and leaving *out the loop and ends of oiled thread*, wind on 4in. of waxed thread in this way at one end of splice, then pass the end of the waxed thread through the oiled loop, seize the ends of oiled thread and draw, when the waxed end will be drawn under the rest, and both ends secured; proceed to wind on waxed thread on the other end, and in the middle in the same way, and your top will look as neat, and be stronger than before.—SCOTUS.

[48596.]—**Harmonium Reeds.**—I should advise "T. B." not to blow the bellows of his harmonium so hard, or to force the bellows so much as to cause the reeds to flatten in pitch. It is not surprising, from such a proceeding, that the reeds do not stand in tune. Too great a force of air on the reeds will flatten and impair them; therefore, if the instrument is required to stand in tune well, great care and attention should be given to the manner in which the bellows is blown. An inexperienced use of the expression stop will produce the same bad effect upon the reeds. The American organ suction reeds are unsuitable for a pressure-bellows as in the harmonium, and even if they were applied to the harmonium, with such undue force of air from the bellows as applied to the reeds of "T. B.'s" instrument, the effect would be so detrimental to the delicate structure of the American suction reeds as to render them (in a very short time) good for nothing. I should, therefore, recommend "T. B." to purchase a good set of ordinary bent reeds, and not attempt to bend them himself, unless he has had some little practice at it. I would further advise him to be very careful in the manner of blowing the bellows, more particularly if his harmonium is possessed of an expression stop, if he uses it. It is much easier to injure the vibrators than it is to repair the injury done. If he will follow the little advice I have furnished, he will have no cause for any further complaint with his harmonium.—G. FRYER.

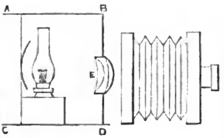
[48600.]—**Speeding.**—I find by an error on my part, or that of the compositor, that the following mistake occurred in my answer to the above which should have read thus:—Multiply the diameter in inches or number of teeth in the driver by its speed per minute, and divide the product by the required speed of driven — and not driver. — D. WOODHEAD.

[48601.]—**Transparent Photographic Views.**—Transparent photographic views are printed by placing the negative from which the transparency is required face up in the dark slide, and then placing a sensitive plate face down upon the negative now put in the back, and expose to light by drawing out the shutter. If the negative is a dense one, expose for about one second to daylight; but if thin, or moderately so, expose to gas or lamp-light at a distance of about a yard for from five to ten seconds, and develop in—saturated solution oxalate of potash, 3 parts; saturated solution of sulphate of iron, ½ part; 60gr. solution of bromide of potassium, 5 drops; mixed just before it is required. Pyrogallic acid, in conjunction with sulphite of soda, may be used, but the iron is the best. For this class of work always use the slowest plates procurable, then the exposure is more under control, and a better colour attained. From photographic or other prints a negative must first be taken, as it is not possible to take transparencies direct in the camera upon gelatine plates. If the negatives are larger than the transparencies are required to be, the camera must be used. Take a long narrow box with both ends out, place the negative in one end and poke the lens in at the other, focus, and expose the plate, developing as above; to illuminate the negative, either place a white screen a few feet in front or use a reflector.—W. T. WILKINSON.

[48603.]—**Putting Watch on Beat.**—If you have been making your watch go faster by twisting your collet on staff, you must pull more hair-spring through the stud it is pinned to. The reason of it being off beat is because your hair-spring is either too long or too short. Remove your cock, let out your spring a little, or take it up a little; you will see by trying it which is right. You soon master that point. You need not oil, if oiled; or it will clog up if not cleaned.—J. TAYLOR.

[48605.]—**Photographic Enlargements.**—To make photographic enlargements by artificial light, the light used must be projected upon the negative or transparency through a pair of condensers in the same manner as the transparency is illuminated in the magic-lantern, and as the larger the negative or transparency, so must the condensers be larger. For enlarging from a carte de visite head and bust the ordinary 3½in. or 4in. condensers of a magic-lantern will answer perfectly; but if a ¼-plate has to be illuminated to the corners, then 6in. diameter will be required, while 9in. will not more than cover a half-plate. The best light to use for enlarging is the oxyhydrogen limelight; but if that is not available the Pamphengos lamp is a very good substitute, the smallest of the two made being best. In the "Photographic News Year Book" for 1882, page 101, I contribute a paper upon enlargements, and give a diagram of an apparatus.—W. T. WILKINSON.

[48605.] — **Photographic Enlarging.** — The sketch below illustrates the simplest and cheapest enlarging lantern that can be made by "Negative." A B C D represent a box—any size will do as long as it is not too cumbersome; E is a 4in. condenser. This is about the right size for enlarging from ¼ plates for vignettes: any smaller is of no use, but larger can be used with advantage. I see some advertised in last week's "Sale Column" at 12s. 6d., and 4½in. at 17s. 6d. This is the cheapest I have seen them advertised at. F is a paraffin lamp. An ordinary lamp with wick well trimmed will do; but I have lately seen some at the oil-shops with double wicks and silvered reflector for 4s. 6d. or 5s. 6d. These I should recommend in preference to the single wick, and if more money can be spared a double-wick Sciopticon lamp (11s. 6d.) gives a splendid light. In front of the condenser is placed the camera with ordinary portrait lens, and the negative in the place of the focussing glass, and with film side towards the lens. The distance the various parts of the apparatus should be one from another, can only be found by experiment. The flame of lamp, the centre of condenser, and centre of negative and lens, should all be in a line with each other. When the proper distance of negative from condenser is found (about ¾in.) it will be a good plan to make a stout cardboard tube to fit tightly over the rim of condenser; against this the negative is placed so that the same distance from condenser is always maintained, and it also excludes a great amount of light from finding its way into the room. Great care should always be taken in this respect, and where the apparatus is not light-tight it should be carefully covered over. A drawing board, or something similar, should now be placed at a distance to suit the required enlargement, a piece of white paper pinned on this, and the subject focussed. This done, the cap is replaced, the prepared paper is pinned in the proper place, and the exposure effected. I have found that for an enlargement 12 by 17 with a single-wick lamp 12 minutes was required, and with a lamp of the Sciopticon pattern 4 or 5 minutes was sufficient; but a great deal depends on the density of the negative and the lens used, so that a few experiments should be made on small pieces of the paper before risking the full-sized sheet. I should mention that the ferrous oxalate developer should be used.—JAMES FEARNLEY.



[48617.] — **Horse-Power and Screw-Propeller.**—From the figures given I can only obtain such a low horse-power that I fear there is a slip somewhere. I have made two separate estimates by different rules, and get nearly the same result in each case; I doubt very much if the point of cutting off the steam is correctly given. Such engines should indicate about 120 h.p. "Bijah" had better get his engines indicated by some friend, if possible, and see where the fault lies. He appears to have plenty of steam, so that he can get more power either by altering his slide so as to use more steam, or by having a new propeller of less pitch. The former had better be tried first, and if it does not answer the propeller should be looked to and examined for truth and pitch. It should be of about 7ft. pitch for the diameter given, and would require to make 170 revolutions to obtain ten knots, which is utmost speed to be expected.—SHIPWRIGHT.

P.S.—Should not the vacuum be 25·5in., and not 35·5in.?

[48623.] — **Bichromate Cells and New Dynamo.**—The calcium chromate can be used in place of the potash bichromate, provided it can be obtained, which is not easy. I do not yet know sufficient about the Ferranti dynamo machine to enable me to describe it to my satisfaction.—SIGMA.

[48631.]—**Rusty Pressure Boiler.**—I think the cause of your having rusty water is because you have no cleanser connected to your boiler. You must lose no time in getting one put in, as your boiler should have a proper cleaning at least twice in the year. In cleaning the boiler, you only open the valve in the cistern and open the stop-cock of your cleanser, and let the water run till you find that your boiler is clean.—J. H. J.

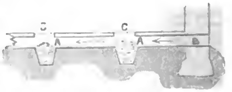
[48643.]—**Photography.**—Your silver bath requires the addition of a few drops of nitric acid; the appearance you describe being due to fog.—W. T. WILKINSON.

[48643.] — **Photography.**—To W. ROBINSON, JUN.—My method of working is as follows: I dip the plate in the bath until the greasy appearance disappears, and then drain it and place it in the dark slide with a thin piece of glass at the back of plate, and expose for about a minute and a half this weather. I pour the developing solution from a small bottle, just sufficient to cover the plate, and I also move my wrist to keep it on evenly, and I allow it to remain on until I see the image appear as full as possible, and then fix it. The solutions I have compounded in the following bath: silver, ½oz.; water, 8oz.; nitric acid, 5 drops. I also coated a glass plate with collodion, and allowed it to remain in bath for ten minutes, and filtered. Developing solution: iron, 1oz.; alcohol, 1oz.; glacial acetic acid, ½oz.; water, 20oz. My operating "room" is the house yard, or upper bedroom, which I find better than yard.—LEARNER.

[48651.]—**Street Medical Coil.**—The best way to set about making one of these is to look well at two or three, so as to carry away a full idea as to the external arrangements preferred, for these constitute the whole affair. The coil itself is a trifle, and any second-hand one bought for the price of the wire will do, if it is cased in a showy frame. If to be made, make up a reel of the desired size, wind on three layers of No. 18 cotton-covered wire, then five of No. 20, and 5 more of No. 26. Make a core of No. 20 well-annealed iron wire, fitting so loosely in the tube that a brass tube will slide freely over it, and then fix it firmly in one end, so as to work the armature. At the further end of the tube fix a leading pipe with a small pulley, and attach a catgut string to the further end of the sliding-tube to run over this, and through the pipe to the make-believe indicator. The whole concern consists in its show-off qualities, so that anyone who knows the least about coils at all can devise one.—SIGMA.

[48653.]—**Stippled Lobby-Walls.**—Your only remedy is to repaint the wall all over. If you desire to have it perfectly flat, give it a coat of colour mixed with all linseed-oil (not boiled) and driers; it must be as near the colour you desire the wall finished as you can get it. Next morning you must go over the wall with the flatting, which must be mixed with turpentine only. You may put about a tablespoonful of japanner's gold-size in it to harden it. The wall you speak of will require three hands at it; two laying the stuff on, and one stippling, or else the piecings will show. To make a good job of flatting, requires the hand of a practised painter; but if you do not succeed write again, and I shall be pleased to help you further.—WM. STANYER.

[48654.]—**Heating Apparatus.**—I know two churches which are heated in the following simple manner:—Fig. 1 is a section through the main aisle of the church. A is a square shaft of brickwork 9in. by 9in., covered with tiles. This shaft communicates with the outer air through opening in wall at B, and is led away to chimney at the other end of church. At intervals of, say, 10ft., square openings are made in the floor, which are covered with hinged gratings through which fire is placed in the firepots sunk below the level of the air-shaft. The flue becomes heated, and a strong induced current of cold air enters, and when warmed escapes through the floor-gratings into the church, while the smoke and noxious gases are led away to the chimney. Of course, this method of warming can only be used in churches having a tiled floor.—R. B.



[48659.]—**Magneto-Electric Machines.**—The alternating current produced in these machines is even better than a continuous one for incandescent lights, as far as the durability of the lamp is concerned. It is not necessary to use a commutator at all with them; but simple collecting springs. But such currents are not suitable for conveyance to any distance, owing to the inductive effects which accompany each reversal.—SIGMA.

[48665.]—**Water.**—From a 2in. outlet, with 100ft. head of water, you will obtain 782 gallons per hour. The distance of outlet from head need not, in this case, be taken into account, as the 6in.

main will supply water as freely as if the 2in. outlet were immediately beneath the head. The rule, then, for getting the answer will be as follows:—First find the velocity of the water due to head, which may be done by using formula $v^2 = 2gs$, where v = velocity in feet per second, $g = 32$, the attraction of gravity, and s = space travelled or head of water; by which we find v = 80ft. per second. Next get the area of orifice; in this case 3·14 sq. in.; and since the area of water passing through is to the area of orifice, as 5 : 7, the area of section of water = 2·444 sq. in. This must now be multiplied by the velocity of passing current, in inches per second to give the total volume passing through per second, which comes to 8,446,461 cubic inches—i.e., 4,888 cubic feet passing through outlet per hour. Now, 1 cubic foot = 6·25 gallons; so 4,888 cubic feet = 782 gallons, which is quantity of water passing through outlet per hour. The amount of water passing through orifice is less than one would expect, owing to the effect of the "vena contracta," which gives the proportion of 5 : 7.—H. B. G.

[48667.]—**Induction Coil.**—You commit two errors. By surrounding the core with a tube of iron or any other metal, you transfer the induction current to that tube; you can get none in the wire. Also, Leclanché cells are not fit for this use; you should use a Smee or other large-current cell to test with.—Sigma.

[48667.]—**Induction Coil.**—Before replying, it would be necessary to know what is meant by testing "in the usual manner." The two Leclanchés mentioned, if used for the primary current, would not do on account of their high internal resistance. Groves, Bunsens, or bichromate cells are best. Querist should also state approximate number of turns of secondary, or its length already wound on, method of insulation, size of coil, &c. The object of making the core of seperate wires is to prevent the formation of induced currents in it, therefore, the iron tube is objectionable.—J. Brown, Belfast.

[48668.]—**Sawing Meat by Machinery.**—If the appearance of the meat so cut is a matter of indifference, Mr. Branagh would find a band-saw do the work well enough. The meat is pushed up to the saw and twisted about on the table, so as to present the parts required to be cut to the saw. With fine saws the flesh would not be torn, and would not exhibit much difference after exposure to air. I suppose any of the firms who manufacture wood-working machinery would fit up a suitable plant.—Nux. Dor.

[48672.]—**Sand-Blast Files.**—I quite agree with the remarks of "J. C." as to worn files, but he does not tell us what he considers to be the cause of the failure;—whether the temper of the files was drawn, or the quality of the steel deteriorated by the process. From my experience with them, the failure was entirely due to the bad condition of the teeth. If "J. C." had closely examined his files, he would, no doubt, have found nine-tenths of the teeth broken out, as is the case with, perhaps, 95 per cent. of all old files. It is not claimed for the process that it produces new teeth, it simply sharpens those which remain intact. Anyone would know that the remaining teeth could do nothing like as much work as a new file. Now sand-blast files are rapidly gaining favour and coming into general use. I understand that all the Sheffield file manufacturers supply their customers with sand-blast files if specified. They cut sweeter, last longer, and "pin" less than ordinary new files. A light pressure only is required to make them "bite," thus enabling one to devote a greater portion of his energies to a more useful purpose—accurate filing.—E. H.

[48675.]—**M.R. Engines.**—Nos. 51—59 were built at Derby in 1876, and have driving-wheels 6ft. 8in. and cylinders 17 by 24. No. 71 was built at Derby in 1876, and has cylinders 17 by 24, and driving-wheels 6ft. It is a 4-coupled engine. There are 10 of the class—viz., No. 1, 9, 10, 13, 70, 71, 73, 74, 96, and 146. No. 80—89 are double-framed 6ft. coupled, built at Derby in 1863, cylinders 16½ by 22. Nos. 70—79 (1862) are of the same class. Some of these latter are, however, on the A list. Also 160—164 (1863). Nos. 101A—115A, 116—119, and 156—159, are of the same class, but they have, I believe, a shorter wheel-base, and are different in a few other respects. They were built at Derby in 1866—68. Nos. 150, 153—155, are of a similar class, but a later late, 1873—4, and have cabs. It is possible that the cylinders are larger, but of this I am not sure. 111—115 (Derby, 1880), 6ft. 6in., 4 coupled, cylinders 18 by 26. No. 147 is a bogie tank, built at Derby in 1875; driving-wheels 5ft. 6in., cylinders 17 by 24. Nos. 170—199 were built by Beyer, Peacock, and Co, 1867. The cylinders are 16½ by 22, driving-wheels 6ft. 2in. They have double frames. The cylinders of those rebuilt have not been enlarged. No. 141 (now 141A) is a double-framed single engine, built by Stephenson 1852. Cylinders were, when built, 16 by 22; driving-wheels, 6ft. 6in. I do not know the size of the cylinders of any of the rebuilt singles, such as 141A, 36, 39, 100, &c. Will any reader inform me? Also the size of cylinders of the rebuilt goods engines which formerly had cylinders 17 by 24? I wish also to correct a few errors in my answer to query 48340. L. and Y. old 177 has leading and driving-wheels 4ft. 10in. in diameter; cylinders, 15 by 24; L. and Y. 608 was built, not rebuilt, in 1876; the old one was broken up. I do not know M.R. 1090—1109.—Meteor.

[48675.]—**M.R. Engines.**—To "C. H." and "J. F. L."—I have coupled these two queries together, as they are both alike. No. 50 and 51, wheels 6ft. 8½in., cylinders 17½ by 24, express passenger engine. Nos. 111, 71, 115, 146, four-coupled passenger engines, wheels 6ft. 2¼in., cylinders 17 by 24. Nos. 82, 84, 115A, 150, doubled-framed four-wheeled coupled passenger engine, wheels 6ft. 2¼in., cylinders 16½ by 22. No. 147, bogie tank, build by M.R. Co. for metropolitan traffic, wheels 5ft. 3in., cylinders 17 by 24: 1090, built by Sharp Stewart, Manchester, 1860, and is stationed at Birmingham, side tank, four-wheel coupled passenger engine, wheels 5ft. 6in., cylinders 15½ by 20; 1101, six-wheel coupled side-tank, wheels 4ft. 6in., cylinders 18 by 24; 174—177, wheel 6ft., 3in., cylinders 16½ by 24. For 800 class see back numbers; 33 was rebuilt 1881, for the purpose of taking the directors about; it was 141A before, so these two engines changed numbers; have cylinders 16½ by 22, wheels, 6ft. 8½in.—Camomile.

[48676.]—**Disconnecting Trap.**—"Savant" should advertise his address, if he wants full particulars of traps and other sanitary improvements. But "Weaver's" House-Drain Ventilator Trap is generally used, made by Stiff, of Lambeth. For disconnecting sink-wastes from drains, a form of gully, which is self-cleansing, supplied by the Domestic Engineering Company, 433, Oxford-street, W., is now specified by medical officers of health.—Sanitas.

[48690.]—**Magnetic Storms.**—There are reports from various parts of the world of earth currents having E.M.F. of 200 cells at times; it is therefore possible that incandescent lights may, on such occasions, be kept in action for irregular intervals, and at varying intensities, on some special occasions. Telegrams can often be worked off by such currents; but their power is so fluctuating that no steady work can be done, and more often it is necessary to get rid of them by using two parallel wires to make the circuit.—Sigma.

[48692.]—**Geneva Cylinder.**—The escape-wheel will be the gauge for cylinder. Select one so that the wheel-teeth will go inside cylinder free, and also that cylinder will pass in between each tooth. To turn in you will require a ferrule; this you can make from a drill-ferrule, by broaching it out so that the cylinder will go through easy, and file it to the required thickness. Stick this on the body of cylinder with sealing-wax, by putting a small quantity of wax on the ferrule and then holding it in a gas-flame until the wax melts; then slip on cylinder. This will fill the inside of the cylinder and support it during the process of turning. To take the height, remove the bottom piece, called the "chariot," which contains the jewel-hole, and screw in place a small brass plate that has a hole in, so that the thick arbor of cylinder that is left to form the pivot will pass through; if the cylinder-body is too long turn down so that the wheel "arms or rim" (not the teeth) lie in the centre of banking-slot. Having got this right, mark for balance just above escape-wheel cock. Now replace "chariot," and make bottom pivot; remove both end stones, and take full height with pinion-gauge. Tools you require will be a set of turns, gravers, a "jacot" pivoting-tool, and a conical pivot-file; and, above all, a lot of experience in turning, before you will be able to turn in a cylinder, or any other part of a watch, properly. I will help you; state what you find difficult.—G. Sumner.

[48693.]—**Spontaneous Generation.**—I should advise "L. V." to study—first, Huxley and Martin's "Biology," Chapters I. to V. inclusive, carefully performing all the experiments therein recommended; he can then read Pasteur's "Studies on Fermentation," Tyndall's "Floating Matter of the Air," and "Bastian's "Beginnings of Life." There are many other works on the subject to which references are made in the ones I have quoted, more especially those of Drs. Roberts, Drysdale, and Dallinger.—John Heron.

[48694.]—**Displacement, &c., of Steam-Ships.**—For comparing the displacements of various steamships, the way I should recommend is this. Multiply together the length, breadth, and mean draught; and of the parallelopipedon thus formed take 60 per cent. as an approximate displacement for each steamer under consideration. The immersed midship section is less easy to find without knowing something of the lines of the ship; but, generally it may be calculated at from ⅘ to ⅞ of the rectangle contained by beam by mean draught.—H. B. G.

[48694.]—**Displacement, &c., of Steam-Ships.**—The displacement and immersed midship section can only be got from their builders or designers. The displacement is calculated by getting the area of a number of vertical sections, and multiplying the mean of these areas by the length. This gives the capacity, the portion of which below the line of flotation is the displacement, which is usually converted from cubic feet into tons. In merchant ships there are the load and the light displacement, the difference being the amount of cargo the ship can carry. This seldom or never agrees with the registered tonnage, which is calculated by empirical rules which, from the increased length and altered form of modern ships, are becoming more and more untrustworthy.—Robinson Crusoe.

[48695.]—**Medical.**—The following simple remedy has been known to cure cases like yours:—Procure a small quantity of ammonia and camphor, mix these well, and rub *briskly* into the feet two or three times a day. If you think rheumatism has settled in your system, having had it for the past twelve years, I know of no better remedy in the world than for you to pay a visit to the now-famous hot-springs at Rotomohana, and Rotorua Lakes in the North Island of New Zealand. These waters contain medicinal properties, the value of which should be more widely known in England, where rheumatism commits its ravages in almost every household. I will just give one instance of the wonderful cure effected in the case of a person who had almost lost the use of his limbs. This gentleman went to New Zealand, thinking that the warm genial climate of the sunny South would restore animation to his shattered system. He remained there some time without any marked change in his condition. Finally he was advised to try the springs at the Rotomahana Terraces. He was carried down to the steamer sailing from Wellington to the Lakes, more dead than alive. After having a number of baths in those healing springs, he returned to his friends without crutches, and is now able to walk about with ease. There have been other cases of remarkable cures of rheumatism, the result of bathing in these waters, but the foregoing came under my own personal observation, and may, therefore, be relied on. Were the rheumy English and other people who are afflicted with this dire malady, acquainted with the healing qualities of these springs, I feel convinced that a large number would make their way thither.—A. A., B.S.P.

[48701.]—**Mercury Break.**—To J. Brown, Belfast.—The trouble referred to is one of the drawbacks of the mercury break. The grey, muddy-looking matter is simply a kind of emulsion, formed of small globules of the mercury, broken up, probably, by the spark which forms as the platinum leaves the mercury. Wiedemann ("Electromagnetismus," p. 274) says, "This evil may be avoided by using a fluid platinum amalgam of greater specific gravity." There is some platinum in my mercury from the dissolving of part of the break, accidentally left some months in contact with it; but I have not made any definite experiments myself on the subject. I also use methylated spirits, and have not tried absolute alcohol, which, however, considering its lower specific gravity and greater fluidity, might give better results. I have tried olive-oil and petroleum, but prefer the methylated spirit.—J. Brown, Belfast.

[48712.]—**Electric Light.**—I see that "Lux Sperans" asks if it is possible to light incandescent and arc lamps from the same dynamo. Certainly it is. The town of Chesterfield, for instance, is thus lighted with 23 arc lamps and 90 incandescent ditto, all supplied from a 40-light dynamo. I believe about 8 incandescent are equivalent to 1 arc light; but of course the exact proportion differs according to the standard adopted, about which the authorities seem to "differ" also. In the case of Chesterfield, assuming the dynamo was working to its full power, the proportion would be as 17 to 90, making each arc equal to 5 incandescents. I see I have also a note that a 20-light dynamo lighted 85 incandescents of 25 candle-power with 10 horse-power.—Lumen Ademptum.

[48719.]—**Engine Query.**—The steam-ports of a cylinder should be given an area equal to about $\frac{1}{25}$ that of the cylinder, though the area of steam-pipe from boiler may be made larger than this with some advantage. The exhaust-port and pipe are also made larger than the steam passages. The diameter of fly-wheel for two cylinders of 2in. stroke will be approximately 9in., with a rim 1¼in. by 1in.; while the best material for crankshaft is wrought iron.—H. B. G.

Saw Teeth Tipped with Iridium.—Mr. John Holland, whose discoveries and improvements in the working of iridium were noticed not long ago, has now made a circular saw with teeth tipped with that hard and refractory metal. The saw is 12in. in diameter, and is to be used for sawing hard woods.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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QUERIES.

[48720.]—**Legal—Landlord and Tenant.**—To Mr. Wetherfield.—A house let on yearly tenancy. Tenant dies, and relatives administer, and they only require house a sufficient time to sell out. Are they, the administrators by law, bound to the tenancy, as the intestate would be had he lived: that is to give the usual six months' notice, or does the tenancy terminate at the death, and no notice necessary?—O.

[48721.]—**Platform Scales.**—My attention has been called to several platform scales weighing up to 4cwt. They weigh tolerably correct if the weights are placed in a certain position on the boards; but when either the weights or the articles to be weighed are moved to the edge of the boards, it will vary from ¾ to 1lb. in a cwt. The scales are new, and cannot therefore be said to be out of repair. Will some one give me some information as to the cause of this, and whether all platform scales act in this way?—D. J., Carmarthen.

[48722.]—**Engine Query.**—Would any of your readers kindly tell me how to set the steam valves of a pair of engines with cylinders 5½in. bore and 10in. stroke? The engines are attached to a crane that I am driving, and I get a deal of bother with the engine sticking on the centres.—Perplexed One.

[48723.]—**Washing.**—(1) Are steam laundries under the Factory Act, and if so, who are the persons to inform when these rules are broken? (2) Will some fellow-reader help me out of the following difficulty?—I have a large quantity of flannel and woollen shirts and drawers to wash every week, and I am constantly having complaints about their shrinking. Some instructions how to wash and dry these things would no doubt be a great boon to many of our fellow-readers besides myself.—Laundry Man.

[48724.]—**Worm-Eaten Furniture.**—What may be applied to worm-eaten furniture to kill the insect or stop its ravages?—G.

[48725.]—**Steam Laundry.**—Can any correspondent of ours give information respecting necessary plant and machinery for starting and carrying on a business as above? Any information respecting working and general management will greatly oblige—Cock Laundress.

[48726.]—**Cornice.**—An expensive yellow metal cornice having been unsuitable for my former residence, was laid by, and now on again taking out for use, I find it very much tarnished, and in some places quite green from damp, &c. Will some one kindly say if there is any way of restoring it to its former brightness and tint? If so, materials and process necessary for the purpose?—Dooukam.

[48727.]—**Rancid Butter.**—Could any of your readers inform me as to best way to sweeten or restore rancid butter?—A. Norfolk.

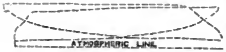
[48728.]—**Hot Air.**—I have a chamber in which certain articles have to be dried by hot air. At present the air is driven by a fan through a red-hot iron pipe, and a temperature of 180° easily maintained by regulating the speed of the fan. Would the moisture be evaporated more quickly by a stronger current of air at a correspondingly lower temperature, say 120°, or is the present draught and high temperature more effective?—Yesallaw.

[48729.]—**Oysters.**—An oyster being forced open is separated from its shell by a knife, and immediately swallowed. Is it alive or dead? Some maintain that the cutting of the connection with the shell causes instant death. If so, why?—Yesallaw.

[48730.]—**Canaries.**—We keep about fifty canaries in an aviary in a greenhouse, but at the age of two or at most three years, they all become asthmatical and die. Is this to be accounted for by the sudden variations of temperature, as they live much longer in cages in the house?—Yesallaw.

[48731.]—**Fitting up Small Lathe.**—I am trying to fit up small lathe 3½in. centre, and want to know the easiest way to bore headstocks without a lathe; size of mandrel to make strong tool; angle of cone in ditto. Also if a collar of tin and zinc is good? How are the coned mandrels of such lathes as Brittania Co. and other makers fitted, there being no caps on headstocks to allow cones to be inserted?—Tyro.

[48732.]—**Indicator Diagrams.**—Kindly state the defects in the engine from which these diagrams have been taken: The engine is a simple high-pressure one, having Cornish valves and link-motion; diam. of cyl., 32in.; length of stroke, 5ft.; steam-pressure, 45lb.—F. W.



[48733.]—**Brittle Brass Wire.**—Some brass wire of different sizes which I have had by me for a few years has become so brittle that it cannot be bent without breaking. Can any reader kindly explain how this has happened, and can it be remedied?—No Name.

[48734.]—**Electricity.**—I have a battery of nine cells. In the outer jars is broken carbon, and in the porous pots granulated zinc. After putting them together, I wetted the carbon, and placed the end wires of one cell on my tongue, and found there was a small current of electricity. I then joined them all in series, and again placed the two end wires on my tongue and received a shock too strong for my tongue to bear. I tried to ring a bell with the current, but it seemed to have no effect upon the magnet. I tried several other experiments with it, and found it would decompose water slowly, deflect a galvanometer needle slightly, make a small scratching noise in telephone when connection was made (showing that it had a slight magnetising power), and caused a sharp tingling if the wires were placed one on each cheek. With one separate cell filled with the solution it did not hurt my tongue to lick the wires, would ring a bell strongly, decompose water fast, deflect a galvanometer needle 70° or 80°, make a loud scratching noise in the telephone, and caused no tingling when the wires were placed on the cheeks. Will some one kindly explain what is the difference between these two electricities? The former current will not deposit copper.—Seaweed.

[48735.]—**Patent.**—Can valid patents be taken out during minority?—Quæsitor.

[48736.]—**Legal.**—To Mr. Wetherfield.—Would you kindly advise me in the following?—I bought a property two and a half years ago consisting of five houses of one flat in a tenement, for which I paid £500. The builder and myself are the sole proprietors of this tenement. The builder was due me £200, so I was obliged either to lose this money or take this property, and then settle by contra, as he was in difficulties. After a bit he starts and builds another tenement in the same street, and up against the gable of the tenement that my property is in, and he ties the one into the other as is usual in street buildings; but this last tenement is like to fall, and it is dragging mine along with it, and my tenants are threatening to leave these houses. Both tenements belong to the builder, less my flat. Can I make him take it back, or can I sue him for damages?—J. H. J.

[48737.]—**Model Engine.**—I have a model engine of the vertical type which is suited for working a screw. I wish to fit the same with a link-reversing motion. Can any of our readers give me information as regards size and shape of the expansion link, also the mode of fixing the lever for shifting the link, as also the throw of the eccentrics? The cylinder has a 2in. stroke. A diagram and sketch would greatly help.—Atelier.

[48738.]—**Diabetes.**—Will Dr. Edmunds please give a few hints as to the above complaint? Also what does Dr. Edmunds think of Dr. Felicact's treatment of the above?—A Countryman.

[48739.]—**Patent Law.**—Can any of "ours" give me their opinion on the following knotty question? A patent was granted in 1872, to which, singular to state, no claim was added, but merely some of the advantages of the process are enumerated, and the real point of value entirely passed over. A large quantity of goods manufactured under this process in America are imported into England between the years 1872 and 1878, and the article was in universal use. In 1878 a disclaimer is filed by the patentee, which disclaims any intention on his part to claim any of the advantages previously mentioned as novelties, but puts in a claim for the valuable point previously entirely omitted. What is the law on these two points—viz., can any important alteration be effected after a lapse of six years, and if it can, would not the fact of the article coming here during the years that the patent was virtually void, prior to the disclaimer being filed, render it null and void?—Yesallaw.

[48740.]—**Science and Art Classes.**—Will some reader kindly inform me how I am to proceed in order to form a "Science and Art Class" in connection with the South Kensington department in a county town in Ireland, with a population of near 5,000. If the Act referring to England in this matter is the same as to Ireland? How many should constitute the class, the rate of subscription, &c.?—Electrician.

[48741.]—**Lever.**—A lever 10ft. long is securely fastened at one end—a weight of 140lb is suspended from the other end. What pressure is exerted at a point 1ft. from the end fastened to the ground?—Yesallaw.

[48742.]—**Bricks, Tiles, and Kilns.**—Will Mr. Everitt kindly state if Mr. Edward Dobson's book on the above subject gives particulars as to glazed tiles and kilns, and methods of firing same?—E. H. E.

[48743.]—**To "F.R.A.S."**—Can you recommend a cheap micrometer to measure spots on sun? If you use a glass grating one in focus, would it not show dust-spots on it? I suppose you must not use a spider's line micrometer, as sun would scorch them. A hint would be acceptable to—An Ignoramus.

[48744.]—**Quinsy and Sore Throat.**—To Dr. Edmunds.—Will you kindly advise in the following?—I have lately been subject to the quinsy or inflammation of the tonsils of the throat. I should be grateful to you for advice as to the means of preventing another attack, and also should be glad to know the best means to prevent its progress when I feel the first symptoms of its coming on? I have had medical attendance on two occasions, with great success; but I wish to be able to dispense with medical aid, if possible, as it comes rather expensive, combined with loss of time, &c. Any kind hints will be thankfully received, and will, no doubt, be of great service to many of "ours," as well as myself.—G. Fryer.

[48745.]—**Winter Sketching.**—I am anxious to make sketches out of doors this winter, and wish to construct a wooden hut for the purpose, with a window at one end. Will some reader kindly give me a few hints as to the dimensions, &c., and could it be made portable?—J. B.

[48746.]—**Corrosive Sublimate.**—How may corrosive sublimate be dissolved, so as to preserve anatomical specimens?—W. S.

[48747.]—**Lunar Photographs.**—Would any reader give me instructions how to produce a photograph of the moon, and oblige—An Amateur.

[48748.]—**Microscopical.**—Will Mr. A. E. Davis say if the Tolles amplifier can be used for, say, ¼ and 1-12 Rosse's objectives? If it can, it will be a great boon to microscopists.—Wm. Cooper.

[48749.]—**Induction Coil and Water.**—To Mr. Lancaster.—Thanks. My object in view is the easy decomposition of water in large quantities and by electricity. I have thought that by trying electrodes of different kinds and which would influence one or other of the gases. Will you please say the possible amount of work in this way I might do with the coil I propose making—6in. long—and what quantity of wire I should get?—Telegraphist.

[48750.]—**Working Models.**—Having seen some mechanical working models of a railway, organ-grinder, ship, &c., I should be glad to know if there is any work published which would guide and assist me in the making of such figures.—Ignoramus.

[48751.]—**Water-Power.**—I have a stream adjoining my farm buildings, which I want to utilise for driving my barn machinery. There is 6ft. of fall, and as much water as a 6in. pipe would take. Wanted to know what power I should have, and whether a turbine or an ordinary waterwheel would be best?—Farmer.

[48752.]—**Tea.**—To Dr. Edmunds.—I note that you strongly condemn the use of tea and coffee. Could you suggest any harmless substitute? I have been using milk during the summer, but find it rather cold for breakfast now that the winter has set in. Would cocoa do? Your attention to this would, I have no doubt, oblige others as well as me. Allow me to say that I have benefited considerably in health by attending to your instructions, and thank you for the trouble you take in writing so freely in this paper.—Iris.

[48753.]—**Legal.**—Suppose I had a wife and three children, two sons named A., aged 25, and B., aged 20 years, and one daughter. I make a will, leaving all my property to my wife, and after her death the property to be equally divided between my son B. and my daughter; to my son A. I give a maximum sum of £1. My daughter dies before me; afterwards my death occurs, and the will is left unaltered; then next my wife dies, leaving the sons A. and B. sole survivors; again, my son B. dies intestate, leaving a widow and two children. What claim has the son A. to the property?—Non Con.

[48754.]—**Musical Box.**—I have received a 12 air musical-box with drum, bells, and zither accompaniments, from Switzerland. It plays the airs all right, and there is no squeaking like I have found in some boxes; but there is a jarring or vibrating noise when it is playing, though I have done everything I could think of to remedy it. The jarring is heard whether the accompaniments are in action or not, and also the lid being open or closed makes no difference. If any reader can suggest a remedy, they will oblige—E. J. N.

[48755.]—**Father's Liability to Maintain Widowed Daughter.**—Will Mr. Wetherfield answer the following questions?—I am nearly 70 years of age, and a working mechanic. I have a daughter in middle life (a widow nearly 40) who has made herself chargeable to the parish. The guardians say I must pay towards her maintenance, and also towards the expenses of her past support. Can they legally compel me to do so?—A Mechanic.

[48756.]—**Screw Propellers.**—Will some correspondent give a simple rule to find the pitch of a screw-propeller? Also, how to find the angle of the blade?—W. B.

[48757.]—**Portrait Lenses.**—Is there any special advantage in using a portrait lens to take portraits with? Having gelatine plates of great sensitiveness, with my landscape lens I can take pictures in a fraction of a second. Unless I stop a portrait combination down very considerably, it would be unmanageable. Am I right in thinking portrait lenses have become obsolete since the introduction of exalted sensitiveness in our plates?—Less Light.

[48758.]—**Stereoscopic Lens.**—What is the meaning of a row of figures from 1 to 12 engraved on the front of the Grubb stereoscopic lens? The mount is patented, but what have those figures to do with its utility?—West Africa.

[48759.]—**Substitute for Hops.**—Some of the leading brewers have been writing to the *Times* disclaiming the use of substitutes for hops. Who *does* use the preparations that are advertised in the brewing papers? I notice another correspondent of the *Times* declares that camomile is freely used as a substitute for hop, and he says it makes such a good bitter beer that it might openly be used but for public prejudice. Camomile grows wild anywhere in England; it never fails like hop, and it is, I believe, wholesome. Why should it not be generally used?—Home Brewer.

[48760.]—**Enamelled Coins.**—In the jewellery trade just now there are many beautiful specimens of enamelled coins, &c., and we think that a description of the method of their production would be esteemed by many readers of your excellent journal. If any of your able contributors would kindly favour us with this interesting process so as to enable an amateur to accomplish it would be considered a boon—at any rate, to—Jewel.

[48761.]—**Legal.**—Will Mr. Wetherfield kindly answer the following?—A. lends B. £50 at 5½ per cent. What is the simplest legal form B. can give A. when there is no security?—Workman.

[48762.]—**Jerks in Railway Trains caused by Continuous Brakes.** Mr. Stretton, in his letter p. 185, under above heading, very truly says "The sensation caused to passengers by carriages 'righting themselves' as it is technically called, is very unpleasant." Would he, or anyone, kindly say what is the best position for a passenger in a railway carriage to take up, so as to neutralise as much as possible this unpleasant sensation to his individual self?—H.

[48763.]—**Linen Manufacture in the United States.**—Can any reader tell me the principal places where linen manufacturing, bleaching, dyeing, &c., is carried on in the States, and whether it is an extensive industry there? Also, name of any books relating to linen and cotton manufacturing in America, or journal devoted to textile trades, and where published? As I intend going to the United States, any information on the subject will be thankfully received. My business is in the finishing department.—Geo. H.

[48764.]—**Engine Query.**—Will some kind reader tell what is the smallest size cylinder with which I could get ½ horse-power, and what weight would flywheel be? Also, size of boiler required, and strength of same?—Anxious.

[48765.]—**Algebraic Question.**—Will any of the readers of the English Mechanic give us the solution to the following algebraic question:—

$$\frac{3^3+4^3}{2^7\times 9^2}+\frac{5^3-13^2}{12^2+10^2}-\frac{3^5+5^2-11^2}{3-4^4\times 3^4}$$

It is in Chambers's *Standard Algebra*, and the answer as given by the key is 2, which, though having repeatedly tried, we are unable to produce.—T. W. and J. L.

[48766.]—**Photography.**—I want to know how to produce a positive picture on dry-plate from a negative of the same kind. Perhaps Mr. Lancaster, who volunteers the information in No. 48821, will tell me. Also, whether the said positive, when produced, will answer for a magic-lantern slide? 2. I have a magic-lantern with 3½ condensing lenses and 2in. object-glasses. How must I set to work to make a camera to take photographs from these? State size of camera required, and all particulars. —Dozey, G.

[48767.]—**Electric Pendulum.**—To Mr. Lancaster.—I would be thankful to Mr. Lancaster to give me the sizes and sketch of an electric pendulum not more than 2ft. long. By sizes I mean size of wire for electro-magnet, size of iron core, length of bobbin, &c. I have purchased no part of the clock as yet, and will, therefore, take your advice as to the works I should procure. I would not wish to have the dial more than 6in. dia., as I intend to inclose all in a fret-worked case with glass front when complete. To save trouble I suppose I may adopt the plan sketched at p. 234 of our Mechanic for transmitting the motion of the pendulum to the works of the clock. I require only the simplest train of wheels to show the minutes and hours on dial. Mr. Lancaster will kindly bear in mind that I have a good supply of tools, and have done many jobs in connection with electricity.—T. J. O. C.

[48768.]—**Gilding on Leather.**—Can any fellow-readers of the "E.M." give me information as regards process of gilding in design on leather, such as bookbinder's process? But, having to cover a large space at one time, I require a tack to hold the leaf till the pattern is burnt in. I have at present used oil, but I think this mars the lustre of the metal leaf.—Dilemma.

[48769.]—**Gas and Leather.**—Will someone inform me what is the best means to employ to prevent gas penetrating through leather?—W. L. Catlin.

[48770.]—**Boring for Sunk Safe.**—We have a safe containing valuable papers lost several years ago in a stream which was high at the time, but now it is generally dry; the bed is of sand extending some 15ft. deep! I want to know if any of your readers can give me any information pertaining to an instrument that it could be found with, or any way that would enable me to find it, if there is any instrument made for such use.—D. C. Meeker, 324, Larimer-street, Denver, Colorado, U.S.A.

[48771.]—**To Mr. Wetherfield.**—The United Telephone Company, in their prospectus, state "Proceedings will be taken against any person who manufactures, supplies, or uses any instruments infringing their patents." Can or cannot a person legally make a telephone or other patent article for his sole private use? For instance, a pair of telephones communicating between his office and factory. Or, would such a course be liable?—Telephone.

[48772.]—**Coloured Lights.**—Would "J. F. E." kindly give a few hints on the making of coloured lights? I cannot get mine to burn satisfactorily. My composition for green is—30 of chlorate of potash, 45 of nitrate of baryta, 9 of shellac, ½ of sulphur. For red—9 chlorate of potash, 14 of nitrate of strontia, 4 of nitre, 1 of sulphide of copper, 4 of shellac. Should the composition be rammed into the case or not?—C. S.

[48773.]—**Small Castings in Bronze.**—Will one of our subscribers who is well acquainted with the matter say what is mixed with the sand for small castings in bronze?—O. X.

[48774.]—**Watch Repairing.**—Would "A Fellow Workman," or some of your able correspondents, kindly oblige me with the following information:—How am I to polish watch-screws, and to know the number of vibrations of a hair-spring before applying it to a watch? What are the best tools to burnish the pivots?—Another Fellow Workman.

[48775.]—**Recovery of Silver.**—In trying to regain silver from my "silver residues" by fusing in a plumbago crucible with carb. of soda in a blacksmith's forge, I had the misfortune to break the crucible, and the liquid mass containing the silver got dissipated among the surrounding coals. The cinders I collected, and would feel grateful if some of "ours" could inform me if it is possible to recover the silver, and, if so, to describe the process?—A Clumsy Manipulator.

[48776.]—**Caustic Soda and Carb. of Soda.**—Will Mr. Allen kindly inform if it is possible to estimate the quantity of each—viz., sodium hydrate and carbonate of soda (Na_2CO_3) by taking advantage of the insolubility of Na_2CO_3 in alcohol—e.g., take the mixture in a dry state and digest with absolute alcohol, filter, test filtrate with std. sol. of sulphuric acid for sodium hydrate, and test filter for carb. soda. The usual barium method is not applicable for my present purpose.—Student.

[48777.]—**Lifting Power of Gas in Water.**—What is the respective lifting power in water of atmospheric air, and the different gases per cubic foot, when confined in air-tight vessels? And what books are those on the subject?—R. E. C.

[48778.]—**Self-Acting Gear for Steam Hammers.** Will some correspondent who knows kindly give opinion as to which is the best valve and self-acting gear for steam hammers, with description of the same.—Edward Turner.

[48779.]—**Legal.**—To Mr. Wetherfield.—I have sold a bicycle to a man to be paid for by monthly instalments. He signed an agreement (with a sixpenny stamp on), which says the bicycle is mine while it is being paid for, and if he fails to pay the instalments, I can claim the machine. Now, as he has not paid up for a long time, I want to know whether I can go and seize the machine at his house, as I have not had the opportunity to take it on the highway. It would be no use to sue him for balance through a court, as he has got nothing. Can I go to his house and legally demand it, or must I get official authority to do so?—New Subscriber.

[48780.]—**Crankshaft.**—The bearing of my crankshaft next the flywheel at times gets hot. It has been in use two years, about six hours a day, and it has given no trouble until lately. I took it out and cleaned it, with no better result. Sometimes a little oil will cool it, at other times it won't. Will anyone tell me what to do to it?—A Driver.

[48781.]—**Pumps.**—I have two plunger pumps driven by gearing, and every time the suction-valve closes they make a thumping noise, and the suction-pipes shake very badly. Could any of our readers who has had anything to do with pump, tell me how to stop the noise and keep the suction-pipes from shaking? The pump sets as firm as a rock.—A Driver.

[48782.]—**Watch Repairing.**—How is the hair-spring fastened to balance-wheel of Geneva watch? Having had misfortune to break off in cleaning, and cannot see how to replace, must I take old spring for size of new one, or, are all made one size? How can I tighten regulator round the jewel-cover as it comes off when trying to put balance-wheel in position?—H. Fay.

[48783.]—**Graphic Methods.**—I wish to obtain a work, if such exists, enabling me to understand the graphic representations of scientific facts and calculations. They seem to be used in all branches of science, but I fail to see the why and wherefore of the methods employed. Any information will be thankfully received.—J. C.

[48784.]—**Photographic.**—Will some kind photographic friend tell me of a ready means of precipitating silver in a metallic form from gelatine negative and silver print fixing baths in a way that as much as possible may be made of the residues?—J. C.

[48785.]—**Tension of Warp Beams.**—In the *Inventor's Record* issued Nov. 6th, 1882, there was a patent offered for sale for maintaining equal tension throughout the entire length of the warp, without either weights or springs applicable to any kind of loom. If any of our readers could inform me how this is done, and give me a drawing of same, I should feel greatly obliged, and I am sure many others of our readers would also.—T. H. W.

[48786.]—**Piano Soundboard.**—To Mr. Davies.—I have made a piano back and have got on the wrest plank and cross pin piece, I have also jointed up the soundboard, but I am now at a standstill as I cannot get at the right thickness to plane the soundboard to. I thought of making it ⅜in. at bass end and a trifle thicker at treble, but I am told it should be thinner at treble end. Will you kindly inform me which end of soundboard should be the thicker? And also, should the soundboard be stouter for a trichord than for a bichord?—Sam.

[48787.]—**Discharge in the Ears.**—To Dr. Edmunds.—Does not this indicate a disease? I was eager to see this fully answered, as I had a son whose right ear discharged much, and we used to witness very like a discharge coming from his mouth at night when asleep. He had this for some time. He used to look pale and thin when he arrived at 15 years of age. He was taken ill and died within four or five days. He was full of spirit and life. The doctor opened him to ascertain the cause of so sudden a death, and found that the stomach was perforated. He could not say if it was caused by typhoid fever, or by tubercular disease; but the doctor, who had known the boy for years, said it must have been the latter, as he foretold his death at 17 years. Now, I have grieved much for not having had the running from the ears seen to; but I had the same thing when a boy, but grew out of it, and thought he would. But why I wish to know more of the matter is, I have a girl aged 9 years, who is in the same way, and the ears smell very strong indeed. I should be glad to know if there is a remedy, as I am afraid of losing her; she has the same appearance.—An Anxious Father.

[48788.]—**Pianoforte Bridges.**—I observe that in old pianos the bridge is made in one piece, whilst in modern instruments it is made in two distinct parts. Can anyone inform me what is the improvement effected by separating the two bridges? And also, why is the bridge which carries the covered strings curved in form, instead of straight, as in the older instruments.—Apollo.

[48789.]—**Scented Soap.**—For more than twelve months past I have successfully made all the soap required for my private family use, working by instructions given in a former number of the "E.M." Lately I have tried to scent the soap, but with indifferent success, as the scent I got passed away far too quickly. Can any of your knowing contributors tell me of any suitable essential oils that will give a scent permanent enough to leave a pleasant smell in the clothes after the wash, instead of the soapy smell, as is usually the case?—Cock Robin.

[48790.]—**Watchwork.**—Will any reader kindly inform me cause of Geneva stopping? It will go in any position when at rest, but in taking it from or putting it sharply into the pocket will cause it to stop. The hair-spring is in good condition, and balance does not foul, but has a great deal of freedom in pivot-holes. Also, what kind of tools are required for preparing and fitting in new pivots.—Dial.

[48791.]—**Legal.**—To Mr. Wetherfield.—Will you kindly inform me what is necessary to do to convert a copyhold plot of ground and two old cottages into a freehold? A quit rent of some 8s. per annum, used to be paid, but no claim has been made by the lord of the manor for many years, but who now sends in a claim for a small amount? I may mention that when a new life used to take possession £20 or so had to be paid; but of late years it had passed from one to another by will only.—A Subscriber.

[48792.]—**Rheumatism.**—To Dr. Edmunds.—Will you kindly give me advice for my wife, who is suffering from rheumatism and weakness? She has been like it for months, and has had medical advice, but don't get any better at all. Her joints are very much swollen, and she is hardly ever free from pain, and seems much worse at night time; her age is 22. We are living in mid-Sussex. Perhaps you will kindly advise me what to do.—An Anxious Husband.

[48793.]—**Copyright.**—To Mr. Wetherfield.—(1) In publishing a pamphlet containing extracts taken from English copyright works, is it sufficient to mention "so-and-so says," or is it necessary to state the title of work in addition to author's name? (2) Are copyright works published in America protected in England?—Copyright.

[48794.]—**To Mr. C. Stretton.**—Will Mr. Stretton say what the difference is in the large ejectors that are being put on M.R. engines? I see they are taking off the upright ones and putting smaller ones on to lie alongside the boiler, and the handrail fits into them. Also, will he say what pressure there is on the wheels when the brakes are put on.—T. Morgan.

[48795.]—**Ringworm.**—I shall feel much obliged to Dr. Edmunds if he will kindly tell me how to cure ringworm in a child's head. I applied iodine until I believed that the ringworm was destroyed. I now wash the head twice or three times a week with pure soft soap and warm water, and rub ointment on the parts night and morning. Still, the skin does not heal; it is covered with small pimples, and feels hot. I have taken her to see a doctor, had a bottle of medicine, and the ointment for her, but they seem to do no good. The child's head is now in the same state as it was two months ago. A word of advice will be thankfully received.—A Mother.

[48796.]—**Ancient Astronomy and Arabic Star Names.**—Do translations into English or French exist of Ptolemy's "Almagest," Hipparchus' "Commentary on Aratus," Aratus' "Phenomena," and of Manilius? Also, where I can find detailed information of the meaning of the Arabic names of the stars? and also concerning the various names borne by stars and constellations in the different countries of the globe. —Spica.

[48797.]—**Gelatine Enamel.**—Could anyone tell me how to get up that beautiful enamel so often seen on showcards? I believe it is gelatine prepared in some special manner, and poured over the cards.—Litho.

[48798.]—**Legal.**—Can anyone inform me if a man dies in a state of insolvency, whether it would prevent his will being proved, or what special causes would do so? Also, cannot solicitors be made to show people the deeds they have been induced to sign, and any they wish me to sign.—Good Will.

[48799.]—**Sundial.**—Will "F.R.A.S.," Mr. Lancaster, or other correspondent, kindly describe the construction of a sun-dial, especially the rules for graduating it, the proportionate size of the gnomon, and best diam. for the dial itself. Please give every detail: both of construction and of putting into position, with working drawings to scale? The latitude is 54.39 N. I would like to put on it compass points, signs of the zodiac, days of the month, and to how much a clock is fast or slow compared with it on any particular day. If these were transferred from the "horizon" of a globe 12in. in diam., would the dial have to be 12in. in diam. also?—Solar Time.

[48800.]—**The Great Comet.**—Can any correspondent say if it made the transit of any star with its nucleus, and if so, was the star visible or obscured, with all particulars?—Solar Time.

[48801.]—**Projectiles.**—If two bodies be projected from the same point at the same instant with velocities v and v_1, and in directions a and a_1, show that the time which elapses between their transits through the other point which is common to both their paths is equal to $\frac{2 v v_1 \sin(a - a_1)}{g(v \cos a + v_1 \cos a_1)}$. "Earnshaw's Dynamics," p. 356. —Vis Viva.

[48802.]—**Photos. for Stereoscope.**—Are any instantaneous photographs of breaking waves, waterfalls, &c., taken for use with the stereoscope?—B.

[48803.]—**Locks.**—(1) Is there any lock suitable for an ordinary writing-desk more convenient and secure than that in general use with, I think, a hook to it? If not, can any reader suggest how a desk with such a lock on can be securely fastened as against inquisitive people? (2) The locks on Gladstone bags seem all capable of being opened by a single key. Can this be altered without substituting another lock? If not, what would be a suitable form of lock? (3) The lock on my bag does not firmly close the ends of the bag. Can this be remedied by a small strap at each end, or is there any better way of effecting the desired object?—B.

[48804.]—**Carnuba Wax.**—Can Mr. Allen kindly inform me of some method by which waxes (especially Carnuba wax) can be detected and roughly estimated in samples of soap? I have his Vol. II. of "Commercial Organic Analysis"; but have been unable to find a method described for their estimation, or to elaborate one myself from the facts and data given. The saponification method does not answer, for the reason, I believe, of the insolubility of the resulting alcohols in cold ether, cold alcohol, and bisulphide of carbon. Also, largely, from the fact that the wax would only be present in small quantity, say 5% or so, upon the total fatty acids. I have also tried benzol and petroleum spirit as solvents; but the results have not been at all satisfactory. I find the separation of the solvent from the aqueous solution, &c., in the separator a great trouble in manipulation. On agitation, a magma of solvent, insoluble alcohol, &c., and aqueous solution, results, from which I have been able to separate the former (in the case of solvents lighter than water) only with great difficulty, and then imperfectly. Any information Mr. Allen could give would be very gratefully received by—Perplexed.

[48805.]—**Renovating Cabinet.**—I want to improve the shabby exterior of a cabinet which was originally painted and varnished. Had I better repaint and varnish it, or can I give it a finer appearance in any other way? How must I proceed in either case?—Learner.

[48806.]—**To Mr. Wetherfield.**—A farmer dying holding a farm on yearly tenure under an agreement of twelve months' notice to quit, either by landlord or tenant—are his executors bound by that agreement, or can they quit the farm at an earlier period?—W. B.

[48807.]—**Influence of Climate on Neuralgia.**—I am very much subject to neuralgia in the face, and I have an idea that a warmer and drier climate, like that of Australia, for example, would be better suited for me. Can any reader of the "E. M." tell me if it would be beneficial or otherwise, and what part of Australia would be best for me, or would Natal be suitable?—Gamma.

[48808.]—**Legal.**—Five years ago £230 was placed in trust with A. for B. B. marries C. C. himself borrows from A., on promissory note four years ago £50. A. absconds. Can A.'s creditors come on C. for the £50, A. still owing B. the £230? Please advise what is best to be done. Should promissory notes be renewed at any time?—Trust Money.

[48809.]—**Electrical.**—Would "Sigma" be good enough to inform me as to how many pint-size Daniell cells (ordinary construction) would give an equal constant current for intensity to that developed by a battery of four bichromate cells, pint size (one zinc and two carbons, 6in. × 2in.), during the first few minutes of its working?—U. S. F.

[48810.]—**Force of Blow.**—How many inches would a weight 15cwt. have to fall to strike a blow equal to a weight 30cwt., falling 7in.?—F.

[48811.]—**Rubber Bandages for Ulcers, &c.**—Can Dr. Edmunds recommend the Martin rubber bandage for ulcers, varicose veins, &c.—Sufferer.

[48812.]—**Work-Bench for Amateurs.**—Can "Sigma" conveniently give sketch and details of the joiner's bench he described in last week's "E. M."? I was very much interested by his remarks, and I am pretty sure I could see the principle of the thing; but his instructions for insuring stability as a working bench were by no means clear to me. As I have no doubt there are others in the same difficulty, perhaps "Sigma" will be able conveniently to give your readers more detailed information. I should also like him to say whether his bench will, without straining, admit of the planing of very rough stuff.—Amateur.

[48813.]—**Estimation of Copper.**—I think Fresenius states in his "Quantitative Analysis" that Ullgren has described a small electrolytic apparatus without separate battery for the estimation of copper in single precipitations. Can any of your readers kindly oblige me with a description of this? I should also be thankful for the particulars of the estimation of copper in copper precipitate by the dry way—viz., quality and proportion of fluxes used, &c.?—Cupric.

[48814.]—**Grinding Glass.**—Will Mr. Lancaster or any of "ours" kindly oblige by telling me the best kind of stone for grinding glass, such as spectacles, and how are the edges polished, or any information in the matter will greatly oblige—Anxious One.

[48815.]—**Steel.**—1. How soft can cast steel be made? The textbooks contain ample directions for obtaining different degrees of hardness—why not vice versa? 2. Can any of "ours" place on record a similar table for softness, with direction to obtain, say, the softness of tin, copper, zinc, lead, &c.—C. Harley.

[48816.]—**Legal.**—The favour of Mr. Wetherfield's reply is requested. A. (now living abroad) took a house from B. in his own name, but for use of his sister, C., to let apartments. B. made the condition that he took it for three years, but will do nothing to make it right inside or out for letting. C. cannot let to advantage because, among other things, a fire cannot be made in one set of rooms from defective chimney. Can C. do anything to get rid of the house? It is rumoured that B. has bankrupted. Would that break the arrangement? And if so, how could C. ascertain it?—Widow.

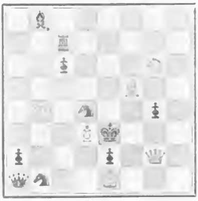
The Precious Metals in the Great West.—It has been estimated that 1,200,000,000dol. of gold and silver have been mined in the west of the United States within the last thirty years, and that, in spite of the recklessness and extravagance which characterised the two decades from 1849 to 1869, a net profit of 30,000,000dol. per annum was realised. Since 1850 the money invested, and the labour expended in mining in the West for precious metals, is estimated at 710,000,000 dol. What may fairly be called the mining territory of the United States embraces an area of 1,190,000 square miles, with a population of barely 1,500,000.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCIII.—By J. Bayner.

Black.



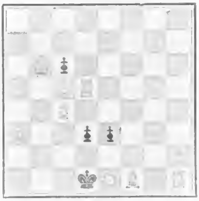
White.

White to play and compel Black to mate in two moves.

PROBLEM DCCCIV.—By S. Loyd.

(From "Chess Strategy.")

Black.



White.

White to play and mate in four moves.

(A fine variation of the "Indian" theme.)

Solution to 799.

White.	*Black.*
1. B to K R 8	1. K to Q 5 (a)
2. B to K Kt 7	2. K moves
3. Mates	
	(a) 1. K to K 3
2. Kt to Q 3	2. P moves
3. B Mates	

Solution to 800.

White.	*Black.*
1. Q to Q R 3	1. Anything
2. Mates accordingly	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 797 and 800 by Dicky Sam; to 799 and 800 by J. B., of Boxford, and P. L. Pavitt; to 800 by W. T. Bayne and W. A. Bowen; to 797, 798, 799, 800 by Celsus; to 799 by Donald Mackay.

E. C. Robinson.—Your problem has at least three other solutions? 1. Q to K 8, &c. 1. Kt to K sq (ch), &c. 1. B to K B 5, &c.

D. Mackay.—We shall be glad to have another in place of the defaulter.

P. L. Pavitt.—It is enough to give the best defences. We have replied to your other query by post.

W. T. Bayne.—In your solution of 799 you have overlooked that if 3. B to K B 6, K can take P.

Dicky Sam.—If in 798, 1. Kt to Kt 3, how do you mate if Black queens the pawn? In 799 there is no mate your way if 2. $\frac{\qquad}{\text{P to K B 4}}$. In 798 the solution is 1. R to Q Kt sq. 2. Kt to K 4, &c.

J. B., of Boxford.—We shall be very pleased if you become a regular contributor. If your problem is correct, it shall certainly be inserted.

In Problem 802, the Kt at Q Kt 7, should be King.

Holloway's Pills possess the power of expelling all pestilential humours from the human system, wherefore they become necessaries in every household at those times when fogs and other atmospheric impurities taint the blood during its passage through the lungs. The purification effected by these Pills will prevent pleurisy and chest complaints.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

We receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 804, 807.
Cements: Nos. 377, 729.
Coils, induction: Nos. 613, 620, 636, 640, 779, 797, 832, 882.
Coils, medical: Nos. 844, 888.
Copying processes: Nos. 750, 753, 761, 762.
Electric bells: Nos. 845, 858, 797.
Electric machines: Nos. 368, 380, 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Lacquers: Nos. 420, 475, 622, 808.
Varnishes: 321, 478, 619, 675, 691, 728, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 29, and unacknowledged elsewhere:—

G. Nickalls.—A. Cary.—A. Norfolk.—B. Wood.—R. S. Smyth.—C. Benson.—A. L. Kaye.—W. Coleman.—W. Gorse and Son.—Rev. H. Algar.—W. H. Davies.—G. Fleming.—A Fellow of the Royal Astronomical Society.—H. P.—W. H. Scriven.—H. J. B.—Tyke.—Charles Slagg.—E. R. Colby.—W. D.—Northerner.—Gasfitter.—W. H. Richmond.—One in a Fix.—Jumbo.—R. J. C. S.—J. S.—Respice Finem.—Prometheus.—W. G. T. Meteor.—Broken Pots.—Alfojoe.—Poppet.—Wasting Steam.—Dan Browne.—W. H. C.

A. Ll. C. (You do not appear to understand that a discovery of the kind would be worth several thousands of pounds. Many persons have been trying to find a method of converting petroleum into jelly.)—Peter. (You must turn the flywheel so as to start the engine in the direction you wish it to run. If it is a one-direction engine, the piston-rod head or cross-block has a guide only on its under surface. 2. Any of the usual black dyes, for which see back numbers.)—One in Distress. (Presumably you have tried the usual remedies; but so severe a case should be submitted to medical opinion, as there is some constitutional cause which the trained physician will no doubt discover.)—Spes. (Dr. Edmunds has already written fully on the subject—as fully as possible in general terms. Anything more must be purely personal, and can only be said after examination of the patient. 2. "Auctioneers: their Duties and Liabilities," by R. Squibbs, published by Lockwood and Co., Stationers' Hall-court, E.C.)—J. T. H. (It consists of a case of thin elastic metal, from which the air is exhausted. A little rack and pinion actuates the index as the increase or decrease in the atmospheric pressure affects the case.)—H. W. Woolf. (Do they not say of what it is made, nor yet give the E.M.F.? At any rate, the replies would be too much like advertisements.)—Tyro. (Surely you can find something that will suit, even in recent numbers.)—Paterfamilias. (A remedy was given by a correspondent in No. 867, p. 212.)—D. R. Smith. (We know no more than was given in the paragraph. 2. As the "chemists" do not know you had better try dealers in dyestuffs. The preparation of vanadate of ammonium is described in most of the standard works on Chemistry. 3. Payen's "Industrial Chemistry" contains an article on the manufacture of glucose. It is published by Longmans. The other question is beyond our province. An advertisement in the "Addresses Wanted" column would probably produce several answers.)—Musician. (See list of back numbers in this column Nov. 10.)—Garnet. (We cannot possibly say what was wrong; but the method is certainly that adopted by the trade. We suspect you have not boiled the solution long enough. See p. 302, No. 847.)—A Constant Subscriber. (Very little; none at all where the immersion alters. The vessel was illustrated in No. 89, and a number of particulars were given in Vol. XIV.)—Smoker. (Use the best ink, and a little liquid ox-gall. Your ink cannot have been the best.)—E. A. Lucas. (What sort of draughtsman? If in an architect or engineer's office he might probably obtain a situation without paying any premium, and with energy and industry work his way up. He has, of course, some knowledge of drawing, and has possibly attended a school of art? If not, he had better do so.)—H. Howard. (The so-called "Tobin's" system has been described years ago in these pages. Write to the Sanitary Engineering and Ventilating Co., 115, Victoria-street, Westminster, for their illustrated prospectus.)

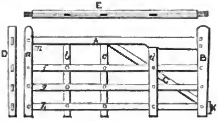
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 8, 1882.

HOME CHIPS.—IV.

Gates.

A FIELD-GATE, though in one sense it is a large edition of a wicket, has certain peculiarities which isolate it from smaller structures of that kind. It is a rather weighty affair, and from the way in which it is hung it has a constant tendency to sag down, which in nine cases out of ten eventually prevents it from shutting properly, however well it may seem to be hung when new. A field-gate is not, as a rule, an amateur's work at all; but full many an emigrant is obliged to learn to make them, and very soon finds himself able to do so as well as a professional. I knew a young fellow who set out one day rather in a hurry to New Zealand without first counting the cost, and had it not been for gate-making he would have had a hard fight for bread and cheese; but his "home chips" had given him some insight into his work, and he was able to earn a living by it in the Colony. "Home Chips" may become of very great service in other cases of the kind, and there are, in fact, a great number of everyday wants, far more worth the trouble of supplying from the amateur's workshop, than the merely ornamental articles which are generally the staple of home production. A field-gate is usually from 8 to 9ft. long, by about 3ft. 6in. high. It has in the present day to admit engines and threshing machines "et id genus omne," and is consequently somewhat wider than was requisite in our forefathers' days, when the harvest-waggon was the widest implement that demanded admission. The frame consists mainly of a top bar, A, and heel-post, B, by which latter it is hinged to the gate-post. But to prevent the sagging that would inevitably take place otherwise, a diagonal strut, C, is added, which has its two bearings in the aforementioned heel-post and rail. These three pieces of timber form a gate without additional rails, and are so used now and then in the Colonies; and in all cases, if understood, they will be seen to form the main framework, upon which the stability of the whole gate mainly depends. In such a framework the downward tendency of A, caused by its weight, is carried by the strut C to the bottom of the strong heel-post B, and the only weak point is at A, supposing any one to sit at the end of the top rail, or any undue downward pressure to be brought to bear at that part. If there is a fracture, it will probably be at A; but the triangular framework behind A is secure and strong. Knowing this to be the case, it would be supposed that all care would be taken to make these elementary details sound and strong, the rest being subservient to, and depending upon them for strength and support. But practically, such is not by any means the case. It so happens that I have had to renew a field-gate recently, and out of curiosity I have thoroughly examined both the old and new one, both, be it remembered, the work of practical carpenters—men who are constantly so employed, and on whose work our various buildings depend. Taking first the old gate (which is better than the new, or was so when made, as the one is of oak, and the other of deal) I notice that all the mortises in the top rail, which were cut to half the depth of the stuff, are broken out—the whole boundary strip having apparently come away entire, exposing all the tenons. No doubt, in originally driving the tenons home, each mortise was split, which is actually the case with the majority of those in the new gate. I have seen this done so often that it seems almost a rule, and no wonder such fracture occurs, for I also notice that in the new gate the rails *f g* were too thick to enter, and were at once thinned down wedge-shaped, and so enabled to be forced in, but with the result stated. Again, in both gates the strut C is mortised into the top rail—nailed to the other two, and does not even touch the heel-post. It is thus a mere sham, so far as it is supposed to act as the main strut between A and B. Its lower end, where the end grain is exposed, will soon get the benefit of the rain, which will run down B and C into the angle formed by the two, and the part will rot away, rendering still wider the interval between them. Instead of this, both ends of the strut should be mortised into A and B respectively, and a good close joint made, and if the tenon and mortise had a little paint laid on before being put together, it would be all the worse for the carpenter and better for the employer. When making "home chips" these little matters can be attended to. The dimensions and scantling are as follows. A and B and *a* are cut out of 3in. deal plank, which, if it is painted or tarred, will last a long time. A is 4in. wide for the greater part of its length running to 7in. as it approaches the heel-post. B is also 7in. at the upper part, gradually sloping downwards to 4in. C is but 1in. thick and 3½in. wide, being cut from the inch board of which the horizontal rails *f*, *g*, *h*, are also made. *b*, *c*, and *d* are also 3½in. by 1in. B, E, and the strut C are on the further side of the horizontal rails, but *d* is on the near side, and this appears to be the most usual arrangement. The front post, or head post as it is called, *a*, is 4in. wide and 3in. thick, like the top rail. *a*, *f*, *g*, *h*, are mortised into it, the mortises being cut quite through and all joints pinned together. The rails *f*, *g*, *h*, are nailed to *b*, *c*, *d*, with the large-headed gate nails made on purpose for such work. In marking the mortises of such a gate as this, those intended to receive the ends of *f*, *g*, *h*, and that of the top rail A, are to be central and in the same plane; but in marking the mortises in the top rail for *b*, *c*, *d*, it must be remembered that the latter are not in the same plane as the horizontal ones, but are on one side; and this is to be allowed for. They must be marked on one side of the centre, the distance from it being 1in., because the horizontal rails are of that thickness. Thus D may represent the mortising of the head-post, and E, where the mortises are black, those of the top rail. Now, in one of the gates alluded to, this has not been done, and the three rails have been forcibly bent round the last upright post *d* to enable them to be got into the mortises in the heel-post B. The block K is a separate piece nailed on to bring the bottom of the heel-post in a perpendicular line with the top, the lower hinge being fitted at that place. The object of making the top rail, and also the head of the gate wider, is to give a better bearing to the large hinge, upon which the gate chiefly hangs. At this upper part, the tendency of the weight is to pull the gate away from the hinge and hinge-post, for which reason the upper hinge is bolted through the top rail, which it embraces between its arms. The lower one is, however, only thrust back towards the post, and there is no tendency to tear it off the gate, nor to pull out the hook on which it swings, except when the gate is allowed to open so far as to swing back until it strikes the post, which thus becomes the fulcrum to a long lever. It is by this carelessness that many a gate is destroyed, and a post should be driven behind it to prevent any such possibility. It will be observed that in this gate, *b*, *c*, and *d* are, in reality, mere light bars, 1in. thick; but it used to be the common practice to make them as thick and wide as the head-post *a*. These lighter pieces are decidedly the better, because there is no object in making the head beyond the stay or strut *c* heavier than necessary. The lighter the gate at this part the better, if it is sufficiently strong to bear the blows and shock of slamming against the fixed post when flung violently to, which is the common but stupid practice of rustics who have not to pay damages. A gate should be so hung as to fall gently shut by its own gravity, but this also gives it a tendency to fall violently back after it has passed the perpendicular to the line of the gate-posts. The post recommended as a stay should be, therefore, driven into the ground, only a little distance beyond the perpendicular line, when a slight impetus will cause it to shut. The strut C is generally made to enter the top rail at about the centre of its length, as shown here. The mortise need not be deep, because there is no tendency in the tenon to draw out of the rail, but, on the contrary, to set deeper into it. Instead of meeting the top tail at the part shown, it is often carried to *m*, under the idea that, so placed, the gate must be stiffer, because the whole top rail is supported. This, however, is not the case, as the angle the strut makes with the rail is thereby diminished. If, however, the gate were to end at A, instead of being so long as it is, this arrangement would be quite satisfactory, and the structure would be very stiff and strong. The principles upon which a gate is constructed are such as apply to many other wooden structures, the rigidity and strength of which depend mainly upon the arrangement of the various diagonal braces. But in amateur work these are often so placed that they cannot in the least add to the stiffness of the framing, and not a few carpenters make similar mistakes. In all such framing we have to consider the direction of the force tending to fracture or displace the timbers, and to consider the nature of the strain to which they will be subjected. For the purpose of "home chips" or field carpentry we do not need a deep knowledge of mathematics, but merely a little quiet consideration of the work in hand. Taking this gate as an instance, we may consider B a fixture upon which we have to construct the rest of the framing, keeping in view the intended purpose of the finished structure. We need not consider at present, however, the fact that the gate has to open. We begin by fitting on the top bar A, and secure it to B by a tenon. Now, A is a comparatively heavy affair. We should consequently make the tenon broad and deep rather than wide, or we divide it and make two tenons, and pin the joint through with good oak trenails. What is now the nature of the strain? It is perpendicularly downward, centring about A; but as we have pinned the mortise at one end of the rail, this is the weak point, and becomes a centre of motion about which the rail tends to turn. Now we should always hunt out the weak points of framework, because it is there that breakage will eventually occur if not in some way guarded against. In the present case, not only does the weight

FIG. 8A.



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of the bar set up a destructive force upon the joint by which it is secured to the heel-post, but the whole of the rest of the gate or framework will be hung practically from this top rail, adding to the latter additional weight and destructive force. Our object is, therefore, to counteract such force by altering its direction, and instead of allowing it to act perpendicularly, we contrive, so far as we can, to convert it into a horizontal thrust against B, which thrust will be borne by the gate-post eventually, to which the entire framework is attached by its hinges; and the nearer we can bring the thrust to the bottom of such post, the more will be the power of the latter to resist and sustain it. The strut C is therefore our next consideration, and we can see at a glance that it ought to have a good bearing at both ends, when it will convey to the bottom of B the downward thrust of A, converting it into a horizontal thrust, or nearly so. A, B, C now also form a truss or complete triangular structure of great strength. The point A is now rigidly supported, and no weight applied at A can destroy the frame thus constructed, unless it is sufficient to bend or crush C, or tear out the tenon by which A is attached to B. When we add the head-post A, this does not affect the top rail beyond the strut, and if we suppose it very heavy indeed, it could only break the rail at A, where the mortises render it rather weak. Practically, its weight is next to nothing. We tenon A into *a*, therefore, because we need an upright post here to support the horizontal bars to keep back cattle. The weak point is at *m*, as we should find by taking hold of the bottom of the headpost, as we could easily move it from side to side; we therefore add a rail *h*, pinning its other end to B. This secures the head-post: *f* and *g* add a little to the strength, but are chiefly necessary to keep back sheep and smaller cattle, and, to stiffen these, horizontal bars *b*, *a*, and *d* are added. But these do not add much to the strength of the gate; and it is *not*, after all, very strong when the bottom rail is as thin as 1in. All the forward part beyond the strut can be readily shaken sideways, by taking hold at A, and though we use a gate as a bit of fencing, it is not capable of resisting much side thrust. But here the gate-post comes to our aid, against which *a* rests.

(*To be continued.*) J. L.

REVIEWS.

The Sun: its Planets and their Satellites. By Edmund Ledger, M.A. London: Edward Stanford.

IT is not often that we find a course of Gresham Lectures published in book form, and we are afraid that many of the lectures delivered in the College in Basinghall-street do not attract any very large audiences. Since the Rev. E. Ledger has held the post of Gresham Lecturer in Astronomy he has done much to attract an audience, and the course of lectures on the Solar System, which have been delivered within the past two years, have been collected, and, by the assistance of the Gresham Committee, published in a handsome, well-illustrated, and readable volume. The descriptions given by Mr. Ledger of the planets and their satellites, necessarily contain the elementary facts to be found in any text-book of the science; but they also contain information which has been more recently announced, or which is less familiar, and that is discussed at greater length than the rudiments. Mr. Ledger has freely consulted all the best-known works in preparing his lectures, and acknowledges the assistance he has personally received from many of the most distinguished astronomers; his work is, therefore, not only a popular exposition of the solar system, but is well fitted for educational purposes, in the training sense, especially as references are supplied to works where further information can be sought. The illustrations accompanying the text are less numerous than the diagrams and pictures shown by means of the limelight during the lectures, but they are still sufficient for the purpose, and include Mr. Green's chart of Mars, and his drawings of that planet made in 1877; a coloured plate of the solar prominences seen in 1871-2; and photographs of the moon, the solar corona, and the lunar mountain Copernicus. The volume contains altogether fifteen lectures, two each being devoted to the Sun, Moon, and Earth, and one each to the principal planets, whose peculiar motions, as viewed from the Earth, are clearly explained by means of diagrams. The critic in reading through the pages will take exception to several statements, but they are almost always those of some author or observer other than Mr. Ledger, who, crediting them to their sources, is not responsible for them. Students of astronomy—especially those who havenot time to thumb the pages of the recognised textbooks—will find this book a readable treatise on a subject which is never fully appreciated in its real wonder and glory except by the observer who also understands what he sees. It will not be surprising if the majority of Mr. Ledger's readers become anxious to study the Sun, its planets, and their satellites by the aid of the telescope.

Metals, their Properties and Treatment. By C. L. Bloxam. New Edition, partially rewritten and augmented by A. K. Huntington. London: Longmans.

Although this work is only a new edition, it is practically a new volume in Messrs. Longmans' series of Textbooks of Science, for even with that common metal iron, so important have been the changes in connection with its metallurgy, that it has been found necessary to rewrite the portion relating to it, and opportunity has been taken to introduce chapters on fuel and refractory materials; at the same time, Prof. Huntington has omitted processes, however promising, which have not stood the test of time. Speaking of the basic process, Prof. Huntington describes the difficulties experienced in making and keeping the lining of the converters sufficiently homogeneous, the cementing material of the bricks being washed out by the metal. That is now overcome by practically making the lining in one solid brick, by placing a core in the converter, and running a "slurry" in, which bakes on the sides. Phosphorus, from being an enemy, has actually become a friend, for it enables a high temperature to be reached with half the quantity of silicon, and it is easily removed by the "after blow." It is actually the practice to put back into the blast furnace a great part of the slag from the converter in order to increase the amount of phosphorus in the pig-iron that is to be converted into steel. Although mechanical puddling is carried on at very few works in this country, Prof. Huntington says that the death-knell of manual puddling, "the apotheosis of brute force," has been sounded. An Appendix contains some useful tables, and there is a list of over two hundred questions for examination.

Cutting-Tools Worked by Hand and Machinery. By Robert H. Smith, M.I.M.E., Assoc. M.I.C.E. London: Cassell, Petter, Galpin, and Co.

This book is one of a series of manuals of technology, edited by Prof. Ayrton and Dr. Wormell, and is the work of the Professor of Engineering in the Mason Science College, whose aim is, while making it educational, to attempt at least to begin the elevation of the art of tool-making from its present entirely empirical to a more scientific position. In designing machines and tools, strength has been studied more than stiffness, and the tendency will doubtless continue, for so long as a machine is strong enough enough it "will do"; but it should be recognised that it is only when a machine combines strength with stiffness that it does well. The chief object of this book is educational—to guide the student into a correct method of thinking about tools, so that he may be able, when assisted by practice, to judge intelligently whether a tool is good or bad, to criticise its details, and eventually to design new tools which shall be better than their predecessors. Any work that will induce students to think, and workmen to study the why and wherefore of their tools, will surely serve a good purpose; but so far as the latter are concerned, it is essential that the author should show himself a master of his subject and familiar with all its details. Prof. Smith, speaking of planes, says that "iron stocks are becoming common for them in America, and to some extent are already used in England,"—a statement that would have passed without criticism some years ago, but which will surprise the younger generation of cabinet-makers and joiners. Figs. 10 and 11 illustrate two well-known forms of iron plane; but we do not find any description of them, probably because they are well known, although only "becoming" common in America. The book is illustrated with a number of small engravings, and fourteen folding plates, mostly of actual machines, drawn to a scale. Prof. Smith probably expects his statements to be criticised, and as there are many amateurs, besides workmen, who are competent to undertake the task in certain points, we recommend a perusal of his pages to all interested in cutting tools.

We have also received *The Great Pyramid, Observatory, Tomb, and Temple*, by Richard A. Proctor (Chatto and Windus), in which the author gives a reasonable explanation of a building which others have endeavoured to make mysterious. "Certainly meant to be a tomb," he says, "it was obviously intended to serve as an observatory, though only during the lifetime of its builder. It was also associated with religious observances."——*Rudimentary Astronomy*, by the late Robt. Main, M.A., third edition, revised and corrected by W. T. Lynn, B.A. (Crosby Lockwood and Co.), is a reissue of a well-known treatise in Weale's series, as cheap as it is good.——*A Treatise on the Metallurgy of Iron*, by H. Bauerman (Crosby Lockwood and Co.), is the fifth edition of another well-known number of Weale's series, revised and enlarged with the introduction of descriptions of recent inventions and improvements in the iron and steel industry.——*Quantities and Measurements*, by A. C. Beaton (Crosby Lockwood and Co), is the sixth edition of a work which has become indispensable to builders and their quantity clerks.——*Stationary Engine-Driving*, by Michael Reynolds (Crosby Lockwood and Co.), is a revised and enlarged edition of a work which was favourably received on its first appearance, and which, in its revised and enlarged form, may be recommended to those who have stationary engines under their charge.——*Common British Insects*, by the Rev. J. G. Wood, M.A. (Longmans), is an abridged account of the more common British beetles, butterflies, and moths, extracted from the author's larger volume "Insects at Home," but brought up to date. It is in a handsome dress, and will form an excellent present or prize for schoolboys (and girls), especially in country districts, where the book will aid in a personal examination of the insects described.——*Hydrostatics, or Theoretical Mechanics*, by J. T. Bottomley, M.A. (Collins, Sons, and Co.), is the complement or sequel to the author's "Elementary Dynamics," and though following closely the programme of the Science and Art Department, is not confined absolutely to the subjects specified in the Directory. As the author says, there is not much scope for originality in textbooks of the kind; but it is a pity that he should introduce mathematical formulæ in an elementary book without giving a full explanation.——*Magnetism*, by THOS. P. TREGLOHAN (Longmans), is a textbook published at a low price, which follows strictly the divisions in the Syllabus of the Department, and is adapted to meet the requirements of the "first stage" of one of the physics courses of the Mundella code.——*Tables for the Qualitative Analysis of "Simple Salts," and "Easy Mixtures,"* by JOSEPH BARNES (Simpkin, Marshall), will be useful to students taking up the work of practical chemistry.——*The Electric Light Popularly Explained*, by A. BROMLEY HOLMES (Bemrose and Sons), is quite accurate enough for its purpose, and some of the author's remarks will be read with regret by those who have invested.——*The Standard of Value*, by W. J. LEIGHTON JORDAN (D. Bogue), is a brochure on "bimetallism."——*Charles Darwin* (Macmillan and Co.), is a collection of the memorial notices of the great naturalist, which appeared in *Nature*. They are by Prof. Huxley, G. J. Romanes, A. Geikie, and W. T. Dyer. A portrait of Darwin forms an appropriate frontispiece to a "memorial" which many will be glad to possess.——*Handrailing and Staircasing*, by FRANK O. CRESWELL (Cassell) is a little volume of the publishers' "Technical series," which is intended to help those who are ambitious to become "staircase hands" in the joinery branch of the building trades. A complete set of lines for handrails by "square-cut" system are given, with instructions for making and fixing geometrical staircases. The book is illustrated by over a hundred working drawings.——*Uniplanar Kinematics of Solids and Fluids*, by GEORGE M. MINCHIN, M.A. (Clarendon Press), is intended to supply a deficiency in the course of mathematical physics generally pursued by students in the higher classes of our colleges and universities. Mr. Minchin thinks it desirable to include as much as possible of the application of mathematics to physical problems; hence, a large portion of this work deals with the theory of fluid motion and electric distribution and flow. The volume will, we do not doubt, be welcomed by all who are interested in the study of experimental physics from the mathematical side.

A NEW EXPLOSIVE.

A NEW explosive, the products of which are of a comparatively harmless nature, has been recently patented in this country by Dr. C. W. Siemens. The invention is a communication from Dr. Carl Himly and Herr L. von Frützschler-Falkenstein. The new explosive is a mixture of saltpetre, chlorate of potash, and a solid hydrocarbon, and is suitable both for mining purposes and firearms, while, if ignited in the open air, the combustion takes place slowly and imperfectly, and therefore without danger. The incorporation of the ingredients is by preference effected as follows:—

The saltpetre, chlorate of potash and hydrocarbon (for which may be taken paraffin, asphaltum, pitch, caoutchouc, guttapercha, &c.) are mixed together in pulverulent form by passing them through sieves or otherwise, and the mixture is then treated with a liquid volatile hydrocarbon, which acts as a solvent to the solid hydrocarbon. A plastic mass is thus produced, which is then formed into cakes or sheets by passing through rollers or otherwise, and is rendered hard by evaporating the liquid solvent used, the sheets or cakes so produced being then converted into grains or pieces of any desired size, in the same manner as ordinary gunpowder. Or the cakes or sheets may be conveniently brought, while still in a plastic condition, under stamps having cutting edges arranged in polygonal form so as to divide the mass into separate grains of corresponding polygonal shape, which are then rendered hard. By this mode of dissolving the hydrocarbon before or after admixture with the salts the great advantage is obtained of providing the particles of the latter with a waterproof coating of varnish of the hydrocarbon, more particularly when caoutchouc or guttapercha is used, thus protecting the compound from deterioration by moisture. The process is also simple and free from danger, as, if the pasty mass should catch fire, the volatile hydrocarbon will first burn away entirely, after which the powder will enter into slow combustion. In addition to the above mentioned advantages of freedom from danger in its manufacture and transport and from hygroscopic properties, as also the comparatively innocuous nature of the products of combustion, it may be mentioned that the compound leaves only a small solid residue which is as innocuous as the gaseous products, and that the combustion in a confined space is complete, yielding very little smoke, which rapidly disappears. Futhermore, the new compound, which has about the same density as ordinary gunpowder and is very hard, possesses with equal volumes more than double the explosive force of the latter. The intensity of explosion can be regulated at will by varying the proportions of the ingredients and the size of the granules. These proportions should, generally speaking, be such that for each volume of the hydrocarbon, when converted into a gaseous state, there shall be present in the other ingredients three volumes of oxygen.

TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

A VOLTAIC current sent through a conductor causes, by induction, it is well known, a contrary current in a closed parallel circuit that is near. On removal of the inducing current, there is generated in the same circuit a current of direction opposite to that of the first. If the resistance of the induced circuit be considerable, the two currents thus generated have the character of electricity of tension, and may reproduce the effects of ordinary electrical machines. This is the theory of the Rhumkorff coil.

Such being the case, it was natural to inquire if the system were not reversible; if, in other words, on sending through the fine wire of a coil the discharge of an ordinary electric machine, there would not be generated in the thick wire an induced current of very small tension, and similar to voltaic currents.

It was in 1875 that Bichat made his first experiments in this relation. He was able, with a Holtz machine and a Rhumkorff coil, to decompose water and to deflect permanently the needles of a galvanometer. He stopped there, either failing to see all the importance of his discovery, or drawn to other work which seemed more pressing. Professor Govi, an Italian, has been engaged for some time with the subject. When he heard of the discovery of the French savant, he suspended his investigation; but perceiving that Bichat had "interred" the question, he resumed operations, and has obtained several highly-interesting results (published in the *Rivista Scientifico-Industriale*).

For the experiment just described to succeed, the electric discharges must be pretty strong. Without this condition (which is easily realised with condensers), the effects of the induced current are too weak to be easily observed. Another condition to be attended to is not to allow much interval between the inducing currents, destroying the quasi-continuity (a point of similarity to the voltaic current).

This induced current has indeed a character by which it is easily distinguished. Instead of being really one and continuous, it is double and discontinuous. When the spark passes, an induced current is generated in one direction, and immediately after passage of the spark, there is another current of opposite direction. But the rapidity of the electric discharge is such that practically these two currents seem to make but one. Another cause of discontinuity is the discontinuity of the inductive sparks themselves. Apart from these features, the generated current behaves quite like the currents produced by batteries with liquids.

Its tension is very small, and then it does not give a spark even with the least interruption of the circuit. On passing the current through the acidulated water of a voltameter, decomposition occurs, and under each test-tube a certain quantity of gas collects. As the current is continually reversed, the gas is a mixture of oxygen and hydrogen, the proportions of which vary in each experiment. By regulating suitably the resistance in the induced circuit, a means may be found (it is thought) of eliminating one of these two currents, and so of separating the gases one from the other.

On putting a galvanometer in the circuit, the needle is not sensibly deflected, so long as the circuit does not present a special resistance; but if an interrupter be introduced (a Froment vibrating reed, e.g.) the needle is suddenly and permanently deflected, and this deflection is so considerable as to inspire the hope of being able to utilise the induced current.

If one of the rheophores be connected with a file, and the other drawn over the rough surface of the file, one obtains a track of reddish light like that produced on repeating the experiment with a voltaic battery. This phenomonen is not that of the spark: it is due to particles of iron and carbon, which, under action of the current, are detached from the line, fused or volatilised, and forming a sort of bridge between the asperities over which the rheophore is drawn.

If the two rheophores, each terminated by a very fine point of carbon, prepared for the voltaic arc, be brought into contact and then separated, one immediately sees a jet of electric light, similar to that furnished by the Gramme machines and batteries. On repeating these experiments with a conducting wire and a bath of mercury, a luminous arc is obtained, due to incandescence of mercury vapours; this arc is less brilliant, but more durable.

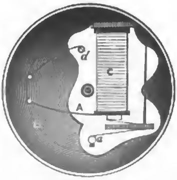
The induced currents circulating round a cylinder of soft iron produce in it rapid magnetisations in two opposite senses, as may be demonstrated, either by the magnetic spectra obtained with iron-filings, or by the vibrations of a very mobile and very light slip.

Lastly—and this experiment is the most curious of all—the induced current generated in a Rhumkorff coil by the electric discharges may be sent into a second coil like a battery current, and will produce in that long sparks, with which all the phenomena of the Rhumkorff coil may be repeated.

These, then, are the chief results obtained in transformation of static electricity into dynamic currents. What may the future of this discovery be? If, with the small Holtz machine, which served as exciter of the current in these experiments, Prof. Govi was enabled to decompose water, redden a bad conductor, and produce the voltaic arc, we need not despair (says M. Battandier in *Les Mondes*), of obtaining powerful currents with improved apparatus, and that with a less expenditure of force. "We may even, perhaps, by multiplying or better insulating the discharges of atmospheric electricity, become master of this fluid, so capricious and menacing, and turn it to domestic use."

BINKO'S IMPROVED ELECTRIC BELL AND BATTERY.

AN improved form of electric bell has been recently patented in this country by Mr. H. Binko, of Queen's-road, South Harnsey, the invention being a communication from M. J. Siegel, of Brünn. As a rule, electric bells are so constructed that the armature is attached to a springing plate, and carries a long projecting arm and knob called the hammer, so as to reach the fixed metal dome called the bell. Such bells are usually fitted by placing the electro-magnets and armature in a wood case, leaving the hammer and bell exposed. By this invention the armature is arranged to work on a pivot or pivots, and the patentee constructs the same especially for larger bells in two parts, one of which carries the knob, and receives its action by means of a lever from the other part.. It will be seen that by this simple arrangement a more correct striking without vibration is obtained, and notwithstanding the use of a shorter hammer a much louder tone. The electro-magnet, armature, and hammer are generally placed inside the bell, and the whole fixed with its metal case on a plate corresponding to the diameter of the dome. A further important improvement is that, whereas in the usual form of electric bells the action of the hammer must be adjusted by means of a screw, by this invention it is possible to turn more or less the whole apparatus round its axis, and so use the centre of gravity of the hammer to regulate the action according to the tone required and the current available. The improved battery consists simply of a zinc rod and a cylinder or block formed of a mixture of carbon and manganese, to which is added a proportion of iron filings, oxide of iron, or oxide of copper by means of moulds and pressure. The solution is as usual of muriate of soda or salammoniac. By this arrangement a powerful and constant current is obtained. The battery acts at once by contact with the solution, and is almost everlasting, as the combination block requires only cleaning, but not renewing, after years of use. After comparative working during twenty-nine days under equal circumstances with one of the best Leclanché batteries, and one of the above construction, the patentee found that the former lost twenty-four per cent. of its strength, and the latter remained almost nominal as at starting. In the engraving annexed A is the metallic base with a standard to which the bell is secured; B the outline of gong, C Coil, *a*, being the contact pillar, and *d* the terminal.



PRACTICAL NOTES ON PLUMBING.—LIV.*

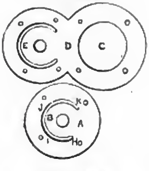
By P. J. Davies, H.M.A.S.P., &c.

(Continued from page 288.)

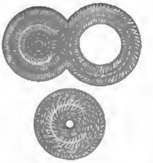
Flange Leathers and Valves.

THESE leathers are illustrated at Fig. 288 and 289, the latter of which is canvas, for hot water, &c., specially made and sold by brass finishers, pump-makers, &c. By referring to Fig. 290, at A, will be seen a flange; the leather between this flange forms the sucker valve B, for a plan of which see A, Fig. 288. When marking these leathers out, mark the valve or flat part as follows:—With the compasses strike the circle H I J K, and with the compasses as they are set, divide the circle into six equal parts, two of which are required for the hinge A; next cut the hole B. When cutting out these leathers care should be taken to cut the open part C nice and clean, or true. Of course you remember that when describing sucker boxes I explained how to treat the leather, by rubbing off all the fleshy part.

F / C.288..



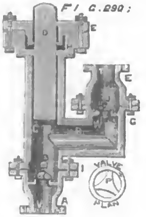
F / C.289



Feather Guide Sucker Valves.

In chemical works and earthenware pumps it is a common thing to use sucker and other valves having feathered guides such as illustrated at Q K, Fig. 290. P is a plan of the valve. The feather P must, of course, extend across the valve passage, and by so doing it blocks up the best part of the same, often to the great hindrance of the fluid to be pumped. Badly constructed water valves are often made with their valves this shape. Of course in the earthenware pump this shaped valve cannot be well avoided.

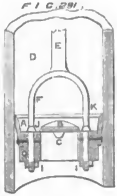
F / C.290;



Pump-Buckets.

Of these there are various kinds. The simplest, and the one generally used about London is that shown at L O P K, Fig. 277. O is the rabbet for the fixing of the leather, K is the seating for the clack, a plan, of which is shown at N, Fig. 273. A B C D, &c. Fig. 277, is the handle and bucket-rod, suitable for the above bucket. The method of fixing the bucket upon the rod is as follows:—At P will be seen a hole bored through the solid wood. Take the bucket-rod and measure upon the solid part of the bucket from P to K the exact distance from the shoulder at E, and the eye of bucket-rod for the key F, to wedge the bucket firmly upon the bucket-rod. Next make the end of the bucket-rod red-hot, and push the same through the hole in the bucket, and withdrawing it as quickly as possible, so as not to burn the hole too large; then let the rod cool, after which fix the bucket firmly upon the rod. This is done by first placing an iron washer under the key, then with a wedge-shaped flat, split pump-key such as shown at D, Fig. 281, driven into the eye, as shown at F, Fig. 277; wedge the pump-bucket firmly upon the pump-rod, after which turn the ends of the key round in such a manner that it cannot work out, nor scratch the inside of the pump-barrel. Also see that the head of the split key is driven in far enough, so as not to scratch the barrel.

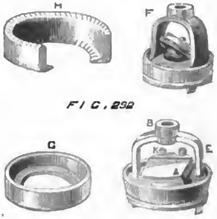
F / C.291.



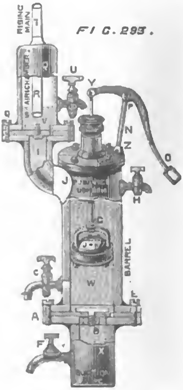
Short Buckets.

These are much used in the West of England and in many provincial towns and villages throughout the country. For this kind of bucket see P, Fig. 277, also Fig. 291. Q is the wood bucket, whereon the leather A is nailed; E the pump-rod. The bucket is attached to the pump rod by means of the two forks F J K known as the languet, and is fastened with rivets, screws, or other equivalents, as at I. This kind of bucket is generally used in wood pumps—in fact, I have never put the long wood bucket, as shown at L P, Fig. 277, into wooden pumps. We generally take the old one out, and send it to the wood-turner's to have one made to pattern, because there are so many different sizes in the bore of these pumps. Next, we have the brass or gun-metal pump bucket, as illustrated at F and E, Fig. 292 These buckets screw on to the end of the pump rod at B and F; such pump rods are, as a rule, made of copper. They work through a stuffing-box, as shown at K, Fig. 293, the one end being screwed into the pump bucket at G, whilst the other is connected with the lever at Y. G, Fig. 292, is the cup leather, and H is a quilted cup bucket, and is fixed as shown at D, Fig. 293.

F / C, 292



F / C. 293.



(To be continued.)

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CART AND WHEEL-MAKING.

By J. Charles King.

(*Continued from p. 197.*)

PROPORTION has been designated as science displayed. Compensation may be regarded as science woven into toil. In few operations of simple handicraft does compensation claim critical exactness and manipulative dexterity more than in spring-making. The plates are not drawn gradually at each end from their middles, but for a short distance only back from their end, as shown by the list of measures (page 197), the reason for this being, the necessity of leaving the spring-plate its full substance at the spot wherein the "slit" and "stud" have to be punched: as this operation obviously weakens the plate at that point where compensating strength has to be left in the "undrawn" plate; if punched in the drawn part of the plate, they are faulty. Of course springs would be better if these "studs" and "slits" could be dispensed with; but in their action they are necessary to prevent the plates overlapping each other by shifting on the centre bearing sideways. Now, to punch up a stud from one side of the steel about the size and form of a young pig's teat—this stud to work in a recessed channel about 1¾in. long in the next plate, is an operation needing precision and care, with dexterity which the eye of an observer must be keen to note, as the stud and slit are both punched at one heat. Fig. 1 shows side view of two plates, with the slit on one plate, and the stud on the other. A is the hollow shell-hole which has been punched up on the opposite side of the plate to the height of from ⅛ of inch to ¼ of an inch. B is the recess or concealed slit (so called from its being only a recess on one side of the plate). This stud fits in the middle of B, with just enough space sideways to admit the stud moving from one end of the slit to the other, as the plates lengthen and shorten in their yielding action of the spring. The tools used to enable a smith to work to such exactness are always shop-made tools, and are termed spring-plate gauges and dies, "slit" and "nib" punches (the words "nib" and "stud" are used with the same meaning). In the diversity of weights of carriages arises the necessity for steel plates of different widths; thus, the gauge has to be made so as to admit regulating the width of steel to make it always central over the die and under the punch, and yet of strength to admit its being used under the action of a sledge hammer. Various forms of bolsters are made to fit into the punching-tools for punching holes. Fig. 2 is an end elevation of a gauge to fit into the square hole of the anvil-top at A, which has a hole vertically down its centre, as shown by dotted line from B; this is to let out the punchings, or scales off the steel. C C are two upright stems, welded on to the bottom, D; they are of 1in. square iron, tapped and nutted at F F; these hold the guide-piece G for the punch. P is the punch of 1in. square steel passing through the head or guide, with easy but correct fit; on the bottom of this punch is a double-shouldered punch-point; the upper one allows the smith to see and feel his work of punching, the lesser and lower shoulder is the one which is stamped down on the plate, taking as small a bearing as possible, so as not to kink the plate, and forming the stop for the punch S. B is a movable "bolster" of steel; the side screw L forms the gauge against which the steel rests in working it through the tool under the punch. A similar tool is used for the slits and nibs in the spring, with movable bolsters for various dies and punches. The next important tool is the spring-tongs, Fig. 3, the spring welded to the handle at A; both smith and mate have a pair, as well as ordinary tongs, ready for instant use. Their obvious use in saving the toil of tightly gripping with the hands will be recognised by all who have had such work to do as nipping springs tightly together. The ends of the plates being drawn, the centre holes drilled or punched (nearly always one or two inches out of centre from the ends), these middle holes become the points from which studs and slits are measured, and marked off to measure, not with a rule, but with a pair of long light compasses, and a dot is punched at the exact measure-mark made by the compasses. These operations being done as described above, the lighter and more critical work of curving (called by spring-smiths "compassing") has to be done; this is curved from the finished spring-drawing sometimes supplied to the smith by the carriage-maker, but more often by the order, "6-inch span," more, or less, as wanted. The table of measures (p. 197), must be referred to as the process of curving is being done; first with the back or main plate, by tapping along the spring while *black* hot, not *red* hot, on the anvil where it may be slightly curved, or across the open jaws of a powerful vice, the jaws parted from 3 to 4 inches—never more. There is less rebound to your hammer at 2½in. apart; you must feel your work yield as you hold the plate in the left hand, and hit accordingly. A beginner would fear to strike the plate with the force with which an experienced workman would, blow after blow, as if it would smash the steel over the jaws of the open vice; yet a flawed plate in curving is hardly known. The left hand's sense of feeling tells the right hand what force to give the stroke till the curve is attained. Watch that you do not get the plate "winding." "Winding-sticks" are sometimes used, but unless they are laid *square with the edge of the plate*, they will cause your work to be winding when you think it is true. For this very reason, they are used only by timid workmen, or to help weak sight.

FIG. 1.

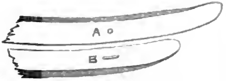


FIG. 2.

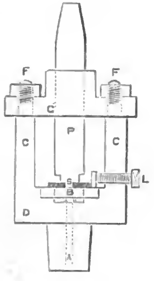
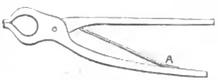


Fig. 3.



(*To be continued.*)

NEW ELEVATING TOOL-POST.*

THE elevating tool-post shown in the accompanying engravings has been made and used for some time past with entire satisfaction. The simple details of its construction will be apparent from the engravings. Fig. 1 is a plan and half-section, and Fig. 2 is a vertical section. A represents the outside, or cast-iron, shell, having a hole carefully bored, to which the nut J is carefully fitted. The steel screw E has a square thread fitted to this nut, and is used for raising and lowering the steel tool-post, C. This tool-post is fitted to the nut by a conical-shaped bearing, I, which allows the tool-post to be turned in all directions, to suit the character of the work. A steel bevel-gear, H, is attached to the bottom of the screw, E, so that by applying a wrench to the square G, and turning it, motion is transmitted through the pinion F to the gear H, thereby raising or lowering the tool-post, as desired. The tool always rests firmly upon the steel ring D in a horizontal position, so the difficulties which ordinarily appear in tipping the tool, to elevate or depress it, do not appear in using this tool-post. Furthermore, the point of the set screw for securing the tool is not readily broken, nor flattened and upset, because it always has a square bearing upon the tool. By the peculiar construction of the screw K, Fig. 1, the shell is closed upon the nut J just tight enough to allow it to move up and down by the wrench applied to the square, G.

It will be observed that the gear, and other working parts, are effectually protected against the damaging effects of chips and dirt that would otherwise get into the bearings. The working parts of this tool-post are positive and quick in their action, so that the tool may be raised or lowered, adjusting the depth of cut, without withdrawing the tool from the work and stopping the lathe. The power applied to raise the tool is applied from a common centre, which has a very rigid bearing upon the carriage; hence the tool cannot gouge into the work in changing the position of the tool. This tool-post can be readily applied to any lathe, by simply planing off the top of the slide upon the carriage and bolting the tool-post upon it by four bolts, as will be understood from the engravings. Instead of applying a tool-post to the top of the nut, when desired, the nut has a slot across the top, the same as the slide upon ordinary lathes, for the reception of a tool-post of the usual style; or an extra nut can be supplied, made in this way. The object of this extra nut is to permit the application of a vice-jaw to the top, when the lathe can be used as a milling machine. Instead of the vice, an angle-plate can be substituted, to which work can be bolted, and the lathe used as a horizontal boring machine. When desired, an emery grinder can also be used in place of the vice and angle-plate, thus converting the lathe into a grinding machine. When used as a grinding machine, the lathe shears should be carefully protected from the emery. When desired, knurled wheels are used instead of handles for elevating and lowering the tool-post, while on larger lathes hand-wheels are substituted. From the description, it will be understood that all the parts subjected to wear are of steel, while those liable to be bruised are case-hardened. This tool-post is made by C. A. Lieb, of New York.

FIG. 1.

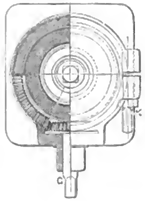
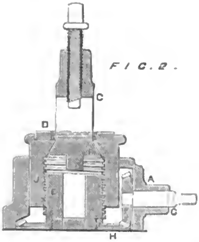


FIG. 2.



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* From the *American Machinist.*

PROF. SCHUSTER ON SUNSPOTS.

During a lecture on "Solar Eclipses" which he delivered last week in the lecture theatre of Owens College, Manchester, Professor Schuster referred at some length to sunspots. He stated that the discovery of such spots was one of the first fruits of Galileo's telescope, and from the time of Galileo's up to the present they had remained a subject of controversy. They divided the camp of solar astronomers, for while some astronomers almost worshipped them, giving them powers to curse and to bless, to others a sunspot was like a red rag to a bull. There were very few spots observed near the solar equator. The greater portion were found between 20 and 40 degrees, and they were never seen above the latitude of 50 degrees. The gigantic solar clouds which, like enormous geysers, burst through the solar envelope and were projected to an enormous distance, were intimately connected with sunspots. The flaming protuberances from the sun were generally about 10,000 miles long, and one had been observed 320,000 miles in length. In order that a body should be projected for that distance the velocity must have been 342 miles per second. It had been noticed that sunspots were at their maximum about every eleven years. We were now, after a protracted absence of sunspots, rapidly approaching the maximum, and should in all probability have reached it in seven or eight months. They would then slowly decrease in number for about seven years, by which time hardly a sunspot would be seen. Afterwards they would begin to increase, and in about eleven years would again reach the maximum. The changes were not absolutely regular, for sometimes the maximum was reached in ten years instead of eleven, and might even be reached sooner. When there were many sunspots the daily movement of the magnetic needle from the north-west towards the west was much greater than when sunspots were few in number, and there were magnetic storms and *auroræ boreales*, as had been the case recently. It had been calculated that if the sun were made of the hardest steel and thoroughly magnetised the distance between it and the earth was so great that it could not successfully affect our magnets. Under those circumstances the connection between the sun and the earth, whereby magnetic storms occurred immediately after sunspots were seen, was one of the greatest scientific mysteries of this age, and at present we were absolutely unable to account for such phenomena.

BRAIN-HEALTH.

The third lecture of the season, under the auspices of the Edinburgh Health Society, was delivered on Saturday evening, by Dr. J. Batty Tuke, F.R.C.P., F.R.S., whose subject was, "The Establishment and Maintenance of Brain-Health." Dr. Tuke said he held it to be a well-ascertained physiological fact that the brain-cells were organs which could be acted on for good or for evil, and that they were directly subject to the laws of health. Turning to the title of his lecture, Dr. Tuke remarked that it involved consideration of the most intricate and difficult social questions. It might be said in passing that, as a nation, we had decided to adopt a system of education which was in itself the greatest brain tonic at our command, a remedy which, if not altogether a specific, must strike deeply at one great cause of crime, misery, and degradation. Especially in our great cities there was a considerable class the members of which might be termed moral idiots. A child brought up, or rather dragged up, in a cellar, whose parents were thieves by profession; whose companions were equally degraded; who was surrounded from his earliest days by scenes of debauchery and wickedness, must almost inevitably fail to develop a moral sense. Right was wrong to him, and wrong was right. Strictly speaking, this was his moral sense. Some of them might feel at times inclined to grumble at the expense and working of the Education Act; but the grumble would cease if they reflected that they, as a nation, were doing their very best to remove a serious opprobrium from society. The Compulsory Education Act was something like the Compulsory Vaccination Act. Society had determined, in the one case, to apply a preventive to the spread of a serious and dangerous bodily disease; and in the latter, to a grave and serious moral disease. As a community, they in Edinburgh might congratulate themselves that they had done, and were doing, their best to clear the city of the noisome dens in which the residuum of society was born and bred. In speaking of the influences which act for good or evil on the brain, Dr. Tuke alluded first to those over which the individual had no control; and, secondly, to those over which every man and woman could exercise control. The influences over which the individual had no control were those connected with his antecedents and up-bringing. A man might be handicapped in life by the mistakes or faults of his ancestors; and, different from the racehorse, he had to carry weight in the race of life according to his imperfections, not according to his advantages. There was a pretty general consensus of opinion that consanguineous marriages were on the whole to be deprecated. If they taxed their memories, and tried to remember how many perfectly healthy families they had known—families without a history of consumption, gout, rheumatism, affections of the nervous system, &c.—he feared the number they could estimate would be very small; and if they took into account the tendency of such diseases to become intensified in the children of cousins, he thought they would agree with him that consanguineous marriages involved a risk which it was not well to incur. Alluding next to a question which was often put him by anxious parents, whether it was advisable to allow their children to marry into families in which nervous disease was known to exist, he remarked that, of course, as an abstract proposition, there was but one answer to the question—that it was not advisable; but while he did not advocate marriage under such conditions, he expressed the opinion that there was not much more, if any, reason for avoiding a family in which there was a history of nervous instability than there was for avoiding families in which other forms of hereditary disease existed. Passing to consider the practical questions connected with the rearing of the infant and child, he said every child's future history depended on the food it got and on its surroundings. Much depended on the mother; if healthy, she should suckle her child, but not for too long. He had met with many cases in which the sole ascertainable cause of nervous symptoms in young children was their being too long suckled. But the mother herself must be well fed, and this brought him to the consideration of another question. In some respects he believed the food of the working-classes in Scotland was improved, partly because wages were higher, partly because in the new workmen's houses the means of cooking were better, and partly because new articles of diet had been introduced into the market. But he also believed that it had become deteriorated in a very important item—porridge and milk—for which had been substituted a much less nutritious, and in itself a somewhat deleterious, article of diet—tea and bread. The physiologist would tell them that porridge and milk was a "typical" food; that was, that it contained all the necessary constituents of food in the most perfect proportions. He had nothing to say against the staff of life so long as it was sound in quality and well fired, except that it was not such a typical food-stuff as oatmeal, and, weight for weight, did not possess as equal power of nutrition as porridge. It was the constant use of tea that he would most strongly deprecate. He hoped his teetotal friends would not be very angry with him if he said that it was quite open to argument whether the teapot or the whisky-bottle exercised the more baneful effects on the public constitution. He did not think the question had ever been fairly worked out. He advised all working men, whether they worked in the workshop, in the office, or in the study, to feed themselves, their wives, and their children, at least once a day on the most perfect form of food which God had given them—porridge and milk. The next subject which naturally suggested itself as exercising an important influence on the child's brain-cells was education. In Edinburgh philanthropy had taken the direction of providing institutions for the education of orphans and of the children of poor people—noble and great institutions which had doubtless effected much good where their function had been exercised for their proper objects. But it was more than doubtful whether they exercised a beneficial influence, if they, in any instance, took a child from its home and the Board School. He held that a man must be very poor indeed to be justified in giving up the care of his child, and that he who could maintain even a very moderately comfortable home outraged the laws of society and of health in debarring his child from its educational influence. To send a child away from the family influence into an atmosphere of necessarily strict discipline and routine should be the last resource of misfortune. The life of a child so placed was artificial, its individuality was endangered, and its experience circumscribed. With every respect for the management of these institutions, he would much rather see a child of his less well dressed, less well fed, living early into real life, his brain-cells absorbing real experience, and becoming educated by normal vicissitudes than see him the best boy in the best hospital. He was speaking as a physician and a physiologist when he advised them to avoid the temptation, should it be presented to them, of sending their children to any institution when, by any sacrifice, they could keep them at home. Of course, a child had to encounter greater dangers at home than when shut up in a monastic institution. They were overworked, and overworked themselves, at school. One of the great causes of overstrain in early youth was the vicious system of offering prizes for competition. It deflected the mind of the child from the main aim and object of its study, and often defeated the object which it was hoped to obtain. The youthful mind must not be pressed too far in the direction of abstract facts and theories. Our whole educational system was running somewhat wild in this direction, and the child's brain did not get time to assimilate the food it got. A sort of brain dyspepsia or indigestion set in. His experience might be exceptional, but it tended towards the opinion that the rising generation was not so well acquainted with the standard literature of our own country as boys and girls were twenty-five or thirty years ago. He dared say its knowledge of the hard facts of history was more exact, the rules of arithmetic might be more thoroughly understood, but he doubted very much whether "Robinson Crusoe," the poems of Burns, the "Pilgrim's Progress," Sir Walter Scott's glorious novels in prose and verse, Prescott's "Conquest of Mexico and Peru," and such like educational influences were as much at work as they used to be. Careful reading of such standard books helped the boy's and girl's brain to assimilate the tougher food it received at school, and introduced a digestive power which helped to diffuse the aliment throughout the whole mental system. Having pointed out the necessity of teachers knowing how to administer intellectual aliment carefully and thoughtfully, and how brain health suffered nowadays, if there was truth in the statement that the pupil was being made for the school, not the school for the pupil, Dr. Tuke remarked that a great deal had been said and written of late about the overworking of girls and young women in schools and colleges, and his friend, Dr. Clouston, had come forward as the champion of health and ignorance for women. He could not help thinking that Dr. Clouston had overstated the position of matters; that he had based his opinions more on the observation of isolated cases than on the general condition of highly-educated women; that he had mistaken the wail of the one for the murmur of the many. No doubt, a certain number of young women suffered and broke down whilst studying, but this did not necessarily imply that study was the cause of the breakdown. Idleness and ignorance were much more prolific causes of disease amongst women than overwork. They were the main producers of hysteria, and all sorts of vapourish complaints, of many ills and evils, and of inanity, if not of insanity. As a matter of fact, it was not an easy thing to overtask the energies of the brain by work. It was not work, but worry, that killed the brain. The latter, he feared, must be ever with us all. The most highly educated and hard-working women whom he had the honour of knowing were eminently healthy. Perhaps this might be the "survival of the fittest"; but even granting that it was so, the more women worked the more fit women they would have. But breakdown from overstrain did occasionally take place, and the first really important symptom was sleeplessness; when that set in there was cause for alarm. Loss of sleep was brought about thus:—When the brain was being actively exercised, there was an increase of blood in its vessels—this was spoken of as "functional hyperæmia." If they continued the exercise of the brain powers too long, there was a tendency for the blood to remain in too great quantity from the cells becoming exhausted and not being able to control the vessels. In sleep the amount of blood was diminished, and sleep could not be procured if this functional hyperæmia persisted. In the absence of sleep, the cells could not recover themselves, and their activity became impaired. Headache, loss of appetite, and general listlessness followed; then changes in the character of the blood, and the trains of symptoms so ably described by Dr. Clouston. As soon as a child or young person developed continuous headache, work should be discontinued at once. In conclusion, Dr. Tuke remarked that most men working in the same department of medicine as he did recognised that if there was a hope of diminishing the amount of brain-disease, it was to be effected by preventive medicine, and he had therefore directed their attention more especially to the transgressions of the father than to those of the son.

A NEW CLASS OF ENGINES.

In beam-engines, such as are now used as steam motors, and for diving pumps and blowing machines, the active or passive substance generally moves in closed cylinders with pistons moving to and fro. Prof. Wellner, of Brunn (whose "steam wheels" were described a short time ago), has lately shown that various beam-engines may without difficulty be made, in which the fluid acts in open vessels by its weight or upward thrust, and, in some cases, they may be advantageous. A first group described consist of direct-acting beam-engines with water power. An oscillating beam, *e.g.*, has at one end a scoop to hold water, at the other a weight balancing half that of the water. The scoop, raised to its highest point, receives water through a pipe, entering a sunk part in its bottom from an reservoir, a valve being automatically opened when this flow is required. The excess of water sends that end of the beam down, and the scoop empties itself below (the valve having closed meanwhile); then it is brought back by the weight to be filled again, and so on. The oscillatory motion may be converted into rotatory in the usual way. This beam-engine may be made double. Again, direct-acting beam-engines for raising water are described. Here oscillatory motion is imparted from a driving shaft to a beam weighted at one end and having at the other a vessel with valve which alternately dips into and fills with water at the lowest point of its course, and delivers the water at its highest point into a trough. Another group consists of direct-acting beam blowing engines. In one of these, *e.g.*, a couple of one-armed levers are worked up and down on terminal pivots, one on either side of a wind-chest in water. By this motion, a vessel like an inverted scoop, to which they are attached is alternately raised and depressed in water, from which it partly emerges at the top, and exchanges its water for air. A valve at the top of the scoop closes on commencement of the descent and the imprisoned air is carried down and forced into the wind-chest. Other varieties of these machines are indicated.

A GOOD PHOTOGRAPHIC VARNISH.[*]

SHELLAC in one of its many shapes forms in this case, as in most others, the foundation upon which the varnish is built; and, indeed, we may say at the outset that a plain solution of shellac makes one most excellent in quality. Shellac, under its various names indicative of its colour, is really only another form of the so-called "seed lac," and also of stick lac, some recipes giving most absurd instructions as to the proportion of the various forms of resin to be used. Stick lac is simply the twig encrusted by the lac insect with the the peculiar substance it produces. Seed lac is the incrustation removed, in which state it presents the appearance of small seed; and shellac is the purified seed lac melted, strained, and placed on large cylinders or slabs to harden, from which the resin is chipped or shelled off as "shell-lac."

Shellac is found in commerce of an infinite variety of shades of brown, from the pale "orange," as it is termed, to the deep garnet or ruby colour, which is useless for our present purpose. Such shellac dissolved in spirit would give a solution that could not be decolorised in any practical manner—at any rate by the working photographer. For our purpose very finest "pale orange" shellac procurable should be purchased, and when varnish is likely to be made in quantity the samples must be first obtained so as to enable the stock to be purchased where the palest sample came from. Those who have not before paid any attention to the matter will be surprised to discover how varied in colour even high-priced shellac will be found. Another consideration, which will scarcely need to be pointed out in the selection of shellac, is to see that the pieces are as clean looking as possible. In this respect also great differences will be found.

A solution of such a shellac in methylated spirit forms the basis of our varnish, and a simple varnish so made will answer for all rough work; but where delicate results are wanted it must be paler in colour, and for this purpose we use "bleached shellac." Bleached shellac dissolved in spirit also makes an excellent varnish; but it is not nearly so hard and tenacious as that from the orange shellac. A good strong coating of it is readily scratched by the finger-nail—a *contretemps* so likely to occur in printing that such a varnish cannot be recommended. White shellac is made by dissolving ordinary shellac in caustic alkali, and then treating the solution with chlorine, which at one and the same time decolorises and precipitates it. This process, though it produces a pale resin of great value for many economical puposes, causes the resin to lose many of those properties that specially fit orange lac for use in photographic varnish. One of the peculiarities of white lac varnish is the frequency with which it dries into a multitude of fine ridges, which no rocking of the plate to an fro during draining and drying will prevent. But for paleness of colour in the coating obtained from it nothing can be better; and in a mixture of the two resins—that is, the bleached and the unbleached—the objectionable qualities of either seem either covered or greatly minimised. This mixture in suitable proportions constitutes the chief part of the varnish we recommend.

Experimenters with "bleached," or, as it is often called, "white lac," must know that unless it be properly stored it practically loses its solubility in spirit of wine; and we know of many cases of failure in varnish-making caused through the purchaser being supplied with a sample that had become insoluble. Of course this would not be likely to occur in a place where the lac was in great demand; but many of our readers live in places where photographic—indeed, any rare—chemicals are most difficult to get, and when obtainable are not always in good condition. However, in the case of white lac, where the experimenter is ignorant of the appearance it should present, he can easily test a small quantity if he have any doubt in the matter. It should be crushed or pounded into small pieces before adding to the spirit, as even in the best samples a large proportion entirely insoluble always exists, and a clear solution must not be expected. Its solubility or the reverse is soon discovered by noticing whether the small particles begin to disintegrate, as it were, or retain their sharp outlines.

A good indication of insolubility is the outer layer of the round pieces or sticks turning semi-transparent. The plan usually adopted to prevent this change taking place is to keep the bleached lac in the dark and covered with water, when, if it remain so covered, it will retain its solubility in spirit for a lengthened period.

The third and last ingredient in this varnish is "sandarac gum." It is well know by varnish makers that, when gums and resins are mixed and and "blended" solution, the character of this solution or varnish is not by any means of necessity an average of the characters of the gums taken separately, and such is the case with sandarac. This gum taken by itself gives a varnish that is quite useless from its brittleness, but when added to a shellac varnish it confers a portion of its own quality of brightness of surface, which it possesses in a high degree, but does not, in moderate quantity, tend to make it "rotten."

The formula for a varnish devised on the principles above enunciated is as follows:—

Palest orange shellac	2½	ounces.
Bleached lac..............	5	,,
Gum sandarac............	¾	ounce.
Methylated spirit	1	quart.

Bruise the bleached lac till reduced to small pieces. Powder the sandarac, and then add the whole to the spirit, putting in a few small pieces of glass to prevent the shellac caking at the bottom of the jar; stir or well shake the whole from time to time, till it is evident that solution is complete. All that is then necessary is to set aside to clear, pour off the clear, supernatant fluid, and filter the rest. It is best to allow a month or two for subsidence, for the insoluble part occupies so large a space that much waste through evaporation, &c., is caused if an unnecessarily large quantity be passed through the filter. We may say we have seen many thousands of negatives covered with a varnish prepared by this formula—both collodion and gelatine—and have not seen a single one that has given way in the slightest degree; hence we feel that the above may be recommended as a standard and reliable formula.

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[*] From the *British Journal of Photography.*

DYNAMO ELECTRIC MACHINERY.

ON Monday night Professor Silvanus P. Thompson, D.Sc., delivered the first of the course of three Cantor lectures for the Session 1882-83 on dynamo-electric machinery in the hall of the Society of Arts. Professor Thompson said that the name "dynamo-electric machine" was first applied by Dr. Werner Siemens in a communication made in January, 1867, to the Berlin Academy. He there described a machine for generating electric currents by the application of mechanical power, the currents being induced in the coils on rotating an armature by the action of electro-magnets which were themselves excited by the currents so generated. Since the great development of electric lighting it had been found convenient to use the generating machines in certain combinations in which the self-existing principle was abandoned. The main principle of the dynamo-electric machine was due to Faraday, who, by moving conductors across a magnetic field, caused currents to be excited with those conductors. As the term was now applied, dynamo-electric machines were machines for converting energy in the form of mechanical power into energy in the form of electric currents by the operation of setting conductors in the form of coils of copper wire to rotate in a magnetic field. The machines might be divided into three classes. The first was that in which the rotation of the coils took place in a uniform field of force upon an axis in the plane of the coil or one parallel to such axis. The second consisted of machines in which there was the translation of the coils to different parts of a field of unequal strength or opposite sign. The third class, which had not yet come into practical use, was where the rotation of the conductor was accompanied by an endless increase in the lines of force cut, this being effected by one part of the conductor sliding on or round a magnet. If he were asked what dynamo-electric machine was the best he would say that none was theoretically perfect, one might be better for one class of work and another for a different description. This, however, he might say, that everything was in favour of big machines. The lecture was illustrated by diagrams and by experiments. The subject of the succeeding lectures is to be the dynamo in practice and the dynamo as a motor.

THE STRENGTH OF BOILER FLUES.

AT a meeting of the Society of Engineers, held on Monday, December 4th, in the Society's Hall, Victoria-street, Westminster, Mr. Jabez Church, in the chair, a paper was read by Mr. W. Martin on the "Strength of Boiler Flues." In the construction of steam-boilers, more than in ordinary engineering matters, it is of special importance, both to the engineer and the public, that the principles involved should be clearly established, since cases of failure produce such disastrous results, which, now that steam-power is so universally used, may affect the safety of the public at large. In most cases, where a boiler fails simply from inherent weakness, it is usually from the collapse of its flue, since the flue of a Cornish or Lancashire boiler is, unless specially strengthened, the weakest part of the boiler. Besides being essentially weaker, the flue is the part which, more than any other, is injuriously affected by faulty construction. This, in conjunction with the consideration that, unless dangerous or almost collapsing pressures are applied, it is extremely difficult to discover their weakness by testing, makes the construction of boiler flues a matter of particular importance. Notwithstanding the interesting character of the problem, and its importance, however, the experimental data upon which our knowledge rests are insufficient and unsatisfactory. The only systematic series of experiments which have been made at all, were made by Sir William Fairbairn 24 years ago, and the formula deduced by him from these experiments is still the one in use by engineers. The reliability of this formula is not, however, beyond question, and its application to different cases can be made to produce somewhat anomalous results. It cannot be denied that the results obtained by Sir William Fairbairn, considered with regard to the ignorance upon the subject prevailing at the time, were of the highest importance; and they immediately suggested simple methods of effectively strengthening flues, both old and new. Nevertheless, the experimental tubes used were very unlike actual flues in construction; they were very small, and were submitted to pressure in a totally different way from that in which flues undergo steam; and since, moreover, almost all the comparable experiments were with tubes of the same thickness, it is evident that the result deduced from them cannot be regarded as final. It is much to be desired that this subject could receive a new experimental investigation, and in such a case, the experiment should be with objects corresponding in shape, and conditions of strain, though not necessarily in size, to actual flues.

SOME CONSTITUENTS OF THE ATMOSPHERE AT GREAT HEIGHTS.

DURING a recent stay for a month on the summit of the Pic du Midi (which is about 9,500 feet above the sea-level), MM. Muntz and Aubin examined the air and aqueous matters repeatedly, with reference to the presence of ammonia and to atmospheric nitrification. The ammonia of the air seemed to be in much the same proportion as that found in the air on low ground; but that of the rain-water, snow, and fog was considerably less than on low ground, for which various reasons are adduced,—the greater rarefaction of the air traversed, absence of nitrate of ammonia, dryness of snow preventing condensation of ammonia, fogs being formed where found, without descent, &c. In all the observations of rain, fog, and snow, for nitrates, an almost complete absence of these latter was ascertained. In this connexion the authors had an examination made of the record of thunderstorms kept at the observatory (nitrates being formed in the air by electrical action). Of the 184 thunderstorms observed from 1873 to 1882, only 23 had been produced at a height above 7,700 (where the original station of Plantade is situated); in the latter the summit of the Pic was surrounded by clouds whence the discharges came. It may be said in general, that in the Pyrenean region the violent electric phenomena of thunderstorms never exceed a height of 10,000ft. (3,000 metres), and that, consequently, the formation of nitrates under the influence of electricity is below this limit. Atmospheric nitrification seems to be chiefly produced in the zone between the sea-level and the mean height of clouds. This absence of fine powders of nitrates, the authors also remark, certainly contributes to the remarkable transparence of the air in high regions, and shows that the plants on high mountains and the soil they have formed can only obtain their nitrogenised matter from the ammonia of the air.

THE Gold Medal, Paris, 1879; the first order of merit, Sydney and Melbourne exhibitions, 1879 and 1881; and the gold medal at Adelaide in 1882, have been awarded to the Trypograph (Zuccato's patent).

SCIENTIFIC NEWS.

THE great comet, according to the latest news, was first seen in Auckland on Sept. 3—not, it appears, by an astronomer. A number of observations have been made with the great 26in. refractor at Washington. On Nov. 6, three nuclei were visible, shining with a much stronger light than the coma in which they were enveloped.

The solar eclipse of May 6, next year, will, it is known, be exceptional in the time of its duration (nearly six minutes), and it is also exceptional in the fact that the line of totality includes so little standing room on terra firma. The French are already moving in the matter, for a report has been made to the Bureau des Longitudes, pointing out what arrangements should be made. Only two small islands are available. Flint Island (long. 151° 48′ W., lat. 11° 30′ S.) and Caroline Island (150° 6′ W., 9° 50′ S.), where the duration is respectively 5m. 33s., and 5m. 20s. The French propose to occupy both these stations in the hope of being able to establish the existence of Leverrier's "hypothetical planets," which his analysis indicated as being within the orbit of Mercury.

Russia took no part in the transit of Venus expeditions, M. Struve thinking that, as experience since 1874 has proved, there is no prospect whatever of obtaining by that means a geometrical determination of the parallax of the sun, even with combined international efforts, such efforts as are made by other nations will be sufficient without support from Russia. There are other methods which he believes to give more accurate results (*e.g.*, that suggested by Mr. Gill) which can be repeatedly made without costly expeditions.

Prof. Challis, Plumian professor of astronomy at Cambridge, died on Sunday last, in his 83rd year. The Rev. James Challis, M.A., F.R.S., was a senior wrangler and first Smith's prizeman, and was elected to the professorship in 1836, in succession to the ex-Astronomer Royal.

The death is announced of Mr. Andrew Pritchard, F.R.S.E., at the age of 78. Many years ago he turned his attention to the microscope, and did much to improve that instrument, while more than half a century back he commenced to publish works in connection with it, his "History of Infusoria" being that by which he will be best remembered.

A committee has been appointed to raise funds for a memorial to the late Rev. Dr. Robinson, which is to take the form of an equatorial refractor for Armagh observatory, where the late astronomer spent fifty-eight years of his life. Subscriptions will be received by Dr. J. L. E. Dreyer, Observatory, Armagh.

A memorial of Professor Jevons is also suggested, in the shape of a Professorship of Political Economy at Victoria University, Manchester.

The Christmas Lectures at the Royal Institution will be given by Professor Tyndall, on "Light and the Eye."

In connection with Owens College, it has been determined to raise a sum of £50,000 for the erection of a series of museums, which will be open to the public three days a week, the collections being held in trust for the public. At the meeting under the presidency of the Mayor of Manchester, subscriptions amounting to £19,000 were announced, fourteen being of £1,000 each.

Dr. Burdon-Sanderson, lately Professor of Physiology in University College, has been appointed to the new Waynflete Professorship of Physiology at Oxford.

The New Law Courts are to be permanently illuminated by the electric light, Swan incandescent lamps being chosen. Some of the standards will have as many as sixteen 40-candle lamps. The machinery will be located in the crypt beneath the great hall. For the temporary lighting on Monday, Messrs. Crompton employed a 60h.p. engine on hastily arranged foundations, and several Crompton arc lamps were used. Upwards of four miles of main wires have been laid in.

The Volta prize of 50,000 francs, offered by the French Government in 1887 will be awarded to the author of the discovery which shall be adjudged to have best increased the facility of applying electricity as a source of light, heat, power, chemical action, or as a transmitter of messages; or in the treatment of disease. June 30, 1887, is the last day for receiving claims, and the prize is open to the savants of all nations.

Another trial with oil has been made at Aberdeen harbour, at a time when the waves were dashing over the pier. In twenty minutes 280 gallons of seal-oil were pumped into the water, and the breakers were reduced to tumbling waves.

The observatory on the summit of the Pic du Midi, in the Pyrenees, due to the initiative of General de Nansouty, became, in September, the property of the State, a sum of 80,000 francs having been voted for the purchase. It is to be devoted chiefly to meteorological observations; but there are obvious advantages in the position for astronomical and physical observations also, and these will not be neglected. Admiral Mouchez, of the Paris Observatory, has lately sent two of his astronomers to the Pic. General de Nansouty is appointed honorary director of the observatory, and M. Vaussenat (his colleague hitherto) effective director for five years.

To illustrate, in a lecture, the direct combination of elements, or the properties of sulphur, it is common to make this substance unite with copper-foil or fine iron-filings. A much more brilliant and truly surprising experiment may be performed (according to Herr Schwarz) with an intimate mixture of fine dust and sulphur. The sifted dust having been intimately, but cautiously, mixed with powdered sulphur or washed flowers of sulphur (abont two parts of zinc to one of sulphur), the mixture is easily ignited with a match, and burns like gunpowder, with a bright, greenish flame, the greater part diffusing as a cloud in the air. The ignition can also be readily effected with the induction spark. Incandescent platinum wire is not so good, as on contact with the powder some of the current is drawn off. Further, the zinc-sulphur powder may be partially inflamed by a powerful blow with a hammer (it should be first firmly compressed). Mechanical effects (shooting) may also be got from the powder, about two grammes of it being equivalent to half a gramme of ordinary gunpowder. A variety of interesting experiments, to which Herr Schwarz was led by his discovery, are described in the reports of the Berlin Chemical Society.

In connection with the recent discussions on solar energy, it has been lately noted by M. Rey de Morande, in the Paris Academy, that fossil botany has given a new extension to Laplace's hypothesis of a gradual contraction of the sun. The extensive coal-beds found in Polar regions appear to show that these latter, at one time, received nearly as much of the solar light and heat as equatorial regions. So long as the sun was of such a diameter as to heat and light the two poles, there was great uniformity in our planet's vegetation, but about the Cenomanian epoch (i.e., the Cretaceous) this state of things ceases rather rapidly. Plants with caducous leaves appear first in northern regions, and gradually spread southwards, confining arborescent ferns and other primitive plants to an ever-narrowing equatorial zone. In the Polar regions, moreover, vegetation disappears. These facts, according to the author (following Dr. Blandet), are explained by the gradual contraction of the sun, but remain inexplicable by the simple hypothesis of a gradual cooling of the earth.

The fatty tissue of adults differs considerably (it has been recently shown by Herr Langer) from that of children. The former is clear yellow, sometimes slightly brown; it is soft, and a section of the fatty tissue presents small oily drops. The microscope reveals only in a few cells needles of crystallised fat. In the child, on the other hand, the fatty tissue is firmer, greyish white, and easily divides into grumes or lumps, like those of wax boiled in water. There are numerous crystals of fatty matter in the cells. The fat of the child contains more of glycerides of palmitic and stearic acid than that of the adult, and less of those of oleic acid. It has also much more of the volatile acids, butyric and caproic, than the fat of adults.

The Kunstgewerbeverein of Halle has lately offered one prize of £15, and five others £5 each, for the best arrangements in furnishing an ordinary parlour (the articles being indicated). The date specified is Jan. 15, 1883.

A curious observation by Leonardo da Vinci has been communicated to *La Nature* by M. de Rochas. It is found in one of his MSS. in the library of the instituto. "If you give a nail," he says, "a great many blows with a hammer to drive it into a board, this will be long and difficult; and if you attach the nail to the hammer with wax, you may drive it wholly into the board at one blow equal to the others." On reflection this will be seen (says M. de Rochas) to be due to the fact that when the nail is attached to the hammer it is already animated with a velocity equal to that of the hammer when it comes into contact with the board; whereas, when it is struck there is a double loss of kinetic energy in the shock: at its head and at its point.

Ether or rhigolene spray, has been strongly recommended by Dr. Mc Colganan (U.S.) as an immediate cure for (principally facial) neuralgia. Since curing himself, he has had occasion to test its efficiency in about twenty cases, and the result was invariably a most gratifying success. In many cases a permanent cure was effected. He supposes a complete change to take place in the nutrition of the affected nerve, in consequence of the intense cold acting as a revulsive.

When fire breaks out in a store of inflammable liquids there is usually very great loss. With a view to lessening this, an Italian Professor has devised an arrangement which he has shown in model at the regional Exhibition of Biela. The barrels of inflammable liquid are placed on a bed of pebbles or sand. The floor is pierced with holes, which open into reservoirs communicating through tubes with the outer air. The liquids from the burst barrels flow among the pebbles and are extinguished, the necessary air failing. Then they flow into the reservoirs, whence they are recovered afterwards. In the experiments made at Biela it was shown that the reservoirs contained 95 per cent. of the liquid used. The thing is to be tried on a larger scale.

We learn from Dingler's *Journal* that Herr von Lüde has been seeking to lubricate the slide-valve lap, especially in locomotives, with water. At first he obtained the water by condensation of steam in a small thin-walled cylinder above or below the slide-valve, fitted with the necessary pipe connections. In this case, however, the heat of vaporisation of the condensed steam was uselessly lost, and no lubrication took place when the engine was working without steam, as in running down inclines. According to his last patent, the lubricating water is brought direct from the boiler. At either end of the slide's course, water is forced into the grooves by steam-pressure. For details, we must refer to the original.

The German merchant service, in the beginning of January, 1881, consisted of 4,660 sea-going vessels, with a total registered tonnage of 1,181,525. The sailing vessels numbered 4,246, and the steamers 414; 119 sailing ships and 397 steamers were of iron, while 4,127 sailing ships and 17 steamers were of wood. The *personnel* numbered 39,660 men. The entire merchant navy was distributed among 268 home ports; of which 61 were on the Baltic, and 207 on the German Ocean.

Mr. Edison, we observe, has published a little book entitled "How to Succeed." He insists, among other things (in order to successful invention), on a natural taste for mechanical pursuits, a good constitution, and power of working long hours at a stretch, continuity of thought, and, above all, patience. While he considers neither a mathematical nor a collegiate education essential, Mr. Edison has a high opinion of the technical schools; the Troy Polytechnical School, he thinks, turns out the best men (in America). The would-be inventor (who should confine his attention to one subject) "can take hold of almost anything; the steam-engine, for instance. Probably a million men have already worked at it. That would not deter me in the least; because that which is known to what is possible to be known, stands, we will say, as one to ten millions. The best method of doing almost anything you can mention in mechanics has not yet been found out. We have not got the most perfect sewing-machine. Fifty years hence the sewing-machine we have now will be laughed at. The mind of man is so almost infinite that the field is unlimited. But the only proper way is to take up one branch; make yourself a specialist."

MESSRS. T. AND S. W. CUTTRISS, of Leeds, have just been awarded a bronze medal by the jurors of the Bradford Exhibition for their exhibit there.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

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DIAMETER OF THE SUN'S FOCAL IMAGE IN A TELESCOPE—RAIN-GAUGE—FOCAL IMAGES OF STARS—PILGRIM SIGNS—SUNSPOTTERY ENCORE—JUPITER—REFLECTORS v. REFRACTORS—MICROMETER FOR SUNSPOTS—LUNAR PHOTOGRAPHY—ANCIENT ASTRONOMY AND ARABIC STAR NAMES—SUNDIAL—THE GREAT COMET.

[20800.]—In reply to query 48674 (p. 282), I may tell "Lens" that if we assume the Sun's diameter to be exactly 32′, then will its image in the focus of a telescope of 50in. focal length measure 0·46542in. in diameter. With a 42in. object-glass, this diameter would be reduced to 0·39095in.; with a 60in. objective, it would be 0·55850in. across; and with an object-glass of 70in. in focal length, its diametrical measurement would be 0·65159in. It must be evident that the image of any body subtending an angle of 16′ would measure 0·23271in. across with a 50in. objective—and so on. If "Lens" wishes to know how these results are arrived at, I may say, briefly, that if we treat the Solar diameter as the chord of an arc, and remember that the chord of any arc = 2 sin. ½ that arc, he will see that he has only to multiply the sin. of half the arc (i.e., in this case 16′) by the focal length of the telescope, to get the semidiameter of the projected Solar image in decimals of an inch. If he understands the very rudiments of Trigonometry, he will see at once how and why this is. If he does not, he must take my figures on trust.

As "M.M.I.Sc.S." (query 48683, p. 282), proposes to graduate his rain-measure by weight, the following considerations may help him. By 5 Geo. IV., c. 74, an imperial cubic inch of distilled water at a temperature of 62° Fahr., and with the barometer at 30in., is defined as weighing 252·458 imperial troy grains. Now, when an inch of rain has fallen in my querist's gauge, it must contain 81 cubic inches of water, and hence 252·458 × 81 (= 20449·098) imperial troy grains. But 437·5 of such grains = 1oz. avoirdupois. Hence, by dividing 20449·098 by 437·5, we get finally 46·7048oz. avoirdupois as the weight of 1in. of rain in a gauge whose mouth measures 9in. square. Quite obviously 0·01in. in such a gauge must weigh 0·467048oz. avoirdupois.

"R. K. P." (query 48686, p. 282) may rest assured that no proper definition of a star can be obtained unless it is viewed with a power sufficiently high to exhibit it as a sensible though very minute disc. The "bright star a low power gives" would be a very puzzling object to bisect with a wire in any astronomical measurements. The "one or two encircling rings" of which your correspondent speaks, are known as diffraction rings, and have their origin in the very nature of light itself. The better the object-glass, the finer and more hair-like these rings, but they *must* be there. "R. K. P." should search your back volumes for a whole mass of information on this subject.

The Pilgrim's Signs (concerning which Mr. Hale puts query 48699, p. 282) were leaden figures worn as brooches or medals, in this country, chiefly if not solely, by those who had made a pilgrimage to the Shrine of St. Thomas à Beckett at Canterbury. Sometimes they took the form of a full-length figure of the Saint himself; at others of medallions with his head in the middle, and a legend round it—and so on. The "square handle" which puzzles Mr. Hale is certainly the upper part of the pin by which the sign was stuck on to the breast or cap of its bearer. Their primary object was to show that those who wore them had personally performed a pilgrimage to St. Thomas's Shrine; but naturally in so ignorant and superstitious an age they were also regarded as charms or amulets. Assuming, though, that Mr. Hale's date is correct, his sign must have been coëval with Ethelred the Unready; and hence can obviously have had no reference to the Shrine of the Canterbury Martyr. I must, however, add that the earliest recognised examples of these leaden signs only date from the end of the 12th century, so that it seems not impossible that his may be a forgery. There was a Saint's shrine at Ely at the beginning of the 11th century, but I positively have forgotten whose now. All the signs I have ever heard of have been found in the Thames. Any respectable dealer in Antiquities would tell Mr. H. what his specimen is worth. I should question if it would fetch much, as the alleged date on it makes me mistrust it.

I do not know how many of my brother-readers saw the *Standard* newspaper for Tuesday, November 21st; but such as did not, I would earnestly urge to obtain a copy of it, if still procurable, and read a really admirable article on the connection of Astronomy with Meteorology. Written, quite obviously, by someone who is thoroughly behind the scenes, its references to a certain notorious Ring of Quacks are quite unmistakable; and hence it is not very wonderful that an appearance should have been put in two days later by a Professor Archibald on behalf of some of the "galled jades" whose withers have been so severely wrung. It may be, of course, that not to know Mr. Archibald is "to be oneself unknown"; but at the risk of inclusion in this category, I must confess that I never heard of his existence before I saw his name appended to the letter of which I am about to speak. Having now made his (literary) acquaintance, I can only suppose that either he is credulous to fatuity, or that his object in writing is "seriously to mislead the non-scientific public as to the present state of astronomy and meteorology." *Utrum horum mavis accipe.* In commenting on the leading article which inflicted such a severe blow upon his friends, Professor Archibald writes thus:—"Your writer further proceeds to say that 'among the best-instructed astronomers it is now considered questionable whether there is any real correspondence between the two sets of phenomena. This statement must be taken *cum grano salis*, unless your writer can prove that the gentlemen in the following list, which gives off-hand the leading writers and upholders of a connection between sunspots and meteorology, are not entitled to be considered some of the best-instructed astronomers and physicists, but come under the category of 'quacks who hover on the outskirts of the scientific world.'" To the letter from which I have extracted these words is appended the following list of names, to which I beg the most careful attention of every reader of these lines. I do so, because if Mr. Archibald really does quote them in the bona-fide belief that they are those of men who believe in sunspottery, I would rather not express my opinion either of his child-like faith, or of his right to attempt to instruct the public. If, on the other hand, the whole letter is intended to throw dust in the eyes of non-scientific readers, I need say nothing more either. "List of gentlemen who uphold a connection between sunspots and meteorology:—Professor Balfour Stewart, F.R.S.; H. F. Blanford, F.R.S.; Charles Chambers, F.R.S.; J. Norman Lockyer, F.R.S.; Dr. Arthur Schuster, F.R.S.; the late J. Allan Brown, F.R.S.; Dr. Chas. Meldrum, F.R.S.; G. J. Symons, F.R.S.; Professor H. Fritz (Zurich), Dr. W. Koffeu (Hamburg), Dr. F. G. Hahn (Leipzig), Dr. Homstein (Prague), M. Poey (Havana), E. J. Stone, F.R.S., Professor P. Smyth (Edinburgh), Dr. B. A. Gould (Cordova), Charles Todd (Adelaide), Frederick Chambers (Bombay), Herr von Bezold (Munich), and Professor A. S. Hill (Allahabad.)" Let us dissect this list. And, first, about "the best-instructed astronomers." Well, at the head of these undoubtedly stands the Radcliffe Observer, Mr. E. J. Stone; then come Dr. Gould, Mr. Todd, and Prof. Piazzi Smyth. Who are the rest? Moreover, when and where did Mr. Stone express his belief that Sunspots had any connection with Meteorology? a question I would repeat with reference to Mr. G. J. Symons. As for Mr. Blanford, I am simply amazed at Mr. Archibald's audacity (or fatuity) in quoting him, after his article in *The Times* for December 4th, 1877 (vide English Mechanic, Vol. XXVI., p. 380). References, too, to your back volumes, will show how far Hahn and Bezold (especially Bezold), can be claimed as believers in Sunspot Meteorology. But, I would ask the reader particularly to note how members of that wretched little sham, "The Committee on Solar Physics," figure in Prof. Archibald's list. Men, be it noted, who have a direct personal pecuniary interest in fostering the Sunspot delusion. Sweep away this trumpery Brompton job, and every member of this "Committee" would be a poorer man by the amount of his share of the annual grant by which it is supported. No wonder *they* are "upholders of a connection between sunspots and meteorology." It might have been more honest, too, had the writer given a précis of Mr. W. Ellis's paper in the "Philosophical Transactions." In fine, I may remark that all persons really familiar with the literature of Sunspottery who will read Mr. Archibald's letter, must perforce be reduced to the dilemma in which I find myself—viz., that of an inability to determine whether it is sheer silliness, or a desire (for polemical purposes), to deceive the unscientific public, that has prompted so very remarkable an effusion. I may, perhaps, just add that anyone who may have felt staggered by its confident tone of assertion, had better read the *Astronomical Register* for August, 1878. He will there see what is the exact worth of all this vapouring assertion when brought to the critical test of statistics.

And, apropos of sunspots, I see by the papers that there has been a commercial panic in America. Now, it was not so very long since we were assured that no such panic might, could, would, or should occur, save at or about the period of sunspot minima; and it is absolutely needless for me to add that we have been and are passing through a maximum period. Why, even the vicissitudes of Trans-Atlantic commerce are aiding in the puncture of this wind-bag.

In connection with the exceedingly interesting observation of a moving white spot upon Jupiter's surface (described in letter 20780, p. 294), I would remark that the idea of the dark belts which streak that planet's disc forming any portion of the body of the planet itself, has been long since discarded. Jupiter is, in all probability, in a state approximating to at least red heat, and is surrounded by an atmosphere of very great depth and density, the currents and convulsions in which give rise to the visible phenomena on his apparent surface. On the occasion of Occultations of Jupiter's Satellites, they have been seen distinctly *through* the limb of the planet. Notably has this been observed on several occasions, at the Observatory at Adelaide, by Mr. Todd and his assistants. Such a phenomenon as this will alone suffice to show the extreme improbability of our ever catching sight of the solid body of the planet. It is a familiar fact that a measurable drift is taking place in the case of the great red spot, and other markedly permanent (or quasi-permanent) details on his surface; a drift which, being seemingly unequal in different Jovian latitudes, throws grave doubt upon all determinations of his rotation period. This, however, is relatively slow; and I am ignorant of any previous record of a spot or marking in such extremely rapid motion as that seen by Mr. Beaven on the 17th ult.

Mr. Jobson (letter 20782, p. 295) will see an immense deal more in the shape of Saturnian detail, &c., with a 6in. reflector than he will with a 3in. refractor. In fact, for planetary and selenographical work there is no comparison whatever between the two instruments. For the measurement of double stars and the like, and for handiness, I prefer a refractor of approximately the aperture of a given reflector. If, however, the object of the observer be merely "star-gazing," he will get almost indefinitely more for his money (especially in the case of large apertures) in the shape of a reflecting telescope than he will in that of an achromatic. In a 6in. reflector by the maker he names he will obtain a superb view of Saturn; the banding on the yellowish ball of the planet; the chief (or Cassini's) division between the rings, and very likely that in the outer ring, first seen by Short; the "crape," or nebulous ring between the inner—and brighter—ring and Saturn; the shadow of the planet itself on the rings, &c., &c., being all beautifully shown. He will, moreover, see six out of the eight satellites.

"An Ignoramus" (query 48743, p. 304) will find a glass plate ruled in squares a very effective micrometer for his purpose. The value of these squares in arc he can determine in the usual way. At a time when I was engaged in making daily drawings of Sunspots, I myself began with such a plate of my own ruling; the lines were exactly 1′ apart. It is described on p. 53 of your XIXth. Volume. The dust difficulty may be got over (if ever it assumes a sufficiently aggravated form) by the use of a camel-hair pencil. I subsequently ruled a brass ring in the same way, and laid down spider-lines over the divisions; and with this I worked until I completed my set of sketches. I don't profess to explain how it is, or to theorise on the subject, but I know, as a matter of fact, that spider-lines seem to bear a kind of charmed existence; and that—for some inscrutable reason—the Sun does *not* scorch them.

"An Amateur" (query 48747, p. 304) should consult pp. 707 to 722 of Chambers's "Descriptive Astronomy."

I may say, in connection with query 48796 (p. 305), that I am unaware of any English Edition of Ptolemy's "Almagest"; but that there was a splendid Edition in Greek and French, published in Paris in 1813 in three quarto volumes. Almost certainly no translation of Hipparchus' "Commentary on Aratus" exists, either in English or French. You reviewed a translation of the "Φαινόμενα" of Aratus by Mr. Poste, on p. 149 of Vol. XXXI. I am ignorant of any translation of Manilius. I have read somewhere that his work was turned into English verse by a writer early in the last century; but I do not know who he was, or where the book was published. "Spica" will find what he wants concerning the Arabic names of the stars in "The Arabic Names of the Stars and Constellations," by W. H. Higgins, published by Hamilton, Adams, and Co. The request for a work giving "the various names borne by stars and constellations in the different countries of the globe," is "rather a large order." He will find a certain amount of information, though, in Flammarion's "History of the Heavens," of which an English translation by Blake, under the title of "Astronomical Myths," is published by Macmillan. Proctor, too, has made contributions to this question in more than one of his works.

I shall be glad to give "Solar Time" (query 48799, p. 305) directions for making a sundial; but as to giving working drawings "to scale," I must ask him to forgive me if I am compelled to refuse. Imprimis, I am writing these lines on the afternoon of Friday, and can by no means spend the very considerable time which it would require to do this; and in the next place, the reproduction of such drawings with sufficient accuracy on a small scale on a wood-block would be, I should think, difficult or impossible. There is the less need for regret in this, however, inasmuch as my querist can do equally well without them. The first thing he must obtain is a dialling scale, to be bought at any mathematical instrument maker's whatever. The boxwood one which I use myself I bought years ago; and it did not cost me more than two or three shillings. Upon this scale, now lying before me, are four series of divisions, lettered respectively "latitudes," "chords," "hours," and "incl meri." With this latter we need not here trouble ourselves. I will suppose, then, that my querist has a similar scale, and wishes to construct a horizontal sundial for latitude 54° 39′ N. Perhaps we had better first set out our gnomon. "Solar Time" knows, of course, that chord of 60° = radius. So from our scale marked "Chords" we take out the length of 60, and with this radius and centre c, and distance ca, we describe the arc ad. Now, from the same scale we take the chord of 54° 39′, and setting one foot of our compasses on d, cross the original arc with the other at a, draw ca, and from a let fall the perpendicular ab; then will the angle acb = 54° 39′, and the side ac be the axis of our gnomon, subsequently to be set up parallel to the axis of the Earth. Cut out the triangle abc, and it will form the gnomon.

FIG. 1

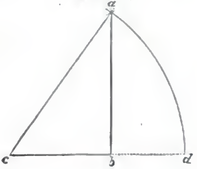
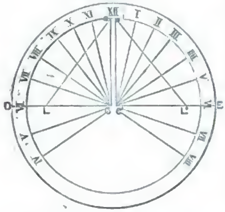


FIG. 2.



Now draw upon the plate of the dial two parallel lines ac, $a'c'$, exactly as far apart as the thickness of the gnomon just made, making ac, ac' equal in length to the base bc of it. Then through cc' draw another line de at right angles for a six o'clock line. This done, take from the scale of latitudes the extent of 54° 39′, and set that off from a to l, and from a' to l'. Then draw the straight lines al and $a'l'$, which will be found to be equal to the scale of hours. It only remains to take off the hours (and their divisions as far as they extend) from the scale of hours, and starting from c for the forenoon and from c' for the afternoon to lay them down from a to l, and from a' to l' respectively. A perfect straightedge must now be laid on c, and the morning hours drawn through the marks on al, VII. and VIII. being continued through c for the evening hours in the summer time. In like manner, the afternoon hours are drawn through c', continuing IV. and V. through it for the corresponding hours of the early morning. Finally, the gnomon is erected truly at right angles to the plane of the dial in the space ac, $a'c'$, with the sharp end of the base c (Fig. 1), at the points cc' (Fig. 2.) The hours and their subdivisions are marked round the edge of the plate, and the dial is finished. To adjust it, by far the most simple way to proceed is this. First, your correspondent must ascertain his longitude. Suppose, for illustration, that he lives at Bishop Auckland, which is 6m. 40s. west of Greenwich. We, of course, want *local* time to set a sundial, and, as Greenwich Time is flashed to every post-office daily at 10 a.m., "S. T." must make his own watch mark 9h. 53m. 20s. at the instant that it is 10 o'clock at Greenwich. Furthermore, let us conceive that he intends to adjust his dial on December 15th. He will find that the Equation of Time on that day is − 4m. 36s.; in other words, that the Sun souths at 11h. 55m. 24s., Bishop Auckland Time. All, then, that your correspondent has to do is to level his dial accurately with a spirit-level, and shift it until, at 11h. 55m. 24s. a.m. local time (= 0h. 2m. 4s. p.m. Greenwich, or Post-office, Mean Time) the shadow of the gnomon lies accurately over the XII. o'clock line, and his dial will be truly in the Meridian. Should he wish to make an erect South Dial, instead of a horizontal one, he must make the angle of his gnomon equal the complement of his latitude—i.e., 90° − 54° 39′, or 35°21′; and must take the distance of 35° 21′ off the scale of Latitudes for the line al and $a'l'$, instead of that of 54° 39′, as previously described. He may put compass points, or anything else, round the outside of his dial—which he can evidently, if he chooses, make equal in diameter to the circle on which they are printed; for he has only to produce the hour-lines far enough. The only limit is, of course, the height of the gnomon, which, about midsummer, might not cast a sufficiently long shadow over a circular dial whose radius was too great. I may say, in conclusion, that the last dial I made myself was constructed of slate, of which I got a fine slab out of a broken mantelpiece, and that the gnomon was a brass one. I made the pattern of the latter out of an old cigar-box, had it cast at a brass-founder's, and filed it up myself. It answered very well indeed.

In reply to "Solar Time's" next query (48800, same page), no recorded observation of the passage of the nucleus of the Great Comet over a star is in existence.

A Fellow of the Royal Astronomical Society.

MARE CRISIUM—REFRACTORS AND REFLECTORS FOR BEGINNERS.

[20801.]—On the 26th inst., 9 to 11 p.m., working on the moon with 6in. Calver and Mr. Neison's map, I marked on it the objects numbered in the accompanying sketch not shown in the map.

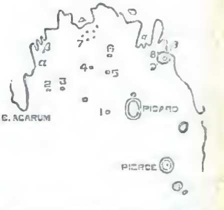
The sketch is an outline tracing from the map with the new objects inserted. I do not know whether they are shown in Beer and Mädler's map or any other published one. Nos. 1, 2, and 3 are decidedly craterlets. Nos. 4, 5, and 6 were seen as round light spots, and may be craterlets. The six spots marked 7 were simply points of light. The object marked 8 bore a strong resemblance to the ring c on the N side of the Mare. It was obvious all round except just under the peak β on its E. side. Neison shows it horseshoe shape, with the gap S., and joins it with a ridge to the crater a. I did not *see* the connecting ridge, but saw the ring all round the S side, and could also make out a round light spot on the floor N.E. The brightest part of the ring was a point, just where the figure 8 is placed in the sketch. The whole formation was more to the N. of the peak a than shown by Neison.

The definition was very steady. I just caught for the first time the companion of δ Cygni as a tiny point on the ring of the bright star on the *n.p.* side, without previous knowledge of the position angle, but five minutes later I could not see it. I should think the appearance of this star, to a practised eye, would afford a sufficient test for almost any aperture.

The close pairs ϵ Arietis, 36 Andromedæ, and 52 Orionis, were all easy with powers of 150 to 250. The two close ones of ζ Cancri were only elongated, but if higher up would, I think, have yielded to a high power.

My experience, not a very lengthy one however, of the merits of the two kinds of telescopes, leads me to think that with equal, or nearly equal, apertures, more can be done with close doubles with a refractor; but that when you come to the moon, planets, and general objects, the silver-glass reflector comes as near as possible to equal the refractor aperture for aperture, and has an immense advantage when the question of cost is a consideration.

If I were commencing again, I would still, however, *begin* with a good 3in. achromatic. The unpractised hand is a little awkward at first with a reflector. This, however, soon passes off, and then the level vision of objects at all altitudes is much appreciated.



I would not have touched on this much debated question except for the fact that the experience of those who have studied with both classes of telescopes may be of use to others who are beginning.

I would say: Get a little first with a small (but good) refractor, and when you want a larger aperture, a comparatively trifling cost will enable you to exchange it for a good-sized reflector.

E. S. Beaven.

LUNAR PHOTOGRAPHS—REFLECTORS AND REFRACTORS—THE "ENGLISH MECHANIC."

[20802.]—"An Amateur" (query 48747) will find a capital chapter on "Celestial Photography," by Mr. A. Brothers, in Chambers's "Descriptive Astronomy," p. 707. But he must not expect to do much in this line with a less aperture than 5in. refractor, or 6in. reflector, equatorially mounted, and driven by clockwork. The reflector possesses the advantage of absolute coincidence of the chemical and visual foci, whilst in the refractor the chemical focus is usually a little longer than the visual, and must be found by experiment.

Mr. Jobson (letter 20782) must make considerable allowance for "personal equation" in this matter. But he is certainly mistaken in assuming that a 6in. reflector would have no advantage over a 3in. refractor. If the silver film be new, it would nearly equal a 5in. refractor for light; and in splitting close doubles would be equal to a refractor of its own aperture. Some time ago I had a 5in. Wray, and made many comparisons between it and my 11¼in. Calver mirror, and I found that 6¼in. of the reflector just about equalled the 5in. refractor for light; but the film was not then new, and the larger diameter of my diagonal prism should also be taken into account. Much prejudice undoubtedly exists against reflectors, from the deterioration of the silver-film, and the varying adjustments. This is generally exaggerated—the film lasts a long time if properly used, and can be easily and cheaply renewed by the observer himself; and, as for adjustments, I take out my mirror every time after using the telescope, yet can place a bright star in field in sunshine, or identify faint objects by night, with greatest ease. Sometimes we hear of the difficulty in applying illuminating apparatus to the reflector: this is mostly imaginary, it being just as easy to do as with a refractor. In my own case, I use the electric light (a Swan incandescent lamp) for this purpose, also for reading circles of telescopes, and it answers admirably.

The English Mechanic.—During an enforced leisure through illness, I have been amusing myself by reading some of the "E.M." Vols. of ten or a dozen years ago; and I inwardly wondered how anyone could be so foolish as to part with back vols. of such a truly encyclopædic journal. The letters of such distinguished correspondents as "F.R.A.S.," Mr. Proctor, "Sigma," "The Harmonious Blacksmith," "Hyperion," &c., not to mention a host of lesser lights, are alone worth all the money. I heartily recommend anyone who has a few shillings to spend in books, to invest the same in back vols.—assuredly he will not regret it.

Leicester, Dec. 4. **W. S. Franks.**

JUPITER.

[20803.]—In the English Mechanic, Oct. 20, 1882, p. 159, I mentioned that some dark spots and patches had lately appeared on the north equatorial dark belt. These objects have recently become much more numerous, but their character has changed considerably. Spots extending north or south of the belt are now rare, and the normal appearance is an oval dark spot, in shape resembling the red spot, but generally much smaller, lying in a direction parallel to that of the belts, though occasionally they make a considerable angle. On Nov. 30th, at 12h. 10m., I saw a brilliant white spot just on the north preceding side of one of these dark spots, which had a striking resemblance to the equatorial whiter spots. It was quite bright and well defined, attracting immediate attention, as it occupies a very unusual position.

Several dark spots have also appeared lately just on the north edge of the south equatorial dark belt, and occasionally separated therefrom. These are rather small, but usually dark and well defined, and probably have the same motion relative to the other markings which the dark spots had which appeared on this belt towards the end of the last apparition—namely, about 9h. 49m. 14s. The belt itself retains the beautiful dark red colour, but the spots are blacker.

The red spot still remains very faint, although perfectly distinct and sharply defined, the dark spot on the following tip, seen since 1880, remaining quite apparent, and on a bad night is somewhat difficult to see at all. The curved belt just following continues to increase in size, and now forms a feature many times more conspicuous than the red spot. The continuation of this belt extends nearly round the planet, and apparently merges in the south equatorial belt, but a very little way preceding the red spot. **A. Stanley Williams.**

West Brighton, 2nd Dec.

BALL'S DIVISION WITH SMALL APERTURES—REFLECTORS VERSUS REFRACTORS.

[20804.]—Upon reading letter 20782, it recalled to my mind that I had often been puzzled by statements in "ours" of very great things being done by very small apertures; so as the night (Nov. 30th, time 10h. 30m.) was fairly good, I opened shutters of house, and brought an 8½in. Calver, with aperture reduced to 2in., to bear upon Saturn, with a power of 170, and, to my surprise, Ball's division was very plainly visible round the ends of ring; and with 3in., the division was "steadily visible, black and sharp," all round; also equatorial belt very distinct. The mirror is not at its best, as it has not been even dusted since Mr. Calver resilvered it in January, 1880: the flat has been polished once since, about a month ago. I tried a 2¾in. refractor, but no power could bring out the division; but it is perhaps fair to state the refractor is an altazimuth; the reflector an equatorial; the position of the planet near the meridian is getting a little uncomfortable for observing without a diagonal, too.

A rough micrometer for the measurement of sunspots may be made as follows:—Cut as fine a thread as possible upon a piece of thin steel wire; then file it flat from both sides, so as to leave it like a fine-toothed, double-edged saw; cut it to fit tightly in the lengthways in the diaphragm of a 40 or 50-power eyepiece. Of course, it wants finishing up smooth and covering with Berlin black.

J. Hildersley.

Fortess-road, Kentish-town.

THE CASSEGRAIN TELESCOPE.

[20805.]—Various correspondents have called on me to join in discussing the theory of the Cassegrain telescope. It would be a heavy tax on my limited time, and I trust they will not think me discourteous. I may briefly state, however, that my plan is to figure the large mirror to a parabola, and match it with the convex; thus, if thought proper, the large mirror can at any time be used as a Newtonian. If those interested in discussing the *theory* of curves will ask Dr. Royston Pigott, he will no doubt be willing to assist with mathematical formula, giving various proportions of focus and diams. for first and secondary mirrors to obtain certain powers and angle of field, &c. He has worked out a large number for me, several of which I have carried out for him.

To Mr. Holmes.—The fault is not in using too much reducing solution, I find. I use half the quantity of potash, and the results are better, as a rule. I am speaking of Mr. Brashear's method. The potash is a source of uncertainty, and it is often best to add it after all others are mixed, and suspend at once. But I advise the use of half Mr. Brashear's amount when films turn out chalky. Let us hear others' success this way. Mr. Brashear's is a capital method—the best, in fact. What is the commercial method? **G. Calver.**

TELESCOPES—CASSEGRAIN—GREGORIAN—NEWTONIAN.

[20806.]—In my last letter on this subject I said that certain rules could be used to check the results obtained by diagrams, and in this, my concluding letter, I propose to give such rules as seem most conveniently applicable to the purpose. I must first, however, ask my readers to correct the engraver's mistakes in the figure on page 205, by altering the straight line K L into a curve struck from the point E, to put the letter *e* at the middle of this curve, and to consider the dotted lines meeting at such point *e* as being "dot-and-dash" lines. Then since the rays converge to, and diverge from, the focus B at the same angle, it is evident that the diameters of the mirrors F H and K L are in proportion to their distances from this point B; that is, their diameters are in proportion to their focal lengths.

Calling F the focus, and D the diameter, of large mirror, and *f* the focus, and *d* the diameter of small mirror, we have

$$d = \frac{D \times f}{F} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

In the case given, we have $d = \frac{8 \times 6}{18} = 2{\cdot}666$in. for diameter of small mirror, or as it was given before = 2·7in.

In Fig. 2 the equivalent length of the Newtonian is deduced from this diameter of small mirror, and we may put the same thing into an algebraical form, thus:—Let N = the equivalent Newtonian focus, and let Δ = the distance of the focal point D in Fig. 2 behind vertex of large mirror, the other letters being as given above. Then, for the Gregorian:—

$$N = \frac{D\,(F + f + \Delta)}{\left(\frac{D \times f}{F}\right)} \ldots\ldots\ldots\ldots\ldots \text{(2)}$$

In this form of the expression, the sum of the terms within the brackets of the numerator is evidently the total distance from the vertex of the small mirror to its conjugate (back) focus behind the large mirror, while the denominator is a repetition of the expression for the diameter of small mirror. We may, therefore, say that in the Gregorian the equivalent Newtonian focus is equal to the total distance of the small mirror from the back focus, multiplied by the diameter of large mirror, and divided by the diameter of the small mirror.

In our example we have this distance = 18 + 6 + 3 = 27in., which multiplied by 8, the diameter of large mirror, and divided by 2·7, the approximate diameter of small mirror, gives 80in. as the equivalent Newtonian focus.

A more convenient form of expression may, however, be deduced, which is independent of the sizes of the mirror, the foci alone being used. This is—

$$N = \frac{F}{f}(F + f + \Delta) \ldots\ldots\ldots\ldots\ldots \text{(3)}$$

This would give N = 81, the difference being due to diameter of small mirror being only approximate in the previous working out.

If we start from the Cassegrain, we get the formula 2, with the terms within the brackets of the numerator changed by the + *f* becoming − *f*. Thus, taking *f* = 4in. (as in the diagram), we get the diam. of convex = 1·77, which would bring out N = 80in. nearly.

Similarly, by using foci only, we get the expression—

$$N = \frac{F}{f} \times F, \text{ or } \frac{F^2}{f} \ldots\ldots\ldots\ldots\ldots \text{(4)}$$

This would bring out N = 81in.

It seems a good place here to remark that though by these rules we may deduce certain values of *f* or N, or otherwise, such values are, to a certain extent, approximate only; for, besides what was said in my former letter as to results being varied by the focal images having in reality a certain magnitude, there is also the fact that the known focus for solar rays becomes an unknown focus for the conditions the small mirror is subjected to when in its position in either the Gregorian or Cassegrain telescope, because the rays then falling on it are no longer parallel, and even the amount of their "vergency" depends on the distance of the object. No abstract formula can take into account these varying conditions, so that all calculations are necessarily more or less wanting in exactitude.

There is yet a further series of rules which may be used to determine the focus, radius, &c., of the small mirrors; and in connection with this I am indebted to the investigations of an old friend, and one of your occasional correspondents. Referring once more to the diagram, Fig. 1, Coddington shows that if r = radius of curvature of small mirror—

$$\frac{1}{EB} - \frac{1}{ED} = \frac{2}{r}$$

Taking the values before given for the Cassegrain, we get $\frac{1}{4} - \frac{1}{17} = \frac{2}{r}$, which makes r = 10·5in., instead of 10in., as determined graphically. This shows that 4in. is (as before stated) somewhat too large for the focus of the convex.

The above expression may be put in another form. Calling EB = x, and B D the distance between foci = D, we shall have—

$$\frac{1}{x} - \frac{1}{D - x} = \frac{2}{r}$$

And from this we finally obtain a formula for x which for the Cassegrain hyperbolic convex is

$$x = \frac{D + r}{2} - \tfrac{1}{2}\sqrt{D^2 + r^2} \ldots\ldots \text{(4)}$$

Or for the Gregorian elliptic concave—

$$x = \frac{D - r}{2} - \tfrac{1}{2}\sqrt{D^2 + r^2} \ldots\ldots \text{(5)}$$

Taking, as in the diagram, a radius of 10in., the focus of Gregorian comes out 6·1 and of Cassegrain 3·9in. instead of 6 and 4 as taken originally. As these only differ $\frac{1}{10}$in. from those in the diagram, we obtain a proof of their practical truth.

It will be seen that in the above the back focus of small mirror is taken as being in its real position *behind* the large mirror, whereas in "O. V.'s" rules this focus was taken *at the vertex* of it. I have not "O. V.'s" letters here, where I write, so I am unable to compare the results obtained. Perhaps he will kindly do so. **A. S. L.**

SPECULUM-GRINDING.

[20807.]—At the request of Mr. Wassell, I send you a few instructions given by Edwards in November, 1782 (a hundred years ago). As Short and Mudge's instructions are very voluminous, I will, if requested, give some extracts from their modes of figuring specula. As in their time only metal specula were worked, and those with a hole through the centre for Gregorians, much may be left out, and only their modes of acquiring spherical and parabolic curves adhered to. Edwards says: —"In rough grinding, figuring, and polishing, two tools only are necessary besides a common grindstone. One chief reason why workmen do not give a good figure to their specula is that they use too many tools, which in a great measure destroy each others' effects. As nature always acts in the most simple manner, so if we always imitate her in this respect we should arrive at a much greater degree of excellence in most of our mechanical pursuits. Besides, the tools generally made are too large in diameter even to give a correct and uniform figure. All the tools I make use of are a rough grinder of tin and lead mixed together; this also serves for a polisher. This tool, with a bed of stones or hones, are all that are necessary."

The rough grinding he does on a grindstone; the edges are turned down by holding a piece of iron against them and so forming the curve required.

"Take it (the mirror) to a convex tool made of lead and tin, and grind the mirror on it with emery. This tool or rough grinder should be made of an elliptical form, and not circular, and of such diameter that the shortest diameter of the ellipse should be equal in breadth to the diameter of the mirror, and the longest diameter of the elliptical tool should be to the shortest diameter in the proportion of 10 to 9 accurately, for a reason to be mentioned hereafter.

"When the mirror is brought to a true figure it must be taken to a convex tool made of some stones brought from a place called Edgdon, in Shropshire, between Ludlow and Bishop's Castle. These stones are of a fine grain, and will easily bring it to a fine face.

"The bed of stones should be of a circular figure, but very little larger than the mirror—viz., about two-tenths of an inch, but not more for 4in. or 5in. specula. If the tool is much larger than the mirror it will grind it into a larger sphere, and by no means of a good figure. If the mirror and tool are of the same size exactly, the mirror will work truly spherical, but apt to shorten the focus less and less, unless the mirror and tool are worked alternately upwards. It had better be one-twentieth part greater in diameter than the mirror, when it will not shorten the focus.

"When the mirror is brought to a fine face and figure by the bed of hones, it is ready for polishing.

"The rough grinder of an elliptical form has to be covered with pitch; the harder the pitch, the better figure it will give. This has to be divided into squares, and about the thickness of half a crown; if the covering is too thin it will alter its figure through the heat from working.

"In regard to the parabolic figure to be given to the mirror, no particular caution is required in polishing. The elliptical tool will always cause the mirror to work into an accurate parabolic figure, supposing the transverse and conjugate diameters bear the same proportion to each other. I could easily give the reader the reason why an elliptical tool of a proper proportion will always give a parabolic figure, and, if the transverse diameter is increased, it will always give a hyperbolic figure; but as I am writing upon the practical part, and not theory, I will not offend his patience.

"To convince anyone of the certainty of my assertions, let him polish a mirror, 2½in. diameter and 9¼in. focal length, upon an elliptical tool, whose diameters are 2¾in. and 3in., and I can assert he will always find the mirror, when polished, beyond the parabola, or it will always prove hyperbolical.

"If he polishes it on a circular tool in the common way, with cross strokes in every direction possible, using first a few round strokes, he will find it will always prove spherical, and consequently short of the parabola.

"A very little experience in these matters will convince anyone of the ease and certainty of giving a mirror a parabolic figure by polishing it in a common manner only with cross strokes in every possible direction upon an elliptical tool of proper dimensions, in which, for common foci and apertures—viz., 2½in. to 9½in. focus, or 3·8in. in diameter to 18in. focus, the diameters should be 10 to 9. The shortest diameter of the ellipse being accurately the same as the diameter of the mirror, and the longest diameter of the ellipse to the shortest diameter—as 10 to 9."

Since writing the above, I see your correspondent "L. L. L." has sent an extract of Mr. Edwards's mode of grinding and polishing specula: but as the above is rather more in detail, I thought it might prove acceptable to Mr. Wassell, and others.

Southwick, Sunderland. **W. S. Scott.**

FLATS OUT OF PLATE-GLASS.

[20808.]—Mr. Holmes (20754), with his usual misconstruction has asserted that I state *my* letter is "a war of words." *That* I deny. Now as Mr. H. has attacked the Gulliver of my argument with his archers of Lilliput, I will endeavour to pluck out the arrows in the order of delivery. 1st. I have already stated that the colour-test is good for the amateur and gave instructions in "How to Make a Flat," that give the amateur a chance of applying it. I should not depend upon it myself. 2nd. I see that "the dread Archer," has removed from us one of the gentlemen Mr. H. quotes. In the midst of his usefulness, Dr. Draper is cut off. While here, to quote from Mr. Brashear's last letter, "He hath done what he could." No one can earn a higher tribute to his memory than this. How few amongst us earn this? Mr. Brashear has already admitted the danger of the colour-test, and has not proved to me by anything else, that the colour test is a better test than the telescopic test, and as it is admittedly dangerous, it is a worse one. 3rd. The words of Mr. H. I here quote:—

"The statement that it (plate-glass) cannot be ground and polished unless annealed, every workman knows to be incorrect." I hold my breath. I years ago knew a person with great experience in one of the largest plate-glass works in the kingdom. He informed me that annealing was the great essential, that some of the sheets of metal became disintegrated in the grinding, others in the polishing process, if there was the least defect.

I have myself experienced this in flint-plate and crown-glass. I question whether any workman has ever tried in a plate-glass factory to work up intentionally unannealed stuff. And I assure Mr. H. that attempts in the smaller way of the optician's shop have been failures. Again, the cut of the diamond is no proof: I find the same effect in cutting up the most perfectly annealed optical crown. This results from the impossibility of maintaining uniformity of pressure in the first place, and in the second, the want of *chemical* cleanness of the surface, which causes the bite and slip of the diamond. 4th. Mr. Holmes does not know as much of plate-glass as I do, or he would know that it can be cut up, is cut up, has been cut up, and will be cut up, not only without disturbing the optical perfection of surface obtained in the plate, but without destroying its optical parallelism, if that has been obtained in the sheet. He would also know that flats of every description made of plate-glass, are freer from error worked in sheet and cut up after, than in any other way. Mr. Holmes must first get a 10in. plate *optically flat* and cut *that* up before he stands on the same ground as myself. And he then must admit that it can be done, even if he cannot do it himself. I have had considerable experience in teaching amateurs—in fact, have much delight in doing so; but I have marked how rapid the change is from the ignorant to the hypercritical. Mr. H.'s second paragraph contradicts the experience of many besides myself: a Nicol prism detects errors of annealing in glass 1in. thick in practice. If, as Mr. Holmes says, the Nicol prism did not show the want of annealing in thicker glass, it would not serve the purpose it does in the optician's workshop. Against my will I have touched this matter again for the sake of all readers of the English Mechanic. I do not assert without experience. Another time I will attend to the last paragraph of Mr. Holmes' letter. **Prismatique.**

REFLECTORS VERSUS REFRACTORS.

[20809.]—In reply to letter 20782, I presume there is an error in the address, as the person whose name is appended to it no longer lives there. My experience of a 3in. Wray is confined to a single evening, and obviously is insufficient to base any decided opinion upon. The definition was very fine on Saturn, but of course the quantity of light was not equal to that of a mirror twice the diameter. The remainder of the questions I cannot answer, except that a 6in. mirror would certainly show the division better than a 3in. o.g., and that I should hardly expect a 3in. to show it very steadily. **Edwin Holmes.**

CROWN-GLASS ACHROMATISM.

[20810.]—In a letter which appeared a few numbers back, by "Orderic Vital," he uses words to the effect that he is still unconvinced that "perfect achromatism" is attainable. I suppose he means attainable by either of the methods which I have proposed in your columns. In common, doubtless, with most of your readers, I entirely agree with him. I never intended to claim anything more than an *approximate* achromatism. In fact, anyone who has worked out the formula for himself will see that both for chromatic and spherical aberrations, it is only a question of approximation. Perfect correction is in no case attainable, not even in the human eye, which is the most perfect optical instrument with which we are acquainted; and even here, experiments show that, though highly achromatic, it is not perfectly so. It is doubtless achromatic in the same sense and from the same cause that a "Wray" o.g. is—namely, because the light passes through two media of unequal dispersive powers, and since *all* rays cannot be achromatised by such a combination of two lenses, there will in each case be more or less of a secondary spectrum; this it is which experiments show to exist.

One advantage which it is hoped will be gained by the first method proposed in the first article in these columns on the subject is that when achromatism is produced by the separation of lenses of the same material there is no secondary spectrum. See Parkinson's "Optics." There may or may not be circumstances which counterbalance this advantage, but most assuredly the mistaken view which both "O. V." and myself fell into at first sight, namely, that when the concave lens is of longer focal length than the other, it must occupy the place of first lens—i.e., that which first receives the light. If this were true, it would imply that the deviation of a ray is different according as it enters at one end of the system of lenses to what it is at the other—the which is manifestly a paradox, in that it depends neither upon the form nor upon the order of the lenses.

I had intended, in the concluding article upon the telescope, to have directed attention to one or two defects (which, however, I believe to be only small ones) in the case where rays are made to converge to a common focus: but that I have lately had such a severe illness that I am afraid that my mathematical inquiries, except those of the simplest kind, have come to an end. However, I hope, some time or other, to be able to get a telescope constructed on one or other of the forms that I have advocated; and if so, I will send an account of its performance. **W. G. P.**

THE LATE DR. DRAPER.

[20811.]—My dear friend, Henry Draper, is no more! It is difficult, in the shade of the tomb, to accurately judge his useful life; but I have thought the readers of the English Mechanic would be glad to know more of him than the usual brief obituary.

Henry Draper was born in Prince Edward County, Virginia, on the 7th of May, 1837, his father, Dr. Jno. W. Draper, being a professor in Hampden Sidney College at the time. His father removed to New York in 1839, becoming connected with the university of that city, in which Henry was educated, taking his degree of M.D. in 1858. A year was then profitably spent in Europe; and it is noteworthy that his after career was largely influenced by the interest he took in going to see Lord Rosse's great 6ft. telescope while abroad at this time.

On his return in the autumn of 1859, he served on the house staff of Bellevue Hospital for 18 months; and on his retiring from that position, he was called to the chair of Physiology in the Academic Department of the university. In 1866, he was also appointed to fulfil the same duties in the University Medical School, but had hardly occupied the chair before the great fire at the Academy of Music swallowed up its neighbour, the Medical School, with its unique collection of apparatus and specimens of all kinds.

Here young Draper appeared in his true place, for scarcely had the ruins in Fourteenth-street cooled before he was negotiating for temporary quarters for the school, and raising funds for the present elegant Twenty-sixth-street edifice. After seeing his college again prosperous, Dr. Draper was compelled to resign his professorship in the college, in order to assume the functions of managing trustee of the estate of the late Cortlandt Palmer, whose daughter he had married in 1867.

While an undergraduate, at the age of 20, he carried on an elaborate series of experiments on the "Functions of the Spleen," in which he made extensive use of photo-micrography, and discovered the value of the proto-chloride of palladium as a negative intensifier.

About 1860, after much thought, he commenced the building of his famous 15½in. silver-on-glass reflector, which he used to make the negative for his well-known 50in. photograph of the moon, the largest yet made, I believe; and in 1864 he published his monograph on this telescope in the "Smithsonian Contributions," which is yet the standard treatise on the subject.

The 15½in. was an altazimuth, but was so successfully used that Draper decided to make a larger one, mounted equatorially; and after incredible labour he finished in 1872, and mounted his celebrated 28in. reflector at his country seat at Hastings-on-Hudson. With this, by using the gelatino-bromide processes, he has photographed more than one hundred star spectra. In 1872 he made a photograph of the diffraction spectrum on one plate, going from a wave-length of 4350 (G.) to 3440 (O.). This plate possesses so much real merit that Secchi has reproduced it on steel in his great work on the "Sun," and the British Association lithographed it for their 1880 proceedings.

Dr. Draper accompanied the American Transit of Venus expedition of 1874, as "Photographic Superintendent," by request of Congress, which appreciated his efforts so highly that it awarded him the unique honour of a gold medal bearing the inscription: "Decori decus addit avito."

His "opus magnum" was his 1874 paper on "The Discovery of Oxygen in the Sun," in studying which subject he used a diffraction grating of 17,296 lines to the inch. This paper excited intense interest and some opposition; but the present consensus of opinion hails it as one of the crowning glories of 19th-century science.

In 1877 and 1878 he visited the Rocky Mountain region on scientific business, in the latter year to observe the total eclipse of the sun. This he successfully photographed, getting an excellent diffraction spectrum of the Corona, which was found to be continuous.

The winters of '80-81 and '81-82 were largely devoted to the photography of the nebula in Orion and its spectrum, getting an especially good negative on Sept. 30, 1880. He also was very successful with the comet of June, 1881.

After the death of Jno. W. Draper, on January 4, 1882, Dr. Henry Draper succeeded his father as Professor of Chemistry in the University, and occupied it till his death.

During his Rocky Mountain expedition, Dr. Draper caught a cold, which never fully left him; but he considered himself fairly well till, while at dinner on Wednesday evening, Nov. 10th, he was seized with pleuro-pneumonia, of which he died at 4 o'clock on the morning of Nov. 20th, 1882. He leaves a widow, but no children. His two surviving brothers are Dr. John C. Draper, Professor of Chemistry in the University Medical College, &c., and Daniel Draper, Ph.D., Director of the Meteorological Observatory at the Central Park, New York.

Few men had more friends than Henry Draper, and none deserved them more. American science can never adequately fill his vacant place.

Roi ne Puis Souza Je Suis.

(Bac. Sc. et Med. Dr. Univ. Neo-Eboracensis.)

[Our own obituary notice anticipated many particulars given above, but we cannot but insert this testimony to the merits of its subject from the pen of one of Dr. Draper's oldest friends, and one of our oldest and most valued correspondents.—Ed. E. M.]

AUTOMATIC REGULATORS FOR GAS.

[20812.]—The regulator described by M. Saignol, referred to on p. 293 of your last issue, has been used by myself for more than twenty years. It is satisfactory in some respects; but is not at all likely to come into general use. It is expensive to make in a reliable form, can only be adjusted and altered by adding or removing mercury, which is exceedingly tedious and troublesome, and it requires a large bulk of mercury, which renders it slow in working. Screws, and other methods of regulating, have been tried in many forms, with the result of practical failure. A good gas-regulator, which will work at any specified temperature, is yet a thing of the future. All known have objections and faults which prevent their general use. **Thos. Fletcher.**

Museum-street, Warrington.

THE BLOCK SYSTEM.

[20813.]—Several railway collisions have recently occurred in consequence of "mistakes" made by signalmen in the working of the absolute block system. In former letters I have pointed out that the only effectual remedy is to make it electrically impossible for a signalman to give "line clear" until the train itself has registered its own clearance of a block section. The Sykes system of electrically interlocking signals and block instruments, also the Hodson and other methods, will be found fully described in the English Mechanic.

In America, a system is now receiving very great attention, and is likely to be largely adopted in that country—it is the Union Switch and Signal Company's "Constant Circuit Rail System."

The line is divided into the usual block sections of a mile or so in length; the joints at the end of each section of rails are insulated from the adjacent ones. At one end of the section there is the usual battery, one pole of which is attached to either rail, while at the opposite end is placed the magnet, one electrode being attached to either rail; this magnet will, of course, give signals upon any form of block instrument, either disc, needle, or miniature semaphore. Thus it will be seen, that a constant metallic circuit is established through the rails and block ,instrument, and that *no telegraph wires are required*. The signal indicating "line clear" can only be given when the electric circuit is complete; when a train enters upon the section from either end, or from a siding, the wheels and axles instantly short-circuit the current, and the magnet being demagnetised, releases its armature, and the signal is thrown to "danger," where it remains as long as a train or even a pair of wheels is on the section. If the line be torn up, a rail taken out or broken, so as to destroy the metallic continuity, the electric current will be interrupted and the "danger" or "line-blocked" signal will remain exhibited, and, as the electric and outdoor signals are electrically interlocked, it is impossible for signalmen to make mistakes.

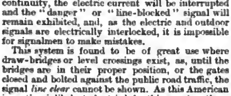
This system is found to be of great use where draw-bridges or level crossings exist, as, until the bridges are in their proper position, or the gates closed and bolted against the public road traffic, the signal *line clear* cannot be shown. As this American invention is likely to be tried in this country, there will be opportunities of testing its practical working. **Clement E. Stretton.**

Saxe Coburg-street, Leicester.

JERKS IN RAILWAY TRAINS.

[20814.]—With respect to this subject, I have read the letters of your correspondents, Messrs. Stretton, Brown, and Molison, with interest; but by practical observation of the "jerks," I must say that I agree with the opinion expressed by Mr. Stretton, and that I consider the theories put forward by Messrs. Brown and Molison are not tenable.

On page 209, Mr. Brown says: "Such a motion of the carriages" (i.e., as Mr. Stretton explains it) "would cause the passengers to jerk *towards* the engine." I confess I cannot see Mr. Brown's reason. Mr. Stretton says that the fore part of the carriage is below its usual position, and the hind portion consequently above; and that it is the "righting" of the carriage that causes the jerk. In my opinion, such a movement of the carriage-frame would tend to jerk the passenger *away from* the engine. I can better illustrate this by means of a figure. A B is the normal position of the carriage-frame; A'B' its assumed position when the brakes are on. The frame, in "righting" itself, will describe small arcs, A A'B and B B', of a circle, having O, the middle of the frame, as centre. The direction of the arrows will show the direction in which the frame turns. The tendency of this movement will be to throw the passengers *from* the engine, and not *towards* it. I need not say that my figure is greatly exaggerated in order to show the meaning better: the angle A O A' ought not to be so large. Mr. Brown also says, at the end of his letter: "If the passengers will sit quiet, and wait until the train stops, they would not experience any inconvenience." It is evident from this that Mr. Brown has not had the "pleasure" of experiencing this jerk, or he would not make the above statement. As a pass-holder on the Midland Line, I experience the jerk every day, and have opportunities of noticing its effect. The jerk is exceedingly unpleasant to such people as sit still: those people sitting with their faces to the engine being jerked against the back partition with some violence. It is also evident from Mr. Molison's letter, on page 230, that he, also, has not experienced the jerk. He says: "The way to prevent this effect is *not to rise from your seat* until the train has stopped." As I said above, the seated passengers *do* experience the jerk. Mr. Molison goes on to say "because in the sitting position (especially with your back against the rail) the body more readily accepts the varying movements of the carriage." I happened to be in one of the Midland trains when reading Mr. Molison's letter, and immediately put his theory to a practical test. When the brake was put on I propped myself against the back of the carriage (face to the engine), having the back of my head and my back pressed against the partition. When the train stopped I again experienced a violent jerk. My back and head, being pressed firmly against the partition, did not move away from it, but were jerked forward *with* the partition. This shows that it is *not the "inertia" of the passenger*, but *the movement of the carriage-frame*, that causes the jerk.



Apart from the above, I made experiments myself with a glass of water, as stated by Mr. Stretton on page 253. I give the results of my investigations.

(1) In a short carriage, fitted with the automatic vacuum brake, a great deal of water was spilt, half to two-thirds of the glassful. This with a very quick stop.

(2) In the same carriage, an ordinary stop being made, nearly the same amount of water was spilt.

(3) Same carriage. Very gradual stop. Less water spilt—about one-third, in one case a little more, nearly half.

(4) In a carriage (small four-wheeled) at end of train, and not fitted with the brake, very little of the water was spilt, only about $\frac{1}{10}$th part.

Mr. Stretton says in his last letter on this subject, on page 252, that the jerk is more violent in the short than in the long carriages. I have not yet made experiments upon this; but will do so in a bogie-carriage and report the result.

Meteor.

[20815.]—The reiteration of statements cannot contradict facts: and the mere reiteration of assertions will not lend weight to an argument. On p. 161 "S. J." put a pertinent question to Mr. Stretton, and received a satisfactory reply—that gentleman being presumably acquainted with the brakes on the trains specified. Two correspondents "corrected" Mr. Stretton from their point of view; and because I ventured to point out that they had looked out of the wrong window, you were last week favoured with two letters of a lively, if not smart, character. When I wrote my letter, which appeared on p. 272, I was under the impression that both Mr. Stretton and "S. J." were perfectly familiar with the very elementary facts retailed by Mr. J. Brown and Mr. Molison; and having pointed out very briefly that Mr. B. and Mr. M. had answered something that was not asked, I ventured to give my experiences as to where the "jerk" in question could be experienced to its full extent. Mr. Brown, on p. 295, retorts with three assertions, neither of which I have denied; but, unfortunately, he throws no new light on the subject. Had I known personally the brakes used on the lines specified by "S. J.," and been also fully informed as to the manner of their application, I might have explained the cause of the jerk; but in pointing out that your correspondents had not answered the question, I made certain statements which I evidently intend to stick to. I repeat—1. That the jerk to which "S. J." referred will be felt whilst the passenger is sitting (of course it will not affect him so much as if he were standing), for I have experienced it hundreds of times. 2. Mr. Brown has correctly stated the effect of the buffer recoil—a point not in dispute, though there are circumstances in which his dictum would not hold good. 3. Tramcars are out of the question.

I am not going to follow here the example of Mr. Brown, and protest—for he protests too much; but I will ask him what sort of a jerk would be experienced under the following conditions:—

Suppose a train of 10 coaches, with brake-vans at front and rear, and long buffers. The rear guard puts his brake down hard; the buffers throughout the train barely touch. What sort of a jerk is it when the brake is released? Mr. Brown will see at once that he has misunderstood what I said about the buffer-springs exerting their power; for in this case it is the drawbar-spring and the "righting of the carriage" (alluded to by Mr. Stretton) which produce the jerk. I specially mentioned the North London line, because it is on that system that I have experienced the jerk most markedly; and it is clear that "S. J.'s" question arose from the fact that actions for damages have been raised by persons who have had arms broken or ankles dislocated by being thrown on to the platform by this movement of the carriage.

On our local London lines we have a great variety of brakes and arrangements generally. Many of the trains have practically no buffers at all, being coupled up closely with buffer-rods bearing directly on springs. The recoil from these is very small, and is certainly not the cause of the jerk to which "S. J." refers, and which Mr. Molison will have it I regard as the cause, though it would have the "opposite effect."

It is my turn to protest now, and I do protest that writers in the English Mechanic, even though they are "science teachers," should at least credit their brother-writers with the bare knowledge of such facts as are to be learned from textbooks, and be careful that, before "correcting" such men as Mr. Stretton, they clearly understand the question. I wonder whether Mr. Molison ever heard that classic quotation, "Teach not a parent's mother to extract the embryo juices of the egg by suction: that good old lady can the feat enact quite irrespective of your kind instruction." However, he makes amends; for does he not say, p. 295, "*the* particular jerk which does occur, and which I have myself experienced, is not so clear as to its cause"? Hear, hear! Why, he is beginning to see that what he has previously said has nothing to do with the question, and I am beginning to hope that my admonition will not be thrown away. Mr. Molison has an amazing capacity for misconceiving, though. I thought, from some remarks in a previous communication of his, that he set a great value on a name appended to a letter, and thinking that perhaps bodily weight might be of some importance in estimating the value of arguments, and age of more importance than either name or weight, I offered to supply mine; but he has taken my offer in a manner which is, to say the least, ludicrous.

If Mr. Brown will consider the conditions of a given brake, and the manner of its application, he will perceive that his answer is not all that is needed. So far as it goes it is correct enough; but it does not meet the special conditions—in fact, is wide of the mark. It is not to be expected that the authors of text books can deal with all the details of a special case. It is their business to teach principles; and without modification they are apt to be wrested from their application by, as in this case, those who obviously have no experience worth speaking of in connection with the action of brakes.

Nun. Dor.

SAW-SHARPENING.

[20816.]—F. Carre's illustration and description of saw-sharpening (letter 20788), should prove a boon to amateurs to whom saw-setting is, to say the least, not at all an easy process. To my eye the teeth resemble, so far as filing goes, the lightning-saw teeth of the saws introduced from America, but I think are easier to form. My brother recently bought one with coarse teeth on one edge and fine ones on the other, a very neat tool at, I think, 5/-, but I did not try it. Evidently it has no set, but the filing appeared to me to be cunningly done—one more American puzzle added to the 15, and the jumping frogs. From the description, I should certainly expect the saw to cut as cleanly as a knife edge. I shall try it forthwith. **O. J. L.**

MEDICAL REPLIES.

[20817.]—"R. M." (48648)—Quinsey and Sore Throat (48744)—Rheumatism (48792)—Ringworm (48795)—Discharge from Ears (48787)—Diabetes (48738).—All these queries are, from one cause or other, ineligible for useful reply. I cannot write out a treatise upon diabetes apropos of no practical point, and the disease is one for which the patient needs careful personal supervision by a skilled professional man. I have never heard of "Dr. Felizet's treatment." Refer to former reply upon diabetes. On discharge from ears I have twice written in back numbers, and have said all that can be said with advantage. Ear disease is sometimes fatal, because the ear occupies a bony case which extends into the brain, and, therefore, disease affecting this bony case causes effusion of pus within the cranium, and fatal compression of the brain. The remedy, then, is trephining of the skull behind the ear. Ringworm is diagnosed by examining the roots of the hairs by means of the microscope, and its cure depends upon the accurate removal of the crusts, and the application of substances which exterminate the vegetable parasites which infest the hair follicles, just as a gardener would destroy weeds in a gravel-walk by sprinkling salt upon them. If she really has ringworm, your getting a "bottle of medicine" for her is as much use as greasing her nose with a tallow candle. The application of iodide of sulphur ointment, after careful removal of the crusts so that the ointment really reaches the parasites and soaks into the hair-follicles, is the remedy. But it must not be used so freely as to irritate the scalp and produce erysipelas. The use of a large soft poultice, smeared over lightly with soft soap, is the best application for the preliminary cleansing. But get competent medical advice, so as to settle first that your child really has true ringworm, and next to direct you as to the detail of the application of the iodide of sulphur ointment, or other suitable application. Ringworm is intensely infectious by means of towels, sponges, brushes, combs, &c. The publication of mere personal prescriptions would be of no general interest to the readers of the "E. M.," and would be hazardous to the querists themselves, as, given without accurate diagnosis and estimate of constitution; such prescribing would do much more harm than good, and would occupy space and time that cannot be afforded. When, again, as in (48792), one is asked to prescribe for a case under medical care, and obviously needing it, my replying would be unprofessional—not as any matter of medical tradeunionism, but as upsetting the patient with his doctor, and doing him much more harm than good in the long-run. Such cases are necessarily ineligible, as also are many cases utterly vague in description, and which need personal investigation before they can be realised. Of these, queries 48648 and 48744 are typical examples.

On Drinks (48752).—This subject is one of so much general interest that I may well occupy further space upon it. I think it a mistake to drink strong tea when we merely need water; but as to suggesting a practical substitute, I confess to being often in considerable difficulty, owing chiefly to people's acquired tastes. One would premise by asking the reader—Does he eat and drink to live, or does he live to eat and drink? For such as practically live in order that they may eat and drink, I think it matters but little in what way they wear out their viscera and extinguish themselves. But for refined gourmets who, while enjoying their eating and drinking, as healthy people enjoy the performance of all their natural functions, yet eat and drink in order to supply their bodies with energy in the best way, and not as a mere animal indulgence, the question is one of large and practical interest. Now, such people in eating and drinking should aim to get the largest amount of energising food at a minimum of cost and at a minimum of wear and tear to the digestive and scavenging viscera of the body fed. To enter upon these interesting food questions would be to travel beyond the question. But the question of drinking has to be considered from the same standpoint, inasmuch as, though drinking is not intended to supply the body with food, yet it should be regulated upon the same principles. While the food may accurately be compared to the fuel in the furnace of a steam-engine, drink has no very perfect analogy in mechanics that occurs to me at this moment. But want of water is much more rapidly and painfully fatal than want of food. Water in the system plays the part, first, of a solvent; second, as a vehicle for carrying the dissolved food into the system, and afterwards from one part of the system to the other in a ceaseless circle of water-carriage movement; thirdly, of dissolving out of the tissues all effete matters and carrying these off to the scavenging organs, such as the lungs, kidneys, bowels, and skin. Now, in cholera, where vast quantities of aqueous dejections occur, the blood becomes thick, treacly, and viscid, and all the functions of the body are obstructed inversely in the order of their necessity for the maintenance of existence. First, The oxidation of food is diminished, and the temperature of the body rapidly falls; Secondly, the elimination of refuse matters other than by the bowels is diminished variously, and effects, practically of poisoning by these retained matters, takes place. Such are the violent muscular cramps which torment the patient for hours previous to death. In slower forms of death from want of water, as on shipboard or in boats at sea, maniacal symptoms are ushered in by the fearful thirst, and these are largely due to retention within the blood of effete matters which, while the blood is adequately liquefied, are carried off in solution by the kidneys. Now, these forms of death are only extreme developments of the appetite for water which we call *thirst*. In quenching thirst, it should be recollected that *water* is the only substance by which thirst can be met; and that intermixing alcohol, coffee, tea, &c., with water, *in order to relieve thirst*, is a mistake. Neither alcohol nor any other liquid would do aught but hasten death from thirst. Much salt in the food makes one very thirsty. Why? Because an excess of salt having been taken into the blood, the kidneys hasten to turn it out of the system; and in turning out the salt, they have to eliminate a large quantity of water in order to dissolve it and carry it off: thus the blood is left too thick, and the person feels thirsty. Now, one reason why beer-drinkers go back so soon and so repeatedly to the public-house is because salt is put into their beer for them; and, taking the effect of the salt and of the alcohol together, there is no doubt that beer aggravates thirst instead of quenching it. Beer-drinkers imagine that abstainers from alcohol drink "a lot of cold water." But, in point of fact, it is the beer-drinkers who drink the "lot of cold water." Any beer drinker who goes to the food department of the South Kensington Museum will there see the constituents of the beer all separated in a visible form in their proper proportions, and he will learn that, out of twenty pints of beer that he buys, nineteen are water! Nearly one pint is alcohol, and the rest is treacly residue, with salt and other unimportant constituents. The treacly matter represents the food material, or residual barley, left in the beer. The alcohol may be partially oxidised in the system, but its effects are chiefly felt in taking the edge off those sensibilities by means of which the system is conscious of fatigue; and a large part of the alcohol is exhaled by the lungs and skin, as is shown by the smell which emanates from the drinker. The salt gives a certain piquancy to the flavour of the beer by irritating the nerves of the tongue, and it serves also to set the kidneys going and bring the customer back to the public-house. Beer, when taken at meal-times by those whose stomachs have been trained to look for it, provokes a secretion of gastric juice, and its alcohol is rapidly washed out of the stomach, in order that the solution of the food may not be hindered. If stronger alcoholic beverages are taken, such as wine or spirit, digestion is more completely arrested pending their removal, and, as is well-known, if the glass of wine be repeated too often, digestion is altogether prevented, and a few hours afterwards the food has to be returned by the way it entered. In this case it is generally said that "the salmon has disagreed" with the unfortunate diner-out; but I have generally observed that the capacity for walking straight is as much impaired as is the capacity for digesting food, and, unless when wine had been taken largely, I never saw "the salmon" make a man ill. Against tea or coffee not very much is to be said, and I never knew of a police-court case in which the defendant ascribed his violence to having taken too much tea or too much coffee. *But for the quenching of thirst, tea and coffee are bad.* The habit of drinking strong tea, or black coffee, directly after dinner, is especially bad, and certainly interferes with digestion. At breakfast time a healthy man has all his sleep in him, and surely it is then unscientific for him to inflict upon his system strong tea or coffee. At "tea-time" tea or coffee may well be indulged in moderately; the bulk of the day's work is done; the body not only wants rinsing out, but fatigue is felt which may well be counteracted by the use of a mild stimulant, such as tea; and bedtime is not yet so near that sleep is thereby interfered with. Most nations that drink coffee largely get a sallow skin; and I am inclined to think that the carbonaceous matter of the roasted coffee, when so largely and frequently taken, may perhaps have something to do with this. For hardworking people, who are not corpulent, I should suggest the thick flake-cocoa as the healthiest and most nutritious breakfast beverage. For those who do not want fattening drinks, and who often cannot digest cocoa, I should say drink hot water at breakfast. Those who dine late, and make their dinner their main meal, need a diluent drink an hour or two afterwards, and if they drink tea it keeps them awake or makes them irritable and nervous. I find for myself that dining solidly, as I am obliged to do when I have done my work (7.30 p.m.), and often needing to work from nine to eleven, a tumbler of hot water brought into my study or laboratory is the best and wholesomest drink, and, after a few evenings, it will be as much relished as the usual draught of tea. The hot-water assists to complete the digestion of residual food, it acts upon the kidneys, and rinses out the effete matters, and thus will be found to wake one up sufficiently, and neither to injure the stomach nor to keep the brain awake after bedtime. In cold weather warm water is by far the best drink at dinner-time, and in hot weather a draught of warm water is far wholesomer and more cooling than cold or iced water. Upon my own dinner-table I always have some of Feltoe's (Albemarle-street) Speciality lime-juice cordial (a pure, finely-flavoured syrup of lime-juice, which is very cheap, and keeps perfectly in a decanter); a tablespoonful or two of this, and then hot water to fill up a tumbler, makes a nice wholesome drink at dinner-time or otherwise, when a mild sort of lemonade is fancied and needs to be had without preparation from the fresh lemon. The use of iced-water is one of the destructive habits in which our American cousins indulge—not because it cools them or quenches their thirst, but simply because they have acquired bad habits and have demoralised their palates. At an hotel in the United States, guests will be seen sipping hot coffee, iced milk, and other things alternately, as well as devouring, in no time, a vast quantity of viands, on the principle of "devil take the hindmost," and mixing up in their mouths substances which to an ordinary Englishman seem to make a strange medley. It may be that the "devil takes the hindmost" at the hotel tables, but I am certain that afterwards the doctor gets the foremost; for nowhere else do we see such a nation of dyspeptics and such need for dentists. The difference between the heat taken into the body by a glass of iced-water or a glass of tepid-water is trivial, and is more than outweighed by the fact that the warm liquid relaxes the skin and promotes free perspiration and evaporation therefrom. The cooling effect produced by this evaporation may readily be noticed by observing the coolness which an afternoon draught of warm tea affords as soon as the skin relaxes. In fact, the hankering after iced-water is a mere itch of the palate analogous to that which a chewer or a smoker is subject to with regard to his quid or his pipe. There are heavy workers in glass furnaces, ironworks, &c., who perspire so freely and part with so much water to carry off the waste from their muscles that they need very large supplies of liquid for their thirst. Such men, if they take beer freely, break down early in life; and what they need is a tepid oatmeal drink, which not only keeps their blood at a proper point of dilution for rapid scavenging and for free evaporation, but also supplies them with harmless food-matter in considerably larger quantity than exists in the treacly residue which is left by beer when the water and alcohol have been distilled off. For such workers—in harvest-fields, at "coal-whipping," in puddling (an occupation which will probably be superseded), in stoking marine engines, in glass-works, &c.—the following drink will be found cheap, sustaining, and very healthful:—Boil a quart of good oatmeal in two gallons of water for fifteen minutes, and when done add a pound of brown crystallised moist sugar, then slice finely two lemons into a thick clean two-gallon cask, with a wooden tap. Pour in the boiling oatmeal and sugar, and then fix the bung. A 4½ gallon cask of this can be made for about a shilling, on beginning work at the foundry or before going to the harvest-field. It will serve a considerable gang of men all day with admirable drink and real refreshment. If the cask have been put into a strong box, the wooden tap and spiggot fixed in through holes in the end and top of the box, the space round the cask then rammed with sawdust, or, in its absence, with hay or other such non-conducting material, and the top screwed on, leaving a proper hole for inserting the bung after the oatmeal has been poured in, it will keep warm all day. If limes or lemons cannot be had, put in an equivalent quantity of Feltoe's lime-juice cordial for flavour. But, in this case, the fresh lemon—with its peel—all finely-sliced, should be used in preference, if practicable. A brass tap should not be used. I have no doubt that a man hawking this round such works, at a halfpenny a draught, would meet with abundant welcome, and do very well. Its cost would be about one-fourth that of beer; it would be absolutely wholesome, and it would contain twenty times the nourishment.

James Edmunds, M.D., &c.
Grafton-street, Bond-street.

LEGAL REPLIES.

[20818.] — Ground Landlord and Tenant (48657).—The lessee has clearly a right to deduct property-tax upon the amount of the ground-rent he pays; and this has nothing to do with the lessor's liability to income-tax. Neither can the lessee be compelled to give up the receipt he holds for payment of property-tax as occupier, for this is probably quite a different amount. But if the whole income of the querist is such that he is not liable to pay any tax, he can petition for its return, and he had better apply to the collector to get the forms necessary to be used for that purpose.

Purchase — Rent — Apportionment (48660).—Upon the completion of a purchase of land or houses the rent accruing due is generally arranged; together with the question of interest upon the purchase money, if there has been any delay. If it was agreed in this case that the current week's rent should go to the purchaser, then, of course, he has a right to it, and he had better sue C. for the amount in the County-court as money had and received to his use. Where there is no such agreement, and upon this point the question is not clear, the accruing rent has to be apportioned between the parties; but in neither case could C. keep it all, so the querist had better demand payment of him and then put him in the County-court.

Interest — Overdue Account (48684).—This querist is entirely wrong in this law. The question is not whether the customer can resist his claim for interest, but whether he has any right to make such a claim. No interest is payable upon an ordinary account, however long it may be overdue, unless by agreement. As one man cannot alone make a contract to bind another, the mere demand of interest upon an invoice is nothing unless and until it is assented to, either expressly or by implication from former payments. Bills of exchange and promissory notes carry interest by the law merchant, but certainly neither invoices nor accounts can do so. The querist can arrive at the same result by a system of discounts.

Churchyards (48685).—I will look into the statutes as soon as I can.

Mortgage—Seizure (48698).—I certainly cannot advise upon the effect of a mortgage without seeing it; but, presuming it merely comprises the house and shop, then upon default these only could be taken by the mortgagee, though probably he would also have power to seize the fixtures upon the premises. It seems unlikely that the stock, having been paid for at a valuation, was included in the assignment; but even this is possible; and, in short, the question cannot be fully and safely answered without my first seeing the mortgage itself.

Will—Vested Remainder (48703).—In the case put, as the estate is given to B. absolutely after A.'s life interest, B. takes what is called a "vested remainder." The result is that, upon the death of the testator, the absolute property in the estate passed at once to B. by virtue of the will, although he could not get possession of the estate until both life interests had fallen in. But as it was B.'s property, he could leave it by his will as he pleased; and his dying in the lifetime of A., or the widow, does not alter the legal position of the parties, and his will would operate, if valid.

Landlord and Tenant—Death (48720).—The tenancy does not determine by the death of the tenant, and his administrators take his position, and should give the proper notice to quit. For their actual use and occupation of the premises since the death they may be held personally liable; but for rent accruing due under the tenancy they could only be charged as administrators, and made responsible upon proof of assets. The notice should be given in proper time and form, and the house let, or the landlord arranged with, with a view to determine the tenancy.

Building—Tenement (48736).—There is no doubt that the owner of a flat has a right to support from the floor below, and generally from the house itself. As the adjoining tenement, by being so badly built, injures that right, he has a cause of action for damages against the builder. But I do not see how the purchaser of the flat can have any claim upon the builder to take it back again. There is, as far as I know, no such form of remedy in English law; but perhaps the property in question is in Scotland. Without fuller facts, and a perusal of the deeds, I cannot advise more exactly.

Will—Lapsed Legacy—Residue (48753).—If the daughter died without leaving children, her legacy would lapse, or fall into the residue. If the will was so badly drawn as to contain no residuary legatee, then this share would go to the executor for division amongst the next of kin. The will speaks from the death of the testator, and, therefore, this daughter's share would then be divided so that a third would go to the wife and a third to each of the sons. A. would thus get a third of his sister's share. As to B.'s dying intestate afterwards, that has nothing to do with A., for, as he leaves a widow and two children, they would take the property he left, she a third and the children two-thirds between them. This question looks very like a puzzle, put by the querist merely for amusement and not for information; but I have answered it, as it may inform others.

Father—Widowed Daughter (48755).—I believe the parish can compel a parent to support his child, even though she be over age and a widow. But an order would only be made upon summons, and after proof that the father had means out of which he could contribute.

Loan—Interest (48761).—The simplest legal form which B. could give would seem to be a promissory note upon a sixpenny bill-stamp, payable either upon demand or as may be arranged, with a statement of the agreed interest. With such a note the lender could always sue for his money upon default, and if interest were paid the note would be kept alive always; otherwise it must be renewed every six years, because of the Statute of Limitations.

Telephone—Patent—Infringement (48771).—I believe that the private user of a patented article is an infringement of the patent, rendering the party liable to injunction. If this is so, then the company would have a right to apply to restrain anyone using a telephone, although made by himself, and for himself, which infringed their patent. But I do not pretend to much knowledge of patent law, which is, in fact, a speciality in legal practice.

Bicycle—Agreement—Seizure (48779).—Presuming the agreement to be drawn as stated, the querist can certainly demand his bicycle without any further authority; and he can seize it, if he can obtain possession peaceably. But he will have no right to force his way into the hirer's house. The querist can also sue for the return of his machine in the County Court, after he has made a formal demand, which had better be in writing.

Copyholds—Enfranchisement (48791).—It is quite impossible to describe here the costly and complicated process of turning copyholds into freeholds, by means of the Acts for their enfranchisement. It can be done either with the consent of the lord, or in a compulsory manner. But compensation must be made, and the querist had better consult his solicitor.

Copyright—Quotations (48793).—In making quotations it would legally be enough to give the author's name, though, practically, it might be as well to add the work quoted from. As there is no treaty of international copyright between this country and America, works published there are not protected here, nor *vice versâ*. It is generally thought the Americans get the best of the business, and many eminent authors have agitated for a change in the law.

Will—Probate—Insolvency (48798).—The fact of a testator dying insolvent would not prevent his will from being proved, except that no one might care to go to the expense of so doing if it could not be paid for out of the estate. As to what special causes would prevent a will being proved, this is a question which might be answered in a volume, but not in these columns. Wills are imperfect in hundreds of ways, any one of which may prevent their being valid, and so being proved. No man should sign a deed without first reading it, and no respectable solicitor would wish any one to do so. The question, as asked, is an enigma; but if the querist will put it more plainly, I will try and answer him.

Landlord and Tenant: Executors (48806).—The executors are bound by the contract of tenancy entered into by their testator in the same way as he would have been himself; and they must therefore give the needful notice to quit according to the agreement. If they quit without notice they will be liable to pay the rent; either as executors, or personally, according to circumstances.

Trust Fund—Debt (48808).—Presuming that the money was held by A. in trust for the separate use of B., her husband, C., has no right whatever to the same. The £50 borrowed by C. of A. is, therefore, an ordinary debt; and if A.'s creditors can get an order attaching that money, I do not think the fact of A.'s still owing B. money would affect the question. But if such process, by means of a garnishee summons, is taken against C., he had better consult a solicitor, and be fully advised. Promissory notes, upon which no interest is paid, should be renewed within six years, or they become useless under the Statute of Limitations.

Landlord and Tenant—Repairs—Bankrupt (48816).—A landlord is not bound to do any repairs whatever, except by agreement. Presuming the three years' lease to be valid, C. can do nothing to get rid of the premises. The landlord's becoming bankrupt would probably not improve her position; and to find out this fact she must search at the Court of Bankruptcy, or in the *London Gazette*.

Fred. Wetherfield, Solicitor.

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STANDARD SCREW THREADS AND GAUGES.

[20819].—Having a quantity of small machines to make with all screws to Whitworth standard, I went to Buck's (Viaduct) for new taps, which he guaranteed were Whitworth standard, and that there was nothing made between ¼ 20, 3/16 24, and ⅛ 28 threads. After tapping some hundreds of holes and finishing machines I find that screws made to Whitworth standard will not fit my ⅛in. holes, and a large quantity of work is completely spoilt. I go to Churchill's (Finsbury). They sell American stocks and dies marked "Whitworth," as follows: ¼ 20, 7/32 24, 3/16 24, 5/32 32, ⅛ 40 threads. They also guarantee them "Whitworth." Are there two sets of gauges? I have several works on engineering. All give Whitworth gauge, but do not go lower than ¼in. What, may I ask, is really the standard? No one seems to know. Is it possible that the machine industry is of so little importance in this country that uniformity in screws is not necessary? Each sewing machine maker seems to have a separate set of threads. Why is this? Why should the "standard" be kept under a bushel? Might not the learned societies professing an interest in mechanical matters use a little of their ample funds for printing and publishing such useful tables, with a request that they be adopted, and thus aid in establishing uniformity? I notice in your valuable paper, under Scientific News, that the Board of Trade were revising (by compounding) the wire gauges. Any change, however slight, renders new gauges and tools necessary, and causes much expense and confusion. Why do they not make a clean sweep of the whole system, and call a spade a spade? Why should any system, in fact, be used that does not tell us the value without reference to some special gauge? Is No. 19, which means nothing, easier to remember than ·042, which means actual measurement, and again, why not equalise the divisions thus:—·040, ·045, ·050, the present ones being most irregular—viz., L.W.G. No. 28, ·138; 29, ·134; 30, ·125; and so on. In the metal trades there are six gauges in common use, besides many special ones; thus—Birmingham wire, Birmingham metal, sheet zinc, iron rod, Nettlefold's (wood) screw, and the Lancashire wire gauge in three parts from H1 to A1, from Z to A, and from 1 to 80, 114 sizes, the largest of which is under ½in. If the decimal division were adopted for measurements of 1in. and under, and made the universal standard gauge, all necessity for the various gauges would cease. We find the micrometer caliper (giving the necessary three decimal figures up to 1in.) is rapidly coming into use in many of the best shops and warehouses, as a means of comparison and reference, and that, as a universal gauge, is all we require. A change of some sort is very desirable, for brass, iron, and steel wire are drawn to the Birmingham gauge, while twist drills are made to the Lancashire gauge, and in very few instances can we find drills and wire that coincide. This subject is of the utmost importance to the mechanic, as exact measurements mean good work. I hope that some one capable of speaking with authority will give us the true Whitworth standard complete, and also that the subject of gauges may have the share of your space it deserves. **B. S. W.**

DRILLS AND CHAMFERS.

[20820.]—I think, in justice to myself, that you should allow me a little further space, lest any misapprehension should arise from the extraordinary letter of "Os" in this week's number. I should not object to any criticisim, however rigorous, provided it emanated from true authority; but the fact is, that "Os's" criticism is utterly untrue and misleading—at least, in some respects. He takes exception to my knowledge of chemistry, when indeed it is himself who is wanting in that respect; and what extraordinary notions of chemistry he must have, in truth, if he supposes it to be a science without exceptions to its laws. He cannot understand why aquafortis, by having soda dissolved in it, becomes increased in its corrosive effect upon steel. What a pity it is that his knowledge of chemistry seems thus to extend no farther than that acid and alkali neutralise each other. Allow me to enlighten him, then, by telling him that nitric acid requires to be weakened before it will act upon the metals. If he has any doubt of it, let him consult, for instance, Tomlinson's "Cyclopædia of Useful Arts and Manufactures," where he will find it distinctly stated.

Tubal Cain.

[20821.]—I must take exception to one or two of "Tubal Cain's" comments upon my letter under the above heading. In the first place, it is not a theoretical exposition, but a purely practical one. Theory has no part in it at all. I can guarantee to make, without difficulty, every drill and chamfer illustrated in it. With one or two exceptions I have the prototypes of those in my possession. I have made hundreds of drills in my time, both for sale and home use, and boldly assert that less difficulty would be experienced by any average workman in following my plan than would be the case with yours; and I have no hesitation in saying that my plan is more expeditious, more simple, and more available in practice. Again, in no sense is the work "altogether beyond the power of unprofessional hands." Had it been so, or had I thought so, I should have hesitated to intrude so much upon the all-too-limited columns of our valuable paper. I give you credit for an ingenious method of making; but I must tell you that you require about four times as long to make a drill as I should. I could make, harden, and temper a drill of a simple kind in about five minutes. Do you not see, too, that your method is only applicable to small or medium-sized drills, and in no sense is it applicable to making chamfers? I fancy, too, you will find that any of Holyoake's needles will not withstand the assault of a good Lancashire file, while a highly-tempered drill, hardened in the ordinary way, will be proof against one. I am very pleased indeed to know of your method of making drills, because it is quite new to me and, no doubt, very effective in a limited degree. **Alfojoe.**

DIE-ENGRAVING.

[28022.]—In answer to "F. C." (20790), the gravers used by copper, silver, or steel-engravers, are all similar; those used by wood-engravers are not suitable; but all have what you call mushroom handles. Figs. 3 and 4 are sections intended to be right size; as to length, break off an inch as directed.

The punches must vary in size, according to the job. Begin with a dozen or two, ⅜in. diameter in middle, varying from ⅛in. to ¼in. diameter at each end, about 2in. long, and shaped like left-hand end of Fig. 2, B.

If Fred. Carre looks again, he will see that he has put his nose to my rose; he is welcome. The rosebud is to be finished on the punch exactly as it is to appear on the paper when stamped; use fine file, and the graver marked Fig. 3, or you may first commence with the hand-graver like the fourth, marked Fig. 1. Before beginning this punch, look well at the Queen's head on a new coin, observe, firstly, it has a hard outline—that is, it does not anywhere soften off to nothing; secondly, the surface of the head is not flat, but is really a part of a very flat ellipse; or if you could borrow a lady's cameo bracelet, not too deeply engraved, and study that attentively, all difficulty would disappear.

The dies are sold by the makers of embossing presses at per doz., very cheap and good; they are never hardened when only used for stamping paper or cardboard.

To make an exceptionally difficult punch, do your best with file and graver as usual, then harden, and temper to a straw colour, drive punch into a spare piece of steel (the side of another punch will do), file the surface flat and take a squeeze, then with hand-gravers improve this matrix to the uttermost, harden, and temper;

soften the original punch, and drive it into this so-called "bed," and you ought to find it perfect.

To finish a die extra well, get a piece of bluestone from the tool-shop, split it like firewood, and make a cold chisel with a fine thin edge from one of your punches, and split up the pieces of stone to the size of a straw, and over an inch long: use with water, and don't press too hard, or the work will be grooved. **Gamma.**

COLOUR.

[20823.]—It is difficult to understand why people, who either do not understand the principles and objects of scientific research, or who disagree with its results, appear to feel so much irritation against the scientific methods and those who employ them. Mr. Calton, 20792, p. 296, comparing his definition of pure blue and mine, asks "may not both be correct?" Of course they can. No doubt they are each true from the different standpoints. But so far from seeing himself that this may be the case, he wants to maintain that the doctrines of scientific men are *not true*, and that his are. He probably realises clearly enough that it would be rather presumptuous for a man who knew nothing of pigments, proportions, and perspective to criticise and condemn his method of representing nature upon canvas. Yet he feels himself fully authorised, upon the strength of occasional looking through a prism (apparently in open daylight), to criticise and condemn the results of the life-working of men provided with the most perfect means of examining the phenomena they study. He seems annoyed because he is told that he is persistently mixing up two things which are utterly distinct, the action of light upon pigments and the colours in light itself. Nor will he recognise that these two belong to different departments—Art and Science. It is his business as an artist to study how to appeal to the senses and the imagination, and by what material means he can most adequately represent upon canvas the effects produced by the play of light upon natural objects—to furnish correct and permanent representations of colour. The scientific man has entirely different objects: as a philosopher he examines the nature of light itself, and the mode in which it produces colour; as a physiologist, he seeks the mode in which these external actions are received and perceived by the senses. These have no necessary connection; the artist and the scientist have no need whatever to dispute, if each will leave the other alone, and it is doubtful if the artist can assist his own objects by the work of the scientific theorist.

I, too, was much pleased with the experiments and diagrams of Mr. Hardie; they are truly and practically scientific, and their teachings are to be relied on. They mix *lights* properly, by first separating out the desired rays with certainty, and then recombining them. But Mr. Calton wishes to make modifications of them which would destroy their value, and make them unscientific; for this would be the result of using coloured glasses and gelatine films. The light from which may be whatever happens, but certainly not pure lights.

Before going a little into the subject, I may say I have no pretensions to be an authority upon it: it is not one to which I have given much time or study. But I have examined it as a part of the field of science, and utilised it both in connection with electricity and chemistry, and have taken care that my knowledge of it should be, if not wide and deep, yet clear and accurate, so far as it extends. Now, Mr. Calton, probably from want of that exact classification of ideas which science necessitates, manages to deduce error from truth. He makes some experiments with a prism, and talks about the rays overlapping as they spread. This is upsetting the first laws of motion of matter or of light. Motion, once imparted, proceeds in a straight line for ever, unless diverted by a new force; just what the rays are one inch from the prism, they are a mile away—they never overlap: but all spread out in an enlarging area equally. That spreading out and consequent dilution may alter their tone to the eye. Also, in looking through a prism close to the eye, only a part of the rays can enter the eye; by the act of rotating it we bring new rays on to the pupil; we do not mix those already entering.

Then Mr. C. says, laying down a law which is erroneous, "Now as blue happens to be a primary colour, it is evident it cannot be made by mixing other hues, any more than gold can be made from other metals." That is an excellent example of "begging the question." Blue is no more a primary colour than green is, *except on his own dicta:* he assumes the whole point, and then deduces consequences. That is not the scientific process, and his illustration will form a broken reed in his hand.

Gold is an element; no analysis breaks it up We can make imitation gold, which nothing but, analysis will distinguish from it. The senses perceive no difference. Blue is a primary colour, an element of light; each particular shade of blue can be separated, and referred to an exact wave-length of light. Exactly the same is true of green. But we can produce blues and greens which the senses cannot distinguish from the natural, by mixtures of light or colours. These, like the imitation gold, analysis can separate into their constituents.

Colours are primary and compound. What is the distinction? Every colour which has a definite wave-length, a fixed position in the spectrum, is a primary. Any colour which, analysed by the spectroscope, breaks up into two or more distinct wave-lengths, is a compound.

A given hue may be identical both as primary and as compound, and may be arrived at by several combinations. The explanation may be found by comparison with sound. Starting from a given note, which means a definite rate of vibration in the air, we can pass through a vast range of notes to the octave, which means a doubled rate of vibration. We divide that range of vibrations into seven parts, holding certain relations to each other which we call "the notes of the scale"; but these notes are defined solely by their relations to the vibration we start from; between them there exist numbers of possible musical tones.

Exactly so with colour: the visible spectrum is one octave of wave-lengths, divided into intervals by just the same proportions as those of the musical notes. These exact tones of colour we call the pure colours, and the intermediate ones, tones or shades of the colours. These pass from one colour to another by insensible gradations, and these are really just as definite individual colours as the series of tones which can be produced by tightening or shortening a string are definite individual notes. Mr. Calton calls this "blending by overlapping," and he is in error. Would he call a semitone in music a compound note produced by the overlapping of the true notes on each side of it? If he does so, a musician would tell him it is nonsense. But so it must be in the case of light, for the two cases are identical.

But we can blend two notes together; we can strike two strings, so arranged that their wave-lengths unite, and accord at regular intervals, and we have a harmony. We do the same with colours, and the combined vibrations may so accord as to produce an effect not to be distinguished by the sense of sight from that of a primary single colour of the same rate of vibration. This is not quite the case in music, because the ear has a higher power of analysis than the eye, and also because the musical notes are never pure: they always generate a series of higher and lower vibrations in addition to the true one; this being the cause of the varied sounds of the same musical note, as produced by different instruments—the *timbre*, as it is called.

Before Mr. Calton again calls a statement "vague" he should settle whether the vagueness is not in his own apprehension. I said, and say again, that a green can be fixed as definitely as a blue. There is no vagueness there; they can be fixed by comparison with their position in the spectrum, as a colour having such a "wave-length." Mr. C.'s definition of green is vague enough truly, "any mixture of colours in which blue and yellow predominate." Suppose you look at a green by means of a light having an excess of yellow or having no yellow in it, what is its colour then? Without waiting for "X. N. X.," I can tell Mr. C. that any colour seen by a sodium flame will be nearly yellow or black. The sodium flame is, however, not quite a pure D yellow, because the burning spirit throws a little light of other colours. **Sigma.**

[20824.]—I am glad to find Mr. Calton has begun to appeal to experiment. Will he permit me to point out that his method of producing a spectrum with sunlight is imperfect, and that he has not obtained a pure spectrum at all? The aperture through which the light is admitted is too large (was it a round hole?). It must be only a very narrow slit, parallel to the refracting edge of the prism. If Mr. Calton will employ such a narrow slit and turn the prism (having its edge parallel to the slit) so as to bend the rays as little as possible and not as much as possible, he will obtain a different result, in which the colours obtained will not "depend upon the distance the rays have to travel from the prism to the surface upon which they are seen." As it is, he has obtained several spectra overlapping, and the "clear space" dividing the blue from the red, &c., is simply the white light produced by the mixture of these different colours. As the screen is moved further away the distance from red to blue in each spectrum increases, and the "clear space" is lessened, and ultimately disappears; the green which makes its appearance, not being produced by mixture of blue and yellow, but being the green, which occupies the centre of the spectrum, and which was at first invisible because mixed with other colours producing white light. But no pure colour at all could have been obtained. Mr. Calton has such a contempt for "scientists," "scientific monopolists," and so on, that I suppose it is quite useless to recommend him to take any good textbook (say, Mayer's "Light") and proceed to test its statements for himself, patiently making the experiments as described. His account of his experiment with the prism shows that he has yet to learn how to make the simplest experiment. I would recommend the use of a small pocket spectroscope for the purpose of analysing colour.

In answer to the questions put to me I cannot admit that "the purest blue and yellow pigments obtainable give a vivid green"; on the contrary, the purer the colours are, the less does the resultant colour resemble green. The original blue and yellow are *pure* only if, when seen through the prism, they are found not to contain green.

A *red* surface illuminated by the monochromatic yellow light of sodium, is seen only to be yellow less intense than that presented by a yellow surface.

Mr. Calton's statement that "mixtures of pigments, properly illuminated, must necessarily produce the same results as mixtures of spectrum colours of the same hue is true, *if* the pigments are of pure colours; *but* no such pigments exist—at least, I have never seen such.

How does Mr. Calton know that blue is a *primary* colour?

"Sigma's" statement that "there are a number of different hues of pure blue and yellow," to which Mr. Calton objects as unscientific, is, undoubtedly "universally accepted." There are, in a pure spectrum, an *infinite* number of different colours, yet they are all included in the *seven* names generally in use—red, orange, yellow, green, blue, violet, indigo. Hence the term "blue" includes a very large number of different colours, all pure.

I will undertake to show Mr. Calton any number (say 10) different pairs of colours, which shall produce white light—not a "colour that may be taken for white" nor "white with a greenish tinge"—but pure white, which Mr. Calton himself shall be quite unable to distinguish, or to say what particular pair of colours has been employed. **X. N. X.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47450.]—**To Mr. Holmes.**—I can only repeat that quicksilvered mirrors cannot be decently repaired in the ways described by "W. T. S.": they can only be made a mess of. I know no way of doing it.—E. Holmes.

[47900.]—**To Mr. Lancaster.**—Many thanks for answering my query.—J. C. B.

[48036.]—**Shells.**—Solid drawn cartridge-shells you can clean in a solution of 2oz. of cyanide of potassium dissolved in two quarts of boiling-water; keep in stone-jar well covered. To use it, hang the shells on wire, put them in the solution for a minute or two till clean; take them out and plunge in cold water, then dry in pan over fire. The solution can be used for a number of times; always heat before using.—Bullseye Bob.

[48049.]—**Lathe (U.Q.)**—The directions given at p. 420, Vol. XXXIV., for making this very simple and effective lathe are apparently sufficient to enable any workman to fit one up. Such lathe, with "bars" made of gas-tube, turned true, and with a screw between these, would make an extremely light and handy tool. The Babbitt metal may be made to either of these formulæ:—

Copper	1·5	5·0
Antimony	13·	10·0
Tin	45·5	85·0
Lead	40·0	—

The latter being used by German locomotive makers. Full directions for casting in position are given as above quoted.—Ploni Almoni.

[48051.]—**Street Medical Coil.**—Not having seen F. Rowe's query, I do not know what he means. Is it an easily portable electro-medical apparatus? Then I advise him to procure my "Doctor's Walking-stick," inside of which are contained all requisites, principal and accessories, always ready for use, requiring no other liquid but a drop of water; its power can be regulated at will. Let him write to me, and I, with pleasure, will send him a full description which will enable him to make one himself. If F. Rowe be a medical man, I offer to communicate to him my invention of a system by which electricity is rendered pharmaceutical—that is to say, can be prescribed by physicians with the same precision as a poultice or a blister, in size, power, and specificity, prepared and kept in readiness by all chemists, delivered according to prescription, and applied either by the patient or his attendants. It must be understood that I offer it only to F. Rowe, and that I will answer to no other.—Ch. Rabache, Morchain, Somme, France.

[48068.]—**Eyesight.**—I have been waiting patiently for information about this query. Despite some assertions to the contrary, I am quite convinced that there is no pair of eyes, though the eyes may be equal for all practical purposes; one eye undertakes to look at near objects, the other at distant ones; if not, both eyes must at all times be equally used, and a perpetual squinting is the consequence, especially in looking at the 300th of an inch, the angle under which it is seen must be very great. I must add another point to what I said formerly about my eyes, which is that I often catch myself making a mistake about distances, especially at night, with regard to the surrounding objects. I hope some kind reader will take up the subject to oblige—Nigel.

[48135.]—**To Mr. Lancaster.**—I should consider it a great favour if Mr. Lancaster would send a sketch of the indicators to the "E. M."—Zu.

[48155.]—**Substitute for Hops.**—Johnston, in his "Chemistry of Common Life," says that the most honest brewer uses of cocculus indicus only so much (I forget the quantity). But it seems there actually and really was a real honest brewer who, in this query, tries to find out this poisonous picrotoxine in order to keep up his 40 or 60 per cent. of profit. If to this is added the fact that publicans and agents make three barrels out of two barrels, it is not surprising that one gets disgusted with the stuff often met with under a borrowed name. I am no teetotaller, but I have become exceedingly shy on account of all the drugs used in beer-making.—Nigel.

[48257.]—**Milky Way (U.Q.)**—There is an elaborate description of the course of the Milky Way in Herschel's "Outlines of Astronomy." No doubt it would be difficult to find two people who would precisely agree as to the boundary of the Milky Way: In fact, it is nearly as indefinite as the boundary of London (I don't mean the begriffined City, but the larger foggy mass usually so known.) Like London, the Milky Way sends off nebulous extensions in various directions into the unencumbered space around, and is in turn invaded by the inevitable "coalsack."—Ploni Almoni.

[48374.]—**Frozen Feed-pipes.**—This query is not clear—as to what is meant. Cannot heat be applied in some way?—T. P.

[48376.]—**Fret Saw.**—There are many of these illustrated in back volumes. The easiest way is to attach one end of saw to a coil spring by a suitable clip, and suspend that from an arm. Then attach other end of saw to a clip, which is at end of a connecting-rod worked either by a lever or a pin on a wheel. If you have not any back Nos., you can get an idea from the advertisement pages.—Essar.

[47381.]—**Galvanising.**—The process is very simple. The iron is scrubbed with sand, pickled in sulphuric acid solution, and immersed in a bath of molten zinc, the surface of which is covered with salammoniac or grease to prevent loss by oxidation. That is the process in brief: there are details, such as heating some articles before they are dipped, and so on. The action of the acid is to eat off the oxide and leave a clean surface.—T. P.

[48382.]—**Bell Indicators.**—By "mechanical," you mean, presumably, those used with pneumatic bells. They are worked simply by the expansion and contraction of "bellows," indiarubber balls, &c., or by the motion of a piston in a cylinder. The electrical have been recently illustrated.—J. T. M.

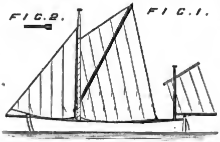
[48397.]—**Greenhouse.**—As to price, I would suggest that a comparison of price lists would give it with tolerable accuracy, and as to "best," opinion seems to differ. If you are making yourself, I would suggest wood, as easiest worked; but I suppose iron, when properly painted, lasts longest and is strongest. Glazing must be carefully done, though, for the expansion and shrinking of the metal, is apt to crack the glass if it is put in too tight.—Essar.

[48400.]—**Gas Power.**—Mixtures of hydrogen and oxygen explode with violence and form water. I should imagine they would be rather troublesome in engines. "P.O." should bottle off his gases and sell them.—Essar.

[48408.]—**Gramme Machine.**—This is one of those questions that even "Sigma" himself declines to answer. The best size, &c., of wire, depends on what the machine is to do and how it is to do it, and, probably, not even those who have been intimately connected with the manufacture of dynamos could answer the question put by the querist. It is really a matter for experiment.—Essar.

[48435.]—**Fretwork.**—See reply to 48376.—Essar.

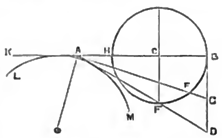
[48481.]—**Rigging Boat—Yawl.**—I send herewith sketch for above, which I think preferable to lug-sail. Unless the tack is abaft the mast it is rather dangerous, and not easily managed. For the jib or foresail a small (Fig. 2) iron bowsprit to fit on the stem-post, and kept in its place by a pin. Mainsail to be spritsail laced to mast, as, when not in use, it can be rolled around it. Sail to be roped round rope-eye in peak for sprit, and look round mast with small loop for heel of sprit. When slid up mast it will jam itself tight. Mizen will be lug-sail, laced on yard and boom, and rope reeved through small block on boom and made fast to each gunwale will, with slight push, right itself in tacking. Clewline running aft alongside gunwale, through eyebolts, will work jib without going forward, and a couple of blocks, with hooks attached, for clew of mainsail, and hooked to bolts level with after-thwart, under gunwale, can easily be shifted from side to side, and boat sailed without any moving about. Pigs of iron best for ballast. Will give further particulars if required.—H. I. B.



[48481.]—**Rigging Boat—Yawl.**—"Robinson Crusoe's" good practical remarks induce me to give "S. S." and your readers the following rig, &c., of a boat I had built to my own draft, and which I used at Valencia, co. Kerry, for some years:—She was built of the best American yellow pine, free from knots; her keel, gunwale, and ribs of elm; and she had an elm bead, 2¼in. thick, put on outside with galvanised screws, to act as a fender. All nails and ruffs were copper, as were the rudder fittings; rings, mast-lock, &c., galvanised iron; and was steered with a tiller. She was 25ft. 8in. long, 5ft. 3in. beam, and 20in. to 22in. deep; had a sharp entrance, dead-flat 12in. abaft the centre, with 3in. rise of floor, and not too much cut away abaft—her bows rising fully 6in., and her topsides tumbled in about 2in. Her rig was "sliding gunter"; a triangular mainsail; lower mast, 13ft. by 3½in.; topmast same length by 2½in., tapering to 1¾in, doubling on lower mast—say 20in., giving a hoist of nearly 20ft. to the sail; boom, 13¼ft. by 2¼in.; mast stepped 9ft. 2in. from stem; a shroud at each side, lower end passed through a thole-pin hole in gunwale, and fastened with a single hitch; forestay for foresail from lower mast-head to hole in top of stem. I prefer this rig for harbour sailing, and where there is a chance of mountain squalls, to a sprit-sail: it keeps the body of the sail and the greater pressure down low, and the topmast, rigged with a down-haul, is quickly lowered for reefing or in a squall. This mast passes freely through two iron hoops abaft the lower mast, and when lowered down, and the boom topped up, the main-sail wraps round all quite snug for unshipping. The main-sheet may be rigged single, with a two-sheaved block on boom and a single block at each quarter; but I prefer two sheets, with two single blocks on boom. When close-hauled, you can bring the boom more amidship: there is less friction; and by leaving the leeward-sheet loose, the windward-sheet is sure to overhaul when let go; but be sure to keep all your sheave-pins well greased. The shipwright, who took great pains to please me in building her, foretold that she would be a very wet boat, from being so sharp forward and her greater width being so far abaft, thinking that she would plunge into every sea; but not considering that by keeping her centre of gravity well aft the foreship would act as the long end of a lever, and lift her over a wave. She proved the driest boat on the coast, was roomy for company, and was a universal favourite in rough water.—Robert J. Lecky.

[48505.]—**M.R. Engines.**—No. 33 is a 6ft. 6in. single-wheel inside-cylinder passenger engine, and is stationed at Birmingham. The L. and N.W.R. 4ft. 7½in. tank-engines, which are numbered above 2000, are 2233—2252, 2282, and 2282. Therefore they are not numbered from 2000 upwards, as "E. W." states in his reply to query No. 48476: 2001 to 2006 being 6ft. 6in. express engines, and 2007 to 2038 being 5ft. 2in. goods engines, and so on.—Prometheus.

[48516.]—**Dividing Circles.**—The following method of dividing a circle into parts in any required proportion, is founded on strict mathematical principles, and is very simple from a practical point of view. In the diagram, A H is taken exactly three-quarters of the radius, join A E and produce to D, where it meets B D, the perpendicular to the diameter. It can be shown that B D is almost exactly equal to the length of the arc E B. The difference is so small as to be quite inappreciable by any practical method. Now cut out a piece of cardboard a part of a circle L M of radius = B D, and pin it down so that it may touch the two lines K A and A D. Then, having divided B D in any required manner such as at G, place a straightedge, so that it may be on G and touch the cardboard circle. Mark the point F. The arc F B will be equal to the straight line B G. In this way if B D be divided into equal or unequal divisions the arc E B can also be so divided, and the divisions on the arc will be equal with those on the straight line. Suppose, for example, we wish to divide a circle less than 5in. radius into degrees, and that we possess an ordinary scale of inches divided into tenths. Make B D 9in., then, after drawing the figure to the proper radius, each tenth of an inch measured on B D would represent a degree on the arc. The proper radius may easily be calculated. B D being equal to the quadrant B E, is $(\pi r) / 2$, so that radius equal $(2\,BD) / \pi$, or in this case $2 \times 9 \div 3{\cdot}1416 = 5{\cdot}73$in. Having divided this circle into degrees, we can then divide a smaller circle of any required radius by drawing it concentric with the circle already divided, and drawing radii, which will mark the degrees on the smaller circle.—M.I.C.E.

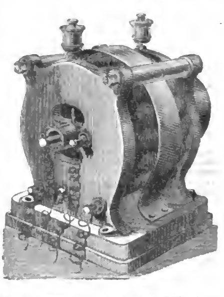


[48533.]—**Angles of Pyramid.**—Seeing that "M.I.C.E." questions the correctness of my reply to this query, I beg to send a worked example. Perhaps he will again be kind enough to set me right if I be wrong. Suppose a pyramid of four equal sides, vertical height 8ft., side of base 12ft., then we know that distance from apex to middle of any side of base is 10ft.; and proceeding by method recommended in my reply, $\frac{6}{10} = {\cdot}600000$ natural sine of half-angle made by any side with side opposite. Now, this sine corresponds to angle 36° 52′ 11″, which multiplied by 2 gives 73° 44′ 22″ as angle any side of this pyramid makes with side opposite.—Scotch Working Mechanic.

[48535.]—**Varnish.**—The recipe is as follows:—1 pint of methylated spirits, 6oz. best shellac, one pennyworth of resin, and twopennyworth of benzoin.—R. J.

[48569.]—**Millstone Fixing.**—If you go by the instructions of "Mack" you will have no trouble with your stones, as I have fixed many on the same principle; but I should advise you to have a check-nut to the four screws. I have got a book called the "American Millwright's Assistant," which gives some useful information on millstones, and if it is any use to you I will lend you it, if you will advertise your address.—A Rechabite.

[48633.]—**The Ferranti-Thomson Dynamo.**—This much-talked-of machine has been on view during the past week in the dark arches under Cannon-street station. Although the statements made about it require to be taken with a grain of salt, there is not much doubt that it is a distinct advance—the construction of the armature being its most



important feature. Several inventors have been trying to do without iron in the armature, and Mr. S. Ziani de Ferranti and Sir W. Thomson appear to be the first who have succeeded. The engraving will give a general idea of the machine, which is one of the so-called "alternating" type; and although weighing less than 12cwt. has been shown working 320 and more Swan "20-candle" lamps, having a real intensity of, say, from 15 to 18 candles. Without careful measured trials the statements made as to the horse-power supplied to the machine and the number of lamps worked by that, should be received with caution; but the engine is stated to develop 26 horse-power, and it is certain that considerably more than 300 lamps were kept incandescent by it. What their actual illuminating-power may have been is a matter of opinion, for it is difficult to get at the real photometric value of a large number of lamps. According to the statements offered, each lamp requires 41 volts, and has a resistance of 32 ohms when hot. The field-magnets consist of thirty-two bobbins arranged on two cast-iron discs somewhat in the same style as the Wallace-Farmer machine. Each core is 6in. long, and is wound with four layers of wire of about ⅛in. in diameter. The coils are connected up in series and the resistance of the whole is said to be 2·5 ohms. These field-magnets are excited by a little Siemens machine. The machine is one of the class which I suppose is known as the disc dynamo. Full details of the construction of the armature are withheld until the completion of some patents; but it is understood that it is composed of a copper ribbon ⅜in. wide, one line thick, and 120ft. long, which is wound on a former so as to present the appearance of having been wound between an eight-armed spool, the copper ribbon being wound upon itself with insulating tapes between the layers. The interior of the armature is open, which keeps the machine cool, though it revolves at a speed of about 2,000 revolutions per minute, and there is no iron core. The whole armature weighs no more, it is stated, than 18lb.; it is 18in. in diameter, and about ½in. thick, a remarkable thinness, which enables the magnetic field to be made very narrow, and consequently exceptionally intense. The current is taken off by connecting one end of the armature conductor to a collar fixed on the spindle and in metallic contact, while the other is taken to a similar collar insulated from the spindle. Metal blocks rub one on each collar, and through little levers used for pressing them down, the current passes to the terminals. The principle, it will be seen, is to dispense with weight and metal in the armature, and gain a compensating advantage by means of speed.—S. R.

[48599.]—**Copper Scale.**—I am sorry I am unable to give any information as to the reducing of copper ores to an impalpable powder. The natural oxides would not contain the same amount of copper as the scales referred to, since they would contain more or less impurities—*e.g.*, silica, iron, &c.—J. C. Belcher.

[48600.]—**Speeding.**—Thanking D. Woodhead for replying to my query, it is hardly the thing I want. Perhaps I was not precise enough. Revs. of engine 90, diam. of pulley on engine 36in., driving 40in. pulley; on this shaft there is 20in. pulley, driving 16, which drives a 12in. pulley on this shaft; a pinion, 30 teeth, drives spur 80 teeth. What number of revs. is the latter shaft going?—Scotia.

[48627.]—**Chemical.**—Take a weighed quantity, dry gently so as to drive off all the water. Calculate the amount of water of crystallisation contained in the amount taken. Deduct this from the loss, and the excess equals moisture. Provided the organic matter contains no hydrogen, it may be estimated by combustion.—J. C. Belcher.

[48640.]—**Stains in Marble.**—A weak solution of oxalic acid will remove the stains—say, a pint of boiling water to one pennyworth of oxalic acid; let it remain till cold, then rub on with soft rag dipped in the solution. You will find this will also remove the polish; but that can easily be renewed by immediately applying a little olive oil on wadding, and rubbing off briskly with a soft cloth not linty. I may add these stains are caused from damp at some time; and, if they are of long standing, perhaps a second application will be necessary.—On Guard.

[48644.]—**The Diurnal Inequality of the Tides.**—Julien Hartshorn will find in the undermentioned French works these phenomena fully explained from cause to effect and mode of production, according to cosmogonical, astragonical, meteorological, and physical laws, in a manner altogether different from, and opposed to, the erroneous hypothesis contained in classical textbooks. Meanwhile, he will find there the origin, mode of production, physical constitution, and real form of our satellite, which form *is not spherical.* These works are:—1. "Origine des Sciences Physiques et Naturalles, et des Sciences Metaphysiques et Morales," in 4ᵉ, pages 103 et suivantes. 2. "Panépistime Physique Simplifieé," 4ᵉ Volume, "Barostatique," p. 120 à 128. 3. "Physique Celeste," Vol. 2, pages 522 à 530, par B. Beron.—Ch. Rabache, Morchain, Somme, France.

[48645.]—**Pump.**—I find in the 21st line of my reply last week I am made to say, "Besides this, it requires *pinning*." The word should be *priming*.—Labor Omnia Vincit.

[48654.]—**Heating Apparatus.**—The best, cheapest in the end, and the most satisfactory way to heat the chapel is to employ one who has made it his life's study to do this kind of thing effectually. The chapel at this place was intrusted to Mr. Grundy, and his apparatus is simply perfect. As the chapel will seat 450 persons, it means, after all, a contribution of 5s. each, in the place of spending money and time on experiments, which are not sure to come out the right way. The advertiser may write to me.—W. H. C., Seaford, Sussex.

[48665.]—**Water.**—I make the discharge 1,526 gallons an hour. "Pressure" wants a "simple rule for working this out." I will give the rule I have used. It is Hawksley's formula, as given in Molesworth:—

G = Number of gallons per hour.
L = Length of pipe in yards.
H = Head of water in feet.
D = Diameter of pipe in inches.

$$G = \sqrt{\frac{(15\,D)^5\,H}{L}}$$

To answer "P.'s" question, we must first find what the 6in. main will discharge, that is 15 × 6 = 90, and this raised to the 5th power, 90 × 90 × 90 × 90 × 90 = 5,904,900,000. This multiplied by 100, the head in feet, and divided by the length, 1,760, in yards = (5,904,900,000 × 100) / 1760 = 335,000,000. Extract the square root of 335,000,000 = 18,303, the discharge in gallons per hour of the main; but the outlet is 2in. in diameter, and as circles vary as the squares of their diameters, that is 6 × 6 = 36, and 2 × 2 = 4, and 36 / 4 = 9, the 6in. pipe has 9 times the capacity of the 2in. Then 18,303 / 9 = 2,034 nearly, and as I should not expect to get more than 75 per cent. of this quantity through a 2in. pipe, then (2,034 × 3) / 4 = 1,526 nearly.—Tyke.

[48667.]—**Induction Coil.**—Will never get any result in his secondary wire with two Leclanché cells. Must try more energetic battery. Bichromate the best.—W. G. T.

[48670.]—**Estimation of Nitric Acid in Nitrates by Fusion with Quartz or Bichromate.**—The following is the method of analysis:—Fuse a few grms. of the sample at the lowest possible temperature, and pour out the liquid mass into a warm porcelain dish. Powder it quickly, and transfer it to a tube. Place 2 or 3 grms. of powdered quartz in a platinum crucible. Heat to redness, and weigh accurately after cooling. Add about ·5 grm. of the sample, and weigh again. Mix the sample and silica by the aid of a thin glass rod, taking care, of course, that nothing adheres to the rod, and heat the crucible gradually at a low red heat, keeping it at this temperature for twenty or thirty minutes. Transfer to a desiccator, and weigh when cold. The loss of weight gives the amount of nitric acid. Care must be taken to regulate the temperature properly, or the sulphates and chlorides present (particularly the latter) may partly volatilise. It should be remembered that this method is not applicable to all nitrates.—J. C. Belcher.

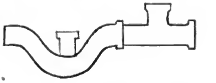
[48671.]—**Micro-Photography.**—The distance between the visual and actinic foci is the same, no matter how much the conjugate focus may vary, as mentioned.—W. Robinson, Jun.

[48672.]—**Sand-Blast Files.**—Would "E. H." kindly say what is meant by "new sand-blast files?" I can understand that old files may be sharpened by means of the sand-blast, but do not understand how they are "cut," so as to be called new sand-blast files.—Nun. Dor.

[48675.]—**M.R. Engines.**—Nos. 51, 82, 84, and 150, are 4-coupled passenger-engines. In regard to the latter part of "Titteswsorth's" answer to query No. 48476, I may state that the new L. and N.W. compound loco., No. 66, "Experiment," has four driving-wheels; and two outside-cylinders, which act upon the trailing driving-wheels, and one inside which acts upon the two leading driving-wheels. It runs between Crewe and London, and has "F. W. Webb's Patent" in small letters on the brass plate under the name.—Prometheus.

[48676.]—**Disconnecting Traps.**—The term "disconnecting trap" is a general one, and is not applied to a trap of any particular form, or to one by any maker in particular. Every trap in a house drain disconnects the air in front of it from that behind it. The space occupied by air in drains and sewers is always much greater than that occupied by the sewage, and as the air is usually foul, both in sewers and house drains, it is necessary to prevent it flowing upwards from the sewer to the house. It is, therefore, recommended both by the engineers of the Local Government Board and by sanitary engineers in private practice, that a trap should be placed in every house drain as near the sewer as possible, so as to leave as short a length of the drain as possible in front of it; and this is the disconnecting trap. But it would not of itself effect the object intended, and it is necessary to make, in addition, a free opening to the air immediately behind the trap; that is on the house side of the trap. These two contrivances—the trap on the lower side of the air opening and the opening on the upper side of the trap—together form the proper "disconnecting trap." The trap itself is usually of the form of a dip-siphon, or a line trap, as it is called in some places, but any form is suitable which will not allow the sediment of the sewage to settle and choke it up. The air opening to the atmosphere immediately adjoining the trap, on its upper side, is built of brickwork 14in. square, and covered with an open grating—the more openings the better, and the spaces between the bars should not be less than 1⅛in. wide. Instead of a brick-built opening, an earthenware pipe may be used. Through the openings the atmospheric air frequently passes downwards and along the drain to its upper end, at which place a free opening is to be made to the air above the roof of the house by means of a vertical ventilating pipe, and this vertical pipe should be of the same diameter as the horizontal part of the drain, or at least not less than 4in. or 5in. All other openings to the drain, necessary for admitting water or sewage to it, should be trapped closely without any air opening. The only openings to a house drain are thus two: the one as low down near the sewer as is practicable, the other as high above the house roof as is practicable. But if there are branch drains of any considerable length, there should be a ventilating pipe at the upper end of each.—Charles Slagg.

[48676.]—**Disconnecting Drains.**—"Levant" will find the ordinary run or siphon trap best adapted for disconnecting house-drains from main sewers, thus: care being taken to insert the square



junction for the free admission of air; to prevent the trap being forced, also to admit a current of pure air to circulate through the full length of his drain. They may be had from any sanitary pipe merchant, price for 6in. about 2s.—J. T.

[48687.]—**Lathe-Bed.**—When a pattern goes to the moulders, the moulder makes a bed on the sand on which he puts his pattern; and in making the bed he makes it high in the middle so as to allow for the bed when it is cast, so that the ends get up, and, if it is made properly, the casting will come out of the sand straight.—C. S.

[48689.]—**Lathe-Bed.**—I have years ago planed some hundreds of lathe and other beds of all descriptions, and can assure "E.P." there are lathes and planing machines working now, that had no filing whatever after leaving my hands, both beds, saddles, rests, and all other parts: they were scraped, of course, and that is all. You ask will a casting from your pattern come out round or hollow? Well, you may have 20 castings made, and no two the same; you may have one hollow, and after one cut it will be rounding, and vice versâ. Again, you may get one nice and true from the mould, and, after one cut, for what it is worth you may throw it on the scrap-heap. The idea of face drawing a casting anything like your sketch in ours, is absurd, and, in fact, it cannot be done. You are quite right in supposing that much depends on the metal, but more depends on the planing. I must say I do not understand how you expect to chip and file a lathe-bed true by bolting it to its standards. Do you mean to retain the tension the casting may contain coming from the mould? If so, I don't think you will succeed, and I, for one, do not envy you your job. The method I would follow would be this: that is if you do have it planed, first set it on the table right side up, pack carefully for first cut, and before bolting down, line it outside and in with scribing block, and take a cut on face, V's, and inside, but be careful and keep your lines by packing before you start; now, after taking the first cut, slack bolts and again test your lines. Should your casting be much out, reline and take another cut; but if within a 32nd, reverse on table, pack the slack parts, again relining and testing, and plane bottom and sides for standards; next reverse on table and finish by lightly planing with good tools. Then you will have a truer bed than you can possibly produce by chipping and filing.—On Guard.

[48689.]—**Lathe-Bed.**—I should say the face will be hollow if the pattern be straight, but how much, depends on the quality of the metal, &c. Were I going to make it I should give it about a quarter of an inch camber on the face side.—Tyke.

[48690.]—**Magnetic Storms.**—It is simply absurd to imagine for one moment that an electric light ordinarily requiring 8 h.p. could be worked solely by a magnetic storm. Evidently the editor of the paper in which you read this astounding statement has a very vague idea of what electricity is—about as vague as that of the man who wanted to know whether electricity was a new kind of beer! I observe that the *Electrician* for this week, in a leading article entitled "Newspaper Science," speaks upon this same absurdity, saying in one part "that if the United States of America, which telegraphs this information to Europe for our edification, will only keep us supplied with the requisite amount of 'magnetic disturbance' of the 8 h.p. sample, such as prevails at Milwaukee, our electric lighting can obviously be maintained in a very literal sense, 'regardless of expense.'"—John Bull.

[48691.]—**Quinine and Iron Tonics.**—Querist has been entirely misinformed with regard to these. Both are taken, both before and after meals, and more than any other remedies in combination. Citrate of iron and quinine (a chemical combination) is used by the hundred-weight, and when an acid is not desirable, is the best preparation. If digestion is weak and acid desirable, take one grain of quinine in ten drops of tincture of steel in water, twice or three times a day before meals.—W. G. T.

[48697.]—**Fan.**—Not more than three, but there are many other things to consider besides the number of wings in making a fan.—Tyke.

[48700.]—**Lantern Transparencies.**—Working with wet collodion, I have always found mercury followed by ammonia to give a good black tone. Gelatine plates, if suitable for the purpose and properly developed, are usually black enough, to my mind; but you might try a dilute solution of sulphuret of potash.—W. Robinson, Jun.

[48706.]—**Cement for Tobacco-Pipes.**—No cement will make a permanent joint in a a tobacco-pipe. The joint is usually made with an internal tube—in most cases a small bone screw—and the join covered with a band. In fitting the internal tube, nothing better can be used than plaster of Paris. I have proceeded thus in hundreds of instances, and never have had my repairs leaky.—W. D.

[48706.]—**Cement for Tobacco-Pipes.**—The following mixture is an excellent one for uniting wood, iron, glass, &c. Mix fresh-precipitated casein with freshly-slaked lime. The necessary casein obtained by acidifying milk, which has been freed from whey, and separately reduced to powder. In consequence of the mixture hardening very quickly, the cement should be applied at once. —W. Henley Richmond.

[48712.]—**Electric Light.**—The most efficient machine for working incandescent and arc lamps together is undoubtedly the one which is at the present moment causing such a hubbub in the electrical world, namely, the "Ferranti" dynamo-electric machine. This, the invention of Mons. Sebastian Ziani de Ferranti, is now open to the public inspection at Cousin-lane, Dowgate-hill, E.C., where all particulars concerning its superiority and peculiarity as compared with existing machines may be obtained. It is impossible to state the resistance of the 20-candle-power lamps employed with this machine, or, in fact, any other, as they may be made of any resistance whatsoever, the resistance depending on the thickness of the carbon filament, and is, consequently, not a constant number.—John Bull.

[48722.]—**Engine Query.**—Begin with the right-hand cylinder; place the engine with crank on bottom centre, and link in full gear. The bottom steam-port should now be open $\frac{1}{32}$in. Turn the engine round until the crank is on the opposite centre; there should be the same amount of opening in the top steam-port. If the opening is unequal, and there is a screw on the valve spindle, adjust the valve by it. If the port is not open at all when the crank is on the centres, then the eccentric is too late, and must be moved round on the shaft. When you have got one side right, reverse the link, and test with the other eccentric in gear. Repeat the process for the other engine. —Labor Omnia Vincit.

[48731.]—**Fitting up Small Lathe.**—This query I purposed answering; but on further consideration I hardly think it possible to bore headstocks and fit the same without a lathe; not that the headstocks might not be drilled with the aid of a smith's brace, and broached out afterwards; but the mandrel and the cylinder of the back poppet must, of sheer necessity, be turned. The cones of the lathes of the Britannia Co., like those of other makers, are carefully turned to standard gauge, and the holes broached till true. But those on the mandrel are not both fixtures, the forward one alone being solid with the mandrel; the other slides on the small end of the mandrel, and is adjusted by two lock-nuts. There is no difficulty, therefore, in getting the mandrel into place, although split collars are not in use. Type-metal is better than pewter for collars, and will stand well as collars to rapidly-revolving shafts; but for small lathes of 2in. or 3in. centre, the mandrel will run well enough in the bored casting, and most of these lathes are so made. If it were a matter of absolute necessity to fit a lathe by file alone, a single-cone and back-centre would be the easiest to manage. 65s. will buy the lathe complete.—O. J. L.

[48732.]—**Indicator Diagrams.**—It is evident that you may work your engine with a far less expenditure of fuel than you are now doing; and may attain this result by having a more modern slide-valve, having lap to cut off your steam at $\frac{1}{2}$ or $\frac{5}{8}$ stroke, and you will be amply repaid for the trouble and expense. I presume that yours is one of the cases in which the valve-gear operates the steam at one end and exhaust at the other by the same movement. In this way you suffer from the double waste of the steam not being cut off till the end of the stroke, and considerable back-pressure caused by a full cylinder of high-pressure steam not being able to exhaust through the passages so rapidly as it ought to do, to produce a good exhaust-line on the diagram. It is a pity that you did not supply the scale of diagram and revolutions per minute in your data.—Fred. Walker.

[48732.]—**Indicator Diagrams.**—Supposing that the diagrams were correctly taken (which, to me, seems rather doubtful), then we will begin with the left-hand diagram. Steam is admitted all right, and cut off is good, but the exhaust valve is closed very much too soon. If the valve just began to close when the piston had to move 1ft. to reach the end of its stroke, the engine would work much better. These latter remarks apply to the diagram from opposite end of cylinder. The cut-off is not quite equal in the two diagrams. I write the above under the supposition that when the diagrams were taken the link was in full gear. If it was not, then that will account, to a great extent, for the early closing of the exhaust valves. As you give no scale for diagrams, and don't say anything about position of link, I have explained the diagrams as published.—Labor Omnia Vincit.

[48733.]—**Brittle Brass Wire.**—You can make your brass wire as soft as possible by heating it to a red colour. It can be subsequently converted into spring wire by drawing.—Nun. Dor.

[48733.]—**Brittle Brass Wire.**—Your wire has probably been exposed to the fumes of ordinary coal gas, which contains much sulphur. Nothing will make the brass "good" again; but the drawing of it through a flame sufficiently hot will allow of your bending it without its breaking.—J. N. W.

[48733.]—**Brittle Brass Wire.**—Heat it to a low red, and either let it cool or quench in water—it makes no difference which.—G.

[48733.]—**Brittle Brass Wire.**—This commonly occurs with all ironmongers' brasswork in a London atmosphere. I have been told that making the wire red-hot and plunging in water will renew its vitality. It will, of course, be soft, if a cure is effected; but this I cannot answer for.—J. K. P.

[48740.]—**Science and Art Classes.**—"Electrician" will find all the information he requires in the "Science Directory," which he may get by sending six stamps to the Science and Art Department, South Kensington.—S. O. Two.

[48740.]—**Science and Art Classes.**—Get the Art and Science Directories from the Secretary of the Department of Science and Art. They contain all information as to the establishing and committee of such classes. I should think it very doubtful if you could get many pupils for science in such a small town, and art is not in a flourishing condition in Ireland at present. The act is the same in Ireland as in England. The rate of subscription would vary with the "quality" of the pupils; but the department insists that the night-classes shall be cheap to allow artisans to receive instruction.—C. J. R., Ventnor.

[48741.]—**Lever.**—Pressure (P) multiplied by its distance from the fixed point or fulcrum, is equal to the weight multiplied by its distance from the fulcrum. That is, $P \times 1 = 140 \times 10$ ∴ pressure = 1400lb.—J. A. R.

[48745.]—**Winter Sketching.**—I should advise "J. B." to get a small iron corrugated house, which, I believe, can be purchased for a few pounds. These houses can be taken to pieces or rigged up in a few minutes. The other day, when I was in London, I saw a house which would exactly answer "J. B.'s purpose, in a place called "Holborn Well," between the Viaduct and Blackfriars; it was like a small sentry-box, with a window in the side, and if I were going to sketch I think that would be the kind of house to purchase.—W. Scotland.

[48746.]—**Corrosive Sublimate.**—I know little or nothing of preserving specimens; but the chief solvents of corrosive sublimate are water (hot 1 in 3, cold, 1 in 16), alcohol, ether, nitric acid, and hydrochloric acid.—R. F. Prettejohn.

[48752.]—**Tea.**—For goodness sake, let us have something left to drink! We can't all live upon dirty water. The country now swarms with teetotallers and abstainers; they tell us that good liquors such as champagne and Johannisberg were only made to be thrown into the gutter. They "rob a poor man of his beer," without for a moment considering whether he can find any substitute to keep body and soul together. Do these gentlemen who go home after a temperance lecture and sit down to their comfortable tea and coffee, of which they consume bucketfuls, know that in many towns and villages the poor cannot afford to purchase a drop of milk from one year's end to the other—and what a beastly (there is no other word for it) mess tea with a little coarse brown sugar and no milk is? In the village where I now live, milk is only to be got at from 5d. to 6d. a quart, and whole families among the poor go without it altogether. With reference to "Iris's" question, of course tea and coffee in excess are bad—everything in excess is bad; too much pudding will choke a dog, and too much turtle soup is bad for an alderman. There are hosts of drunkards in England: they require particular treatment—to be kept from drink; there are hosts of scrofulous people: they also require particular treatment—let us say cod-liver oil and steel; but this is no reason why all England should be forced to take cod-liver oil and steel. There was a large gathering of teetotal lecturers a week or two since in the county town near which I reside. Some of the lecturers were hospitably entertained by a family of my acquaintance. On the return of these gentlemen from their lecturing, one of them consumed at his dinner eight large cups of very strong tea, and the other the same, or nearly the same, quantity of coffee, while the lady of the house drank with her dinner one glass of light claret with water. Now, I ask any of your readers, with a grain of common-sense in their heads, to tell me which of the two parties, the lady or the lecturers, had the most wholesome meal. Now, I have one suggestion to make to abstainers and teetotallers. Before they deprive the poor of all their little comforts in the way of food, let them expend their energies in endeavouring to make some arrangement whereby they (the poor) may be enabled to obtain a supply of wholesome milk. If they can establish cow or goat clubs in all villages, then tea and coffee will be a wholesome and nourishing substitute for beer and spirits; but at present, I consider that it is far preferable that the hard-labouring poor should stick to their small beer rather than injure their stomachs by swamping them with strong tea and coffee without milk; and I fancy that should the lady I have referred to above, and her guests the lecturing clergy, wish to effect an insurance on their lives, that the lady would, *cæteris paribus*, be able to do so on very much more favourable terms than the tea-drinking guests. Ask Dr. Edmunds.—F. R. C. S.

[48752.]—**Tea.**—Begging Dr. Edmunds's pardon for intruding, perhaps "Iris" would like to know that a good substitute for coffee may be produced by parching grains of wheat in a dry saucepan over the fire. It may then be ground and used as coffee.—R. F. Prettejohn.

[48756.]—**Screw-Propellers.**—Place the blade to be measured in a horizontal position, with the face downwards, at any convenient distance from the centre of shaft—say, 4ft. 6in.; place a wooden straightedge across the face of the blade, and get some one to hold it in that position; then, by sighting and marking where the line so formed (by the edge of the straightedge) cuts the rudder-post at top, and the sternpost or keel, as it may be, at bottom; then measure the three sides of the angle so obtained—that is, from the mark on the rudder-post to the top of keel forming the perpendicular—from that along the keel forming the base, and the straightedge on the face of blade forming the hypothenuse. Then find the circumference suitable to the diameter of 9ft.: the circumference divided by the perpendicular, and multiplied by the base, gives the pitch. It will simplify the operation if it can be imagined that the propeller is bolted on to the chuck of a lathe, and that the rudder-post is the face of the chuck. Another, and perhaps a simpler method, is to take a piece of string, and fasten a weight at each end—two nuts, for instance—throw it over the blade when in a horizontal position, with the face downwards, at any suitable distance from the centre of shaft. Measure from the bottom or leading edge of the blade to the string which is hanging plumb—call that the base of the angle; the length of string itself to the following edge, the perpendicular; and the face of the blade, the hypothenuse, and proceed as before. Example:—4ft. 6in. radius = 9ft. diameter = 28·274ft. circumference; suppose 7ft. to be the length of perpendicular, and 4ft. the base; then 28·274 divided by 7 and multiplied by 4 = 16ft. 2in. pitch nearly. By any suitable method form a right-angled triangle on the blade, at a given radius from the centre of shaft. The hypothenuse will represent the breadth of blade. One side must be at right angles, and the other parallel to the centre of shaft. Divide the circumference of the given radius by the side at right angles, and multiply by the side parallel, and the result will be the pitch.—HARTLEPOOL.

[48757.]—**Portrait - Lenses.**—Although portrait-lenses have not, by any means become obsolete, you are quite right in supposing that excellent portraits may now be easily taken with landscape-lenses.—W. ROBINSON, JUN.

[48759.]—**Substitute for Hops.**—"Methinks the brewers do protest too much," in the face of the fact that values of hops have advanced to such an extent that substitutes are eagerly sought after in the Mincing-lane Market, and drugs which can, on account of their bitter qualities, be used in the manufacture of beer, have been in speculative demand to such an extent that in some cases the values have advanced 300 to 400 per cent. It has generally been supposed that beer could only be made "bitter" through the medium of the hop-plant; but this innocent delusion must be given up, the laws of supply and demand having taught us that there are other plants not familiar to Kent or Surrey which can be used for the same purpose. Calumba-root, well known for its tonic qualities, has advanced in value from 22s., at which it was obtainable a month since, to 96s. per cwt.; camomiles from 40s. to 120s.; quassia from £5 to £40 per ton; Guinea grains, which have always been more or less in use for brewing purposes, from 32s. to 60s. per cwt.; and the most surprising of all, Chiretta, a drug which a month since was almost unsaleable at 3d. per lb., has actually been sold at 3s. to 3s. 6d. per lb. Good bitter beer can be brewed with camomile and sold for something less than the ordinary hundred-and-fifty per cent. profit which a publican gets on a glass of bitter (of the usual size) at twopence.—C. T. B. W.

[48765.]—**Algebraic Question.**—There are two misprints. In the numerator of the first term read: $3^4 \times 4^3$, instead of $3^4 + 4^3$; and in the denominator of third term read: 3 +, instead of 3 −, and you will find the answer 2.—NIOEL.

[48765.]—**Algebraic Question.**—As the question stands it produces a hideous fraction; but if the first numerator be altered to $3^4 \times 4^3$, and the last denominator altered to $3 + 4^2 \times 3^2$, then the expression is equal to $2 + 1 - 1 = 3 - 1 = 2$.—R. F. PRETTEJOHN.

[48766.]—**Photography.**—The negative and dry-plate should be placed in contact, exposed for a few seconds (more or less, according to the density of the negative), to a gas or lamp flame, and then developed in the usual way. The lantern condensers would be useless for camera purposes, but the object-glasses might do if achromatic. What is the focus?—W. ROBINSON, JUN.

[48769.]—**Gas and Leather.**—The most efficient means of preventing the deteriorating effect of gas upon leather is to abolish the "yellow flame" entirely, placing in its stead the electric light. This change would be attended by paramount benefits, especially if you have much leather exposed to the light, as there is no other good remedy to be recommended without involving the total abolition of the gas.—JOHN BULL.

[48771.]—**Patent Law.**—It is a shame to worry Mr. Wetherfield with questions of so trivial a nature, which are answered in the words of the actual letters patent themselves. No one can legally make a telephone or any other patented article for his private use; but, as a matter of fact, owners of patents rarely interfere, because the damages are small even if the infringer can be found out. I don't suppose any of the telephone companies would interfere with a man who put up a telephone for his private use and the amusement of his friends at his own house; but, clearly, a telephone circuit between the office and the factory is a beneficial user, which the telephone companies would justly regard as an infringement.—NUN. DOR.

[48772.]—**Coloured Lights.**—It seems unfair to take up space in the "E. M." on this subject, when I have in the last two numbers recommended a book, to be had for 3s. or 4s., which exhausts the whole subject. But perhaps I may help your correspondent "C. S." thus far. He does not say what size his coloured-light cases are. This is very important, for these coloured lights require different compositions, according to size. For lance work, that is, cases $\frac{5}{16}$in. diameter, I have no trustworthy recipe but the following (red), which is splendid. Chlorate potash 20, nitrate strontia 4, shellac 4, calomel 2, picrate of ammonium 1. Take care the nitrate of strontia is good and dry, and these lights will not keep long. For green, chlorate of baryta 5, nitrate of baryta 2, calomel 1, shellac 1. For $\frac{1}{2}$in. to $\frac{3}{4}$in. cases, chlor. potash 8, nitrate of strontia 4, shellac 2, calomel 1. For green, chlor. potash 6, chlor. baryta 4, nitrate of baryta 3, shellac 2, calomel 1. For large cases—that is, $1\frac{1}{2}$in. to 2in. in diameter, nitrate of baryta 13, picrate of ammonium 12; and for red, nitrate of strontia 23, picrate of ammonium 27, are as good as any. All coloured fires must burn the case with the composition; therefore, the case should be as thin as possible, and only pasted at the last round. The case should be horizontal, or pointing downwards, when fired, to get rid of the cinder that forms. The cases should be primed with a few grains of chlor. potash 16, charcoal (fine) 3, sulphur (washed) 2, stearine 2, and some meal-powder or portfire composition over this. The composition should be pressed into the cases, enough to prevent its shaking out, and a very little spirits of wine sprinkled over it will assist it in holding to the case; but it will burn better without. If you want to judge of coloured fire, turn your back to it. Wash the sulphur well. Full directions were given in a recent number of the magazine. Tie a handkerchief over your mouth and nose when dealing with picrate of ammonium. Be accurate in weighing, and the composition cannot be too well mixed. Get your ingredients good. I have given the name of a pyrotechnical chemist in the last number of "E. M.," from whom also "Practicus'" book is to be had. I may add the two following fires, which will burn in a heap on a slate or tile:—Red. Nitrate strontia 18, sulphur (washed) 5, chlorate of potash 2, charcoal (fine) 1. Green. Nitrate baryta 20, sulphur (washed) 4, chlorate of potash 4, calomel 2, charcoal (fine) 1, shellac 1. Any pyrotechnical chemist will let you have all these ingredients in fine powder, and sulphur washed; but I always wash my sulphur myself.—J. F. E.

[48775.]—**Recovery of Silver.**—Grind the cinders up and boil with dilute nitric acid; decant the liquid off, and add just sufficient common salt to precipitate the silver as chloride. Dry this, and fuse with carbonate of soda.—S. O. TWO.

[48775.]—**Recovery of Silver.**—Your best plan, I should say, would be to endeavour to separate as much of the cinder and coal as possible, and then to re-fuse with a little fresh carbonate of soda. Perhaps, also, a little nitrate of potash would help the fusion.—W. ROBINSON, JUN.

[48780.]—**Crank-Shaft.**—It seems most likely that the oil is in fault. Next time you are bothered with the bearing heating, mix some good powder blacklead with the oil, and use that to it. White-lead and tallow, oil and flowers of sulphur, are good for curing hot bearings. Is the crankshaft level?—LABOR OMNIA VINCIT.

[48780.]—**Crank-Shaft.**—If "A Driver" will take a spirit-level and try his shaft, I think he will find the flywheel end the lowest; if so, he must take the brass out and pack it up, so that the two bearings come exactly level.—YOUNG WHEELWRIGHT.

[48780.]—**Crank-Shaft.**—The heating of your bearing is probably caused by the fact of the surfaces being worn so as to prevent the shaft from taking a proper bearing upon the brasses. The best remedy in such cases is to raise the shaft and thoroughly clean both it and the brasses, then cover with a paste of powdered plumbago and oil. If it happens to be the back bearing and your flywheel be tolerably heavy, you might also try running without a cap, keeping a piece of clean suet upon the journal, and occasionally oiling.—FRED. WALKER

[48781.]—**Pumps.**—It is very unusual for the suction-pipe to be affected in this way; but if the pipe be long, so that the bucket or plunger has a considerable column of water to maintain during the commencement of its return stroke, and consequent closing of the valve, an ordinary check-valve, suitable for the size of the pipe, fixed to the bottom of the same, will, no doubt, remedy the vibration. If the discharge pipe was similarly shaken at each stroke, an air-vessel would prove beneficial, if fixed above the discharge-valve.—FRED. WALKER.

[48781.]—**Pumps.**—There are many things that will cause a knock on a pump. Are your suction-pipe ends supported in any way? Are the holes in ends of pipes perfectly free and clear? The teeth in spur-wheel are probably worn just at the point where the ram begins the down-stroke. A small snifting valve in suction-valve box will often cause the valve to work quietly. If "A Driver" likes to advertise his address, I shall be happy to correspond with him, having pumps under my own care.—LABOR OMNIA VINCIT.

[48784.]—**Photographic.**—You might recover the silver by precipitation with zinc, or by boiling with caustic potash and grape-sugar; but the best plan is as per my reply to 48524, p. 279, which see.—W. ROBINSON, JUN.

[48786.]—**Piano Soundboard.**—To Mr. DAVIES.—If the soundboard of a piano were like that of a violin—equal in its dimensions both at the bass and treble end—the difference in thickness would be a very important consideration, and "Sam" would be quite right in making it thicker at the treble; but as it depends almost entirely upon the bars for its rigidity, its thickness, within reasonable limits, is of very little account. The theory of soundboard construction requires that its elasticity should be increased according to the number of vibrations it is expected to undergo. This sounds rather formidable; but, in a piano, it is rendered extremely simple, from the fact that the size of the soundboard varies in much the same proportion; therefore, if the bars are everywhere of the same thickness, their resistance and elasticity will increase in pretty nearly the same degree. The tone of a piano depends upon (1) the length and thickness of the strings, (2) the thickness and blow of the hammers, and (3) the strength or rigidity of the soundboard; and these three conditions are so intimately connected, that it is impossible to give a reliable rule for either of them separately. For an ordinary 4ft. wooden back the soundboard may be a full $\frac{3}{8}$in. thick, with a single bar between each bracing of $\frac{3}{4}$in. picked spruce, 3in. wide, each end of each bar being tapered from 12in. in the bass to 4in. or 5in. in the treble. If there are two bars between each bracing, they should not exceed $\frac{5}{8}$in. in thickness, nor 2in. in width, the taper being a trifle shorter. In a back of this description there must necessarily be a space of about 4in. behind the bracings which it is impossible to bar at all. This will, in a measure, cause an unequal vibration of the soundboard, and affect the crispness of the tone, by giving it a hollow sound, though this is generally less perceptible with two bars than with one. The soundboard should be in all respects the same, whether it is for a bichord or a trichord, unless it should happen that the latter is worth more trouble, since a soundboard should be influenced by the vibration only of the strings, and has (or ought to have) nothing whatever to do with their tension.—W. H. DAVIES.

[48789.]—**Scented Soap.**—Toilet soaps are commonly made by remelting the ordinary soap, and adding the desired perfume. In making Windsor soap, cumin oil, oil of lavender, or oil of thyme would be used to scent it. The perfume for rose soap is attar of roses, oil of roses, or gilliflower water. As you do not say anything about the colouring matter, I presume you have been successful in that branch of the manufacture.—W. HENLEY RICHMOND, Parkside House, Bootle, Liverpool.

[48789.]—**Scented Soap.**—See Piesse's "Art of Perfumery."—R. F. PRETTEJOHN.

[48803.]—**Locks.**—Chubb and Son have locks to suit any size and shape of desk, and they are practically unpickable. 3. You can have a kind of spring catch fixed one at each end of the bag. They are better than straps. The best quality of bags generally have them affixed.—NOMEN.

[48807.]—**Influence of Climate on Neuralgia.**—I cannot tell "Gamma" what effect the climate of Australia or South Africa would have on neuralgia; but I can assure him that a proper application of galvanism would remove the complaint; and if he will advertise his address, I will write and tell him how to go to work; or if within reach, he is welcome to try my apparatus before making any of his own.—W. S. W.

[48807.]—**Influence of Climate on Neuralgia.**—Perhaps my experience may be of use to "Gamma." I was troubled for nearly a year right off, besides a previous attack or two, and swallowed all manner of remedies, both from doctors and others. At last I gave it up, and took to a good deal of walking more than before. It disappeared in three days; and so long as I keep up the out-door exercise, I have no return. Neuralgia is often the effect of too much confinement.—E. HOLMES.

[48809.]—**Electrical.**—To "SIGMA."—I do not remember the probable internal resistances of the two batteries, and the answer depends on this. But there is no legitimate comparison. Ignoring the resistance, twice as many Daniells would be needed to give the force, and this would be the number against a large external resistance. But as the internal resistance of the Daniell is many times that of the bichromate, it would be necessary to couple up in parallel circuit as many times that as represents twice the difference between the resistances of the cells; that is, if the R of one Daniell is six times that of one bichromate, it would require 12 rows of 8 cells to give the same current against a very small external resistance as four bichromates would give. The external resistance is an essential part of such a question.—SIGMA.

[48810.]—**Force of Blow.**—This is measured by $(m\,v^2)/2$, or, which amounts to the same thing, it is equal to the product of the weight multiplied by the fall. The 15cwt. will, therefore, have to fall twice as far as the 30cwt.—that is, it must fall 14ft.—W. A. S.

THE first sheet of the geological map of Europe, decided upon at the Bologna Congress of last year, has been engraved.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last Ploni Almoni has replied to 48049, 48257.

48082. Simple Eccentric Link Motion, p. 98.
48097. Egyptian Railways, 98.
48102. Dynamo, 98.
48107. Tin and Zinc Work, 98.
48116. Cigarette Making, 98.
48117. Electro-Plating Solution, 98.
48136. Eczema, 98.

48362. Polariscope Slides, p. 192.
48368. Parker-Smith Brake, 193.
48395. Astronomical, 193.
48402. Slide-rule, 193.
48403. Lantern Ghosts, 193.
48404. Safety Matches, 193.
48405. Interference of Light, 193.
48409. Telescope Driving Clock, 194.
48412. Gunter's Quadrant, 194.
48413. Ornamental Slide-rest, 194.
48415. Steam-Cock, 194.
48416. Brush Electric Lamp, 194.
48428. Arithmetical Progression, 194.
48432. Electric Railways, 194.
48438. Gearing, 194.
48439. Foundry Practice, 194.
48440. Crucible Steel, 194.

QUERIES.

[48817.]—**Restoring Silk and Woollen Goods.**—Can any of your readers give any means for restoring the original colour of black silk and woollen goods, when on being put under pressure, a jet black turns to a white or greyish black? It must be something that can be easily applied, and that will not rub off by passing the goods through the hands.—T. H. W.

[48818.]—**The Weather.**—Apart from my own wide and varied experience of weather throughout the world (which is a personal matter), the recent public comments on the present month's weather emboldens me to ask, by your leave, scientific readers of the "E.M." if any reasonable theory can be found to account for the very varied condition of England's climate? I, though a careful observer of the barometer, &c., can find no real clue, and my experience of weather in the China seas, where 1-10in. is not inconsiderable, and also in S. America, where violent storms are not unusual, proves incontestably to one that we in this country know next to nothing about the laws of "our" weather. Why, as a rule, gloom? Why so without rain? Why almost incessant damp? I have studied Maury and other authorities, and have personally witnessed weather in various quarters of the globe; but I confess I cannot explain the extreme variability of our climate.—E. R. Colby.

[48819.]—**Casting Blowpipe Solder.**—Can some one kindly give information as to the method usually adopted in making the long thin sticks? Also whether anything can be added to the alloy to cause the solder to appear bright after casting? I use tin and lead in equal proportions, and the surface always goes dead on cooling.—Northerner.

[48820.]—**Smell from Gas-Stoves.**—Will one of the "E. M.'s" readers kindly tell me the best and easiest way to prevent a beer-warmer or muller from giving off an unbearable smell of burnt gas? There is no easy way of carrying a small flue from it, as the warmer is in the centre of bar-counter, and not wished to be shifted. Is it caused by the yellow flame? I thought it ought to burn blue, as there is a perforated tube to admit air before the gas reaches the ring-burner.—Gasfitter.

[48821.]—**Filtering Solution of Citric Acid.**—Will some friend kindly inform me what to filter a strong solution of citric acid through? I have tried filtering-paper; but the action of the solution on the paper causes it to leave a deposit after it is filtered. It must extract some alkali or something out of the paper during the process.—One in a Fix.

[48822.]—**Legal—The Petroleum Act.**—Will Mr. Wetherfield, or any one versed in the above Act, kindly expound it in relation to the following?—A. resides in a town where there is a Local Board, to whom he applies for a license to store petroleum, and it is granted for *twelve months at a fee of two shillings and sixpence*. B. lives in a village where there is no local board, and he has to apply to the magistrates in petty sessions assembled in A.'s town, and it is granted him only for *six months at a fee of six shillings!* Is this legal, and why cannot B. get his license for the same term and fee as A.'s? I do not think it justice for the law not to be equally applied in villages and towns alike?—Jimbo.

[48823.]—**Roman-Candle Stars.**—Will J. S. Richard kindly describe how Roman candles stars are manufactured by the pumping method?—J. S.

[48824.]—**Astronomical—The Tides.**—Will "F.R.A.S.," or some other kind reader of the "E. M.," help me in the following difficulties concerning the tides?—When the sun and moon are in conjunction (at new moon), we experience a high tide, which is the result of the sum of their attractions upon the earth and the water on both sides of the earth. Surely when the sun and moon are in opposition (at full moon), we ought to experience a very small tide, which would be the result of the difference of their attractions. Yet this is not the case, as the highest tide is at full moon.—Rebecca Finem.

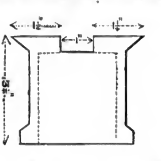
[48825.]—**Riveting Pottery and Glass.**—Will any kind reader who has had experience in riveting pots and glass, say what is the best kind of drills and tools, wires, &c., to be used?—Broken Pots.

[48826.]—**Bench Lathe.**—I have the necessary castings, flywheel, &c., of a large bench-lathe, and would feel obliged to any correspondent who would give me instructions for setting up same, making the stand, bed, &c.? Also the best wood to use for bed?—Puppet.

[48827.]—**Steam Boiler.**—I should feel much obliged if some of your numerous correspondents would explain why my steam boiler does not keep up steam as it should? It is a horizontal boiler 10ft. long, and 4ft. 3in. diam., centre flue containing furnace 2ft. diam.; grate-bars 3½ft. long; three Galloway tubes; bridge of firebrick; the draught is carried from furnace in centre flue back, and split there, carried at both sides through wide flues to within 9in. of front, then dip down and under centre of boiler bottom to smoke-stack. The draught is good, and with the most skilful firing it will keep up 40lb. of steam. The engine or piston is 8½in. diam., 16in. stroke, 145 revs. per minute. The work is driving a 30in. circular saw through 9in. deals, or driving a frame with six vertical saws through 12in. red pine, never both together.—Wanting Steam.

[48828.]—**Gas-Engine.**—I have a 3 man-power gas-engine by your late correspondent, "Sunlight," new, but cannot get it to work. Can anyone who has seen one at work give me any information as to adjustment of valves, &c.? I may say mine is a low-pressure one, with single cylindrical valve. If it is of any use, I should like to have it working. If not, I am quite prepared to break it up, and sell it for old iron, as I am rather doubtful whether it ever did or ever will work by gas. Address advertised this week.—Dun Browne.

[48829.]—**Lathe-Bed.**—I should feel obliged if "E. P., Liverpool," or some other kind reader, would help me out of the following difficulty:—I have to make a lathe-bed 30in. long, with gap, and request information with respect to the pattern: what thickness should sides, &c., be, and how is pattern made so as to be taken from the sand? I inclose a section, with sizes.—W. H. Scrivan.



[48830.]—**Wood Bending.**—Will any of your readers kindly inform me how to bend ½in. boards? Also the best and cheapest wood to purchase for this purpose?—R. P.

[48831.]—**Electro-Magnet.**—I have a piece of soft iron 6in. long by ½in. diam., which I wish to make into a horseshoe electro-magnet. How shall I proceed, what size wire shall I get, and what kind? How many layers shall I wind on to get the best lifting-power with four Bunsens (quart)? Do I require bobbins? Is this the proper way to wind the wire? After I have wound round one limb, I wind the other on the contrary direction. What weight would it carry? Will be grateful for correct information.—W. R. H.

[48832.]—**Embossing.**—Will any reader kindly inform me how I can emboss leather, similar to book-covers?—E. Minns.

[48833.]—**Henry's Solution of Salts.**—Will any reader tell me how to make this useful medicine? I understand it is composed of Epsom salts and sulphuric acid; but I wish to know the proportions, and how to make up.—Perthshire Farmer.

[48834.]—**Natural Waters.**—Would Mr. Allen, or some other of your able chemical contributors, kindly describe how to estimate quantitatively the $CaCO_3$, $CuSO_4$, $MgCO_3$, and $MgSO_4$, in natural waters? I can find the Cu and Mg, but I do not know how to find the proportions in which they exist as carbonates and sulphates in the water. Has the total quantity of CO_2 and SO_3, both free and combined, to be first found, and then the proportions in which these acids combined in the carbonates and sulphates of lime and magnesia found in some manner.—W. G.

[48835.]—**Fusible Plugs.**—Will some of your readers kindly give the results of their experience in the use of fusible plugs for steam-boiler furnaces, stating what reliance can be placed upon them, the best form to be used, and are they generally used, or only seldom used, at the present time for steam-boilers?—Constant Reader.

[48836.]—**Continuous Brakes.**—I would like to ask Mr. Stretton what he considers the best kind of brake to use on a short line having stoppages every two miles. Further, if any of "ours" can state the price—naming the brake—that each of the following vehicles would cost, fitted complete?—Six-wheel carriage, usual length; four do.; six-wheel van; four do.; ordinary tank-engine, six wheels single. The cost is to include all labour of fixing and all gear of every kind, so that the amount stated would give price fitted of each carriage, van, and engine, ready to couple together for running.—Working Fitter.

[48837.]—**Weight of Waggon-Tires.**—Will some kind arithmetical correspondent of this useful paper please inform me the simplest or shortest method how to find the weight of railway waggon-tires? We get the dimensions of section of tire, and inside diameter of tire, and we have to find out what weight of metal is to be in tire so as to come accurate to gauge. The persons that have been doing it till now make aim at a trade secret of it, although they own it's simple enough. I have heard that it can be done by decimals. If so, please say how.—D. G. Jones.

[48838.]—**Coil-Making.**—I made a small pocket-coil lately by my own small knowledge of electricity, and, not to my great surprise, I could hardly feel any current passing, upon joining a small bichromate cell in the circuit; the core is 2in. long, ¾in. thick. After putting the usual few turns of brown paper around it, I wound on the core two layers of No. 24 cotton-covered copper wire, then two or three turns on the primary of foreign note-paper steeped in melted paraffin; on this I wound nearly two ounces of No. 36 silk-covered wire. I joined the two ends of primary to battery, the contact-breaker in the circuit, of course, the two ends of secondary to handles. The contact-breaker will vibrate, but not so as to keep the buzzing noise usual with coils. I believe the battery is plenty large enough, because it will work another coil in my possession of about the same size, by the look of it, splendidly. Will Mr. W. J. Lancaster, or some other electrical correspondent, please tell me what's the matter? and greatly oblige—D. G. Jones.

[48839.]—**The Microscope and Bacillus Tuberculosis.**—What are the requisite powers and best method of examining the Bacillus Tuberculosis in the sputum of phthisis?—E. W.

[48840.]—**Thermopyle.**—How can I construct a thermopyle, and demonstrate heat is produced in the contraction of muscle?—E. W.

[48841.]—**Rupture.**—To Dr. Edmunds.—I should feel much obliged for advice. My child, aged 14 months, is troubled with the above. We keep a truss on, but in spite of that it will come down during a fit of coughing or crying. Should like to know whether anything could be done by an operation, or is there any chance of it getting all right with the truss? The rupture was congenital.—Anxious Parent.

[48842.]—**Warm Bathing.**—This is generally supposed to relax and enervate the body, and most persons are deterred from using the warm bath, especially in winter, from the fear of catcing a cold. On the other hand, this is said to be a popular error, and that the warm bath, by increasing the circulation on the surface of the body, renders it more capable of withstanding the effects of cold than it otherwise would, even at a temperature of 96° to 100°, though to stay more than twenty minutes or half an hour with such a temperature, is admitted to be debilitating. Will some of "ours" advise a sexagenarian on the subject who has had congestion of the lungs some years ago, and remains delicate, requiring care to avoid cold, but who adopts the via media of a tepid bath bi-weekly, warm to the hand but sensibly cold to the body, on rising in the morning?—Lumbago.

[48843.]—**To Mr. Wetherfield.**—The executors of a will in which I am interested refuse to give me any information beyond the fact of my being entitled to a very small legacy. I have seen the will at the Probate Court, and I find that, in addition to the said legacy, I am one of the residuary legatees. The estate is being wound up, and I wish to know if I can compel the executors to furnish me with a statement of accounts, and how I should proceed to obtain it? What is the charge per folio for a certified copy of a will?—Sol-la.

[48844.]—**To Mr. F. Wetherfield.**—A. contracts to complete certain work for B. by a fixed date, or, in default, to be fined 20s. for each day's delay. In the course of the work certain alterations in the original plan are made by agreement between A. and B. The work not being finished by the date agreed upon, can A. claim that the agreement as to fines has become absolutely void because of the alterations in the plan? Or, on the other hand, can B. insist on payment of the fines subject to a reasonable allowance on account of such alterations?—S. S.

[48845.]—**Rheumatism.**—To Dr. Edmunds.—Will you kindly give us as good a letter on rheumatism as you did the other day on gout, telling us how to ward off attacks when subject to them? Also, remedies in simple and bad cases, and anything else that may be useful to know. By doing so I think you will earn the thanks of the majority of the subscribers to "ours."—F. R. S.

[48846.]—**Transparencies.**—To "M.I.C.E."—Would you give a little fuller account of your formulæ than that contained on p. 64 of No. 887? Following that, I have partially succeeded, but not quite, and think it may be owing to inexact quantities—e.g., ½lb. of sulphate of iron in a quart bottle which holds only a pint and half, makes a difference of being either 72 or 128 grains to an ounce. Again, I cannot get a bright green solution with my sulphate, but it is a brownish muddy solution. How is this? Lastly, several plates are, when finished, of a greenish hue, owing to a powdery deposit which forms on them and in all parts of the developing-dish. Why is this? Mr. Edwards, No. 891, p. 146, adds a solution of citric acid and ammonia. Have you tried this addition, and do you recommend same?—R. H.

[48847.]—**Noisy Exhaust Steam.**—I shall feel obliged if any of your kind correspondents can inform me of a method of doing away with the noise caused by the exhaust steam of a pair of marine engines (cylinders 8in. diameter) blowing into the chimney. Is there any means by which this noise can be done away with?—J. W. Richard.

[48848.]—**Legal.**—To Mr. Wetherfield.—Please give me your opinion on the following case:—A. died 34 years ago possessed of real property value about £2,000, and personal property, amount of which I don't know. He had two sons and six daughters, and left his eldest son B. his sole executor, £450 in stated legacies to be paid out of "his real and personal estate," twelve months after his decease, to his other son and daughters, which were all paid except to two daughters, who continued to live with B., the three being unmarried. Two years ago B. died, leaving the annual value of his real estate to two trustees for the benefit of three sisters and one brother, at their decease to become the property of a nephew, and directing all his "just and lawful debts to be paid out of his personal estate," which amounted to about £300, and his liabilities, with funeral and testamentary expenses, amounted to £200. The unpaid legacies were £100 and £70. The trustees divided the remaining £100 between the sisters, and said the personal estate was exhausted, and refused them the £70 balance. Are they legally entitled to the full amount of the legacies left them by their father, and, if so, how will the trustees have to raise it? One of them is the future owner's father. When B.

made his will ten years ago he owed over £300, and his personal estate then would be about £40. I think the word "real" must have been omitted in mistake.—Perplexed.

[48849.]—**Rack and Pinion.**—Will any reader please inform me how to set out a rack for a pinion of 20 teeth—that is, how to space the teeth of the rack so as to gear properly with the pinion?—H. G.

[48850.]—**Blower for Brick Chimney.**—I want to fix a steam blower in a chimney that is about 18in. square inside. To do this I intend putting an iron tube in it. Will someone please say which is the most effectual: one made the shape of a ring with several holes in top side, or a piece of pipe contracted at the end to blow the steam up straight? I have a notion that the inside of some locomotive chimneys are cone-shape inside. Is this so? If so, should the large or small end be on top, and why? The boiler is of the Lancashire type.—E. H.

[48851.]—**Painting Bath.**—The paint having come off my bath (lined with lead) I should be glad to know what is the best paint to use for repainting, and how to remove it, if it is necessary to do so, the little that remains on?—Amateur.

[48852.]—**Dyeing.**—Having a small quantity of canary coloured material, such as used to be worn as waistcoats years ago, I should be glad if any reader would instruct me how to dye it black or other dark colour that would make it wearable?—Amateur.

[48853.]—**To "Alfojoe" or "Fellow Workman."**—Would you be kind enough to give complete instructions for fitting hairsprings, especially to Geneva watches? We have had excellent articles on the subject by our late and good friend "Seconds' Practical Watchmaker," but we are told in those articles to make a brass pin, and after broaching the hole in collet to fasten hairspring with the pin. I can manage very well all but the pinning in to the collet. I am sure an article from "Alfojoe" on this subject would be gladly welcomed by other reader besides—E. H. E.

[48854.]—**American Iron Planes.**—I have noticed that the irons of these planes when new are ground at a very blunt angle, and I should like to know if the sharpening on the hone is to be kept at the same angle (which I suppose would be possible owing to the thinness of the steel), or whether another bevel, as in ordinary beechwood planes, must be made? If the latter plan is adopted, does not the iron want grinding more frequently than that of the English plane?—Devoniensis.

[48855.]—**Brick Moulds.**—What is the best to dress the wood moulds with to keep out the maggots or worms? —Brick Mould.

[48856.]—**Electric Light for Small Room.**—I wish to light a small room (19ft. by 14ft.) with electric light. Will some reader kindly tell me what kind of lamp is cheapest and most suitable, and what size is necessary? Also, which is the cheapest and best means of generating the electricity, a battery—or a small dynamo? I have some knowledge of mechanical work, and might be able to make some of the parts if I had the instructions. As it is, I know almost nothing about the light. Kindly give some idea of cost, and oblige—J. A. R.

[48857.]—**Painting.**—Will Mr. Stanger, or anyone else who knows, kindly inform an amateur if he can procure any book which gives useful information on the above subject? I want instruction which would aid me in painting greenhouses and doing other out-of-door work. At present I buy my own whitelead, and do a good deal in the painting line in a haphazard way: but I should like to have some rules which would deal with the uses of raw and boiled oil, dryers and turpentine, with the mixing of colours and the nature of the different coats from priming upwards?—Devoniensis.

[48858.]—**Planing Machines.**—Will some fellow-reader inform me how the quick return is given to planing machines, either rack and pinion, or worked by long screw, and which is considered the best way of working bed—screw or rack and pinion? A sketch of working parts would greatly oblige—J. D. A.

[48859.]—**Peroxide of Hydrogen.**—Could any of your readers kindly inform me of a cheap and effectual method of producing peroxide of hydrogen. I understand it is, or can be made, on a commercial scale?—D. M. S.

[48860.]—**Child's Diet.**—To Dr. Edmunds.—You kindly advised me some time ago on infant's food. May I again trouble you to advise us follows?—My baby, age twelve months, has no teeth as yet. Can you kindly state cause? Diet has been as follows: Up to seven months he was fed at the breast, and with milk diluted with water; from then to now (five months), he has had milk slightly diluted, and Savory and Moore's food, Liebig's. He is a strong, healthy child, inclined to stoutness; bowels in good order. When otherwise, give Gregory's powder, or fluid magnesia. He had whooping cough at three months old. Will you kindly state up to what age I may feed as above, and when a stronger diet will be required? All food is taken from a feeding-bottle.—Siovald.

[48861.]—**L.N.W.R. Locos.**—Will "Prometheus," or any other of your correspondents, kindly inform me what the pressure-gauge on the left side of the cab of "66 Experiment" indicates? I have heard something about back-pressure. Has it anything to do with it?—H. Bill.

[48862.]—**Medical — Chilblains.** — To Dr. Edmunds.—I suppose these come from the following three causes:—(1) From want of circulation, thus: no exercise in cold weather; (2) from the blood being in a bad state; (3) from getting wet or damp feet in cold weather. Will Dr. Edmunds say what is the proper treatment for the above when they first appear, when the toes are inflamed and itchy? And also when this stage has been neglected or not properly treated, and they get into the broken condition. I have heard when they first come, steeping the feet in as hot water as you can bear at night, is good; but others say no: thus showing the proper way of treating them is not well understood.—H. F.

[48863.]—**Voss Multiplate Machine.** — To Mr. Molison.—Please let us have, if you can kindly do so, working drawings of the Multiplate Voss. Is it an advantage that the plates should be large, or that they should be numerous: that is to say, which gives better effect, increase of size, or increase of number? If the plates were of vulcanite, would the effect be better, or would any alternation or combination of glass and vulcanite plates be more efficient than either of these substances alone? In fact, what would give the best results, neglecting expense?—A. W. S.

[48864.]—**Electric Signs.**—I have constructed a couple of mottoes on Mr. Willing's principle for Christmas decorations, but cannot get anything like the effect of those shown by that gentleman at the Crystal Palace. They will work, but the swing is not enough to give good effect. A sketch would oblige—On Guard.

[48865.]—**Animal Charcoal.**—I suffer from indigestion, for which I have been recommended animal charcoal, which I find is beneficial to me. . Will some one who knows kindly inform me the most economical way of preparing the same on a small scale?—Odin.

[48866.]—**Astronomical Apparatus.**—Will some astronomical correspondent tell me what apparatus it would be advisable to have, and its probable cost, in order to commence the study of astronomy, including a telescope through which Saturn's ring and Jupiter's moons might be observed?—W. S. W.

[48867.] — **Battery Power.** — Could any reader kindly inform me which would have the strongest battery power: a six-cell Smee battery (each cell holding one quart), or a bichromate, with the same size cells?—J. C.

[48868.]—**Building Society.**—To Mr. Wetherfield.—I joined a Building Society, which started about seven years ago, and as I am about to go abroad, I wish to withdraw my subscriptions in accordance with the rule of the Society, which states that such may be done after three months' notice. Now, however, I am informed they will not be able to refund for two years. Any advice will greatly oblige—R. L.

[48869.]—**Mechanics.** Can any correspondent help in the following questions from "Todhunter's Mechanics"? —(1) Two weights support each other on a rough double-inclined plane by means of a fine string passing over the vertex, and no friction is called into operation. Show that the plane may be tilted about either extremity of the base through an angle 2 ε without disturbing the equilibrium, ε being the angle of friction, and both angles of plane being less than 90° — ε. (2) A plane equatorial pentagon is formed of five equal uniform rods—A B, B C, C D, D E, and E A—loosely jointed together. The angular points, B and D, of the pentagon are capable of sliding on a smooth horizontal rod, and the plane of the pentagon is vertical, the point C being uppermost. Show that if θ φ be the respective inclinations of the rods A B and B C to the horizon in the position of equilibrium, 2 tan. φ = tan θ. I cannot understand the first, and it seems to me as if I have proved the second impossible. J. C.

[48870.]—**Symme's Theory.** In the October No. of *Harper's Magazine*, there is a paper called "Symme's Theory." Can any of your readers tell me whether there is any foundation for the statements there as to the mild climate at the N. Pole, and the asserted northward migration of birds and animals? Have these statements received, of late years, any confirmation?—F.R.C.S.

[48871.]—**Subsidence near Maidstone.**—About three weeks since there was a paragraph in the *Standard* about a very extraordinary sinking of the earth near Maidstone. Can any readers there tell us anything further about this?—F.R.C.S.

[48872.]—**Saw-Table.**—Will some of our able correspondents inform me the best way to make a band-saw table (portable) to cut either square or bevel? I want it to cut fellоes or shafts. My saw is 13ft. long, and ½in. wide.—A Young Wheelwright.

[48873.]—**Water.**—Would "H. B. G.," or any other, help me to reckon the following? I have a rain-water sheet-iron tank, with an overflow hole 1in. horizontally, and 2in. perpendicularly, and the hole is 1½in. below top. What is the maximum water that can flow through this hole?—Another Tank.

[48874.]—**Steam-Power.**—To Fred. Walker and "L. O. V."—An engine with 3ft. stroke, cutting steam off at half-stroke, with 30lb. pressure, would there be any saving to increase the pressure on boiler and cut off earlier? If so, what pressure should I have, and what should I cut off at, and what advantage will there be in doing so? My boiler could stand 40lb.—Carmel.

[48875.]—**Coals.**—Could any of our Berks readers inform me (and a few others) if there is coal in the neighbourhood of Knight's-park, Reading? If so, how is it that they don't use it, as coal is very dear in this quarter?—Anxious to Know.

[48876.]—**Vice for Bench.**—Would some reader say which kind is the most suitable—a vice with a leg, or a parallel one (I do not mean a "grip-vice")?—Novice.

[48877.]—**Egg-Shaped Sewer.**—An egg-shaped sewer, whose diameters are D and d in. respectively, is running full. The lower part is a length of 500ft., at a gradient of 1 in 150, and the upper part 1,500ft., at a gradient of 1 in 80. Can any reader give me a formula for the pressure in lb. per sq. ft. of the liquid against the sewer brickwork at any point on the upper gradient, and state what might be taken to be the breaking pressure per ft. of good ordinary brickwork in lias lime under such conditions: the sewer being assumed to have no covering of earthwork above the spring of the arch?—Phrases.

[48878.]—**Air Currents.**—When air is forced through a tube, (1) how can the rate at which it travels through, and (2) the forward pressure per sq. in. exerted by it, be measured?—R. A.

[48879.]—**Sphygmograph.**—Will Dr. Edmunds, or any fellow-reader, say if the sphygmograph is a thoroughly reliable instrument in examining heart-disease? And, how can an inexpensive one be made?—E. W.

[48880.]—**Working Models by Electricity.**—I am about to fit up a number of mechanical models—about twenty in all—made from cardboard, and to be worked principally by a revolving motion. They are all small and very light, the largest of them being a windmill, 6in. from its base to the top of fans. I should feel obliged to anyone for information how to work them by electricity, how to apply it, the kind of constant battery required, and chemicals for charging the same? Also if it is possible to work a small tin paddle-steamer of about 6in. in length, in an aquarium 27 × 36, with electricity, and how to do it, and what to do it with; or is that size of a steamer too small?—P. K. M.

[48881.]—**Engine Indicator.**—Could any one suggest a simple and cheap plan for fixing an indicator to an ordinary horizontal engine with balanced disc, about 10h.p., and making about 200 revs. per min.? I want something that will register the number of revs. the engine makes for 24 or 48 hours, and that the engineman cannot tamper with.—Indicator.

[48882.]—**Organ Tuning.**—Will any reader kindly inform me of the number, shape, sizes, material, and mode of using of the cones or cups used in tuning metal organ-pipes? I can tune all right enough, so far as the ear is concerned, having tuned pianos and harmoniums for 30 years, but cannot produce the nicely coned ends to the pipes when I open or close them.—Amateur Organ Tuner.

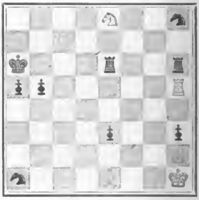
[48883.]—**Air-Gas for Gas-Engine.**—Is it possible to produce air-gas suitable for driving a small gas-engine from ordinary benzine? If so, what surface of benzine should be exposed to the air in the generator to produce, say, 30 c. ft. of gas per hour? Should the benzine be kept agitated in the machine in order that the vapour may leave it, or would it be sufficient to have something like cotton, saturated with the benzine, through which the air would be drawn? I believe it is possible to produce gas from gasoline for above purpose, but I don't think it could be obtained here. Any information about the matter will greatly oblige—R. K. S.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCCV.—By J. B., of Boxford.

Black.



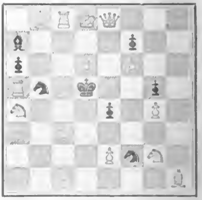
White.

White to play and mate in four moves.

PROBLEM DCCCVI.—By J. Pierce.

"The Pear."

Black.



White.

White to play and mate in two moves.

Solution to 801.

White.	*Black.*
1. Kt–Q B 4	1. Anything.
2. Mates	

Solution to 802.

White.	*Black.*
1. R at Q 4 to Q 3	1. Anything
2. Mates	

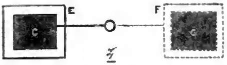
This problem received "special mention" in the Baltimore Problem Tourney. The number of mates is nineteen.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 15, 1882.

THE VOSS MACHINE.—II.

By John T. Sprague.

THE various forms of induction machines, of which the Voss is the latest and best development, are based upon the principle of the electrophorus; they utilise the successive charges which may be obtained from it by alternately connecting the cover and sole, and removing the cover. The original of all the various forms was Varley's multiplier, in which was, for the first time, applied the principle of "accumulation," which, applied also by Mr. Varley to the magneto-electric machine, is the foundation of the powerful generators of current electricity now in use. In the generators, both of static and dynamic electricity, the principle is that a small initial charge can be used to convert mechanical energy into electrical energy, and to develop a high force. The principle may be understood by means of the diagram. E F are plates of metal (which in the instrument were arranged in a row) in front of which the plate C (which represents the electrophorus cover in principle) can rotate. The plate is carried on an insulating arm, but with appliances by which at proper intervals it can be connected to what is miscalled "earth," but is really a zero point or a discharger, to which C can be connected at the required moments, as also can other plates similar to E, F; this zero connection may be called z. A small charge of + electricity is put upon E, which represents the electrophorus face. z, therefore, represents its back at this stage, and in the position shown, C is momentarily connected to y, and therefore takes a − charge equal to the + on E. C is now moved, breaking connection with z, and carries its − charge over to F, with which it makes momentary contact; contact with z following, a + charge is at once induced on C, which it in like manner carries on and adds to that on E. In the actual instrument, of course, the charges which are induced upon C are accompanied with a corresponding opposite quantity removed, by the agency of z, to another set of plates similar to E F, in which the same series of operations are carried on. At length the charge rises to the full "potential" of which the insulation of the instrument admits, and then the electricity overflows into the external circuit.



Just such a series of inter-actions occurs in the machines arranged by Holz, Carré, Töpler, and others, as also in the Voss machine; the special property of the Voss is that it requires no initial charge to be given it, because, as with magnetised iron, there always remains some residual charge about it which can be worked up.

An examination of the machine while working in the dark is both interesting and instructive. It will be seen that an aigrette, or brush discharge, occurs into surrounding space at one of the appliances k, while at the other there is a small star of violet light indicating the + and − charges of what we may properly call the "field induction system," for it plays the part of the field magnets in dynamo-machines. If a metal point, held in the hand, approaches either of these parts, the instrument ceases to act, and if a momentary circuit is closed between them, the direction of the circuit is apt to be reversed—a consequence which appears also to result from making the paper shields too long.

A line of fire will be seen tending to the points of one of the collecting combs, and a similar effect is seen at the points of the secondary comb of the figure p, which plays the part of the zero connection z in the diagram above. But here is manifested the relation between inductive circuits, which is the same in principle as in the case of currents and conductive circuits.

We have here two derived induction circuits—that of the field system along the surface of the plates, and the external path between the two conductors, and these two divide at the collecting combs. If we bring the conductor knobs close together, we reduce the external inductive resistance; the greater part of the available electricity takes that road, and may be seen streaming into the collector system. But, if we open the space so as to get a long spark, an increasing change takes place in the ratio of the two resistances, and increasing action is seen to occur at the zero comb, while that at the collecting system is reduced. The long spark has, therefore, less electric energy in it than the shorter. The spark appears like a continuous stream of lightning; but this is an illusion due to "persistence of vision." It is really a succession of sparks, each enduring probably $\frac{1}{1000}$th of a second, but following each other at intervals less than one-sixth of a second, the intervals being indicated by the snap at each discharge. When a wheel rotates rapidly all its spokes vanish into a sort of blur, but such a wheel is seen by a lightning-flash as though it were at rest. The discs on the plate of the Voss disappear in this manner; but in the dark they are seen as if at rest, or even as though moving backwards. We have, in fact, the conditions of the rotating vacuum tube worked by an induction coil, which presents the appearance of a stationary cross or star; or may have an appearance of reverse motion, according to the relation between the speed of rotation and the action of the break.

If we place the balls of the conductors so far apart that sparks will barely pass, and then tie a piece of soft thread across the space, they will pass freely, notwithstanding that the thread is a partial conductor, because, the resistance being reduced, the current is drawn over to the external circuit, and the charge on the field can be raised to a higher potential. This thread will now give some valuable instruction. Approach the balls so that the thread hangs quite loosely and takes up a partial charge, + at one half, and − at the other; the same, therefore, as the balls close to it. It will be seen at once that, though charged alike, there is no repulsion between the balls and thread adjoining, but a small attraction. There is, however, a strong attraction for the other end of the thread, and it is drawn over as tightly as possible in opposite directions, leaving a loop which instantly turns up over the thread, and stands balanced between the attractions acting on its two sides. Sometimes it will manifest a preference for the positive ball, and remain on that side. If the thread is cut in the middle, its ends rise and meet as soon as the machine is worked, and will cling together for a long while; if forcibly separated, they will fly over to the adjoining Leyden jars, the outsides of which are in opposite polar conditions to the balls near them.

By taking off one of the conductor balls, leaving a point, the star and brush discharge is produced, and illustrates the difference between the + and − actions of electricity, according to which ball is removed; when the brush is produced at the ball, there is a hissing sound which is not produced when that discharge occurs at the point without developing the brush discharge.

I have found some curious effects when passing the discharge through a sensitive galvanometer: if connected direct from the collectors, of course the potential cannot be raised highly, because the outer circuit carries it off; in this case the deflection increases with the speed of rotation: interposed resistance up to 10,000 ohms produces, of course, no effect, as it is not any appreciable ratio to the air-space between the glass and combs. A resistance of several megohms would be requisite. If connected from one conductor to a third separation ball from which the action occurs, I found a deflection of 50° with the balls in contact; on separating a ¼in. so that sparks crossed, the deflection fell instantly to 10°, showing that, notwithstanding the greatly increased potential or force, there was less quantity generated. As the balls separated, the deflection increased till at the distance at which sparks ceased, and only a hissing discharge was produced; the deflection rose to 45°, although under these conditions the galvanometer was only a derived circuit, taking, probably, less than one-half of the current generated.

A metallic-sponge benzoline-lamp placed between the balls gives remarkable effects. On working the machine with the lamp insulated, a slight tendency of the flame to one pole is observed, with an evident blowing action from the other; when the lamp is connected to either pole, the flame tends to the other. But this is masked by a very much stronger action which occurs when the connection is on one side: then the flame is driven in a bubbling cascade down the wick stem, burns much more strongly, as though the benzoline were rapidly drawn up; and if the speed is great, the lamp may even be extinguished by this action.

ECONOMICAL STEAM-POWER.

THE most economical steam-engine plant for any given purpose is not so easily decided upon as may be thought, for arrangements adapted to one set of conditions may not be suited to another, and may, indeed, be actually bad; but as a rule, one large engine is more economical than several small ones working up to the same aggregate power. Mr. W. Barnet Le Van takes exception to that view, and in a paper on the subject presented recently to the Franklin Institute, he says that the most economical application of steam-power can be realised only by a judicious arrangement of the plant—that is not only the engines and boilers, but the accessories—the portions that come between the engine and the machines to be driven. Referring, presumably, only to American practice, he says that it is only occasionally a factory, a mill, or a waterworks may be found in which the whole arrangements have been planned by a competent engineer; that but few users of steam-power are aware of the numerous items which compose the cost of steam-power, and that a smaller number still pay sufficient attention to the relation which these items bear to one another. A large number of persons, says Mr. Le Van, take for granted that a boiler or engine which is good for one situation is good for all: a greater error than such an assumption can scarcely be imagined. It is much too strong to call such an opinion an "error," for it is certain that if a boiler and engine produce power at an economical cost in one situation, they can also do so in any other in which it is possible to work them. Whether they are the best for the special work is another matter; and it would appear that it is in connection with the "considerable number of details" that Mr. Le Van intends his remarks to apply, and that not as regards the special type of engine, but merely as regards the production and application of the motive power generally. Thus, he says, take the case of a mill in which it has been supposed one engine could do the work most economically: the question is, Whether it would not be better to divide the total power required amongst a number of engines? Mill-owners and engineers in this country will, we imagine, decide definitely and at once that the single engine of ample power is the most economical; and there can be no doubt that so far as the production of steam-power is concerned they are right. But there are other points to be considered; and it may be that under certain conditions, or in certain circumstances, it will be found more profitable to employ several small engines instead of one large one. Mr. Le Van finds the following advantages in the system of dividing the motive power of a mill:—(1) Saving of expense in lines of shafting of large diameter; (2) dispensing with the large driving-belt or gearing; and (3) the general convenience of sub-dividing the work to be done, so that, in the case of some slight breakdown, only that portion of the mill affected would be stopped. The first advantage is rather illusory; for with one large engine it is only the first and second shafts that need be of large diameter, and the extra cost is more than balanced by the outlay for similar parts in a number of smaller engines, to say nothing of the extra work in fitting up and looking after them. By way of supporting his second advantage, Mr. Le Van mentions an instance in which a large driving-belt absorbed 60 horse-power out of 480, or "about seven per cent." There is some confusion here it will be seen; but whatever the loss of power may have been in any special case, it is only the loss that cannot be avoided that is of any moment, and it is more than probable that whatever may occur in connection with a large belt will be equalled if not exceeded by the combined loss of several driving-belts. The third advantage is the most important point, as Mr. Le Van says, for it is evident that where a mill depends upon one engine, a break-down involves the stoppage of the whole establishment, whereas if each department were driven by a separate engine, a break-down would result in loss only to the department in which it occurred. Mr. Le Van instances the case of a whole mill being stopped because a governor-belt broke—an annoying event, no doubt, but scarcely affording positive proof that the employment of a number of engines to do the work of one is sound economy. Now to take the disadvantages: We find (1) that each engine must have its own special shafting, and is subject to as much wear and tear as the large engine, which could moreover be obtained at a lower sum per horse-power. Further, a multiplication of engines means an increased number of attendants, an increased length of steam-piping, and an augmented consumption of oil, &c. (2) A large driving belt is not absolutely necessary—several mills, for instance, have a number of cotton belts driven from one large pulley. (3) The causes of stoppage are multiplied by the number of engines, and assuming everything to be of best quality, and carefully looked after, we should expect the combined stoppages to equal, in actual loss of working time, one stoppage of a large engine, unless indeed the latter broke down altogether—an event which, however, could only be regarded as an accident, i.e., something that could not be provided against. Such an event does not enter into the calculation, however; though it is obvious that one or two of the small engines might break down hopelessly, and the loss would be incurred by their departments only. Viewed from that stand-point, there is an advantage in having several small engines instead of one; but engines properly made and carefully looked after, do not frequently break down in the fashion we mean, so that we must place that point on one side as beyond the argument. In fitting up a mill, the first item to be considered is the interest on the first cost of the engine, boilers, &c., and it will generally be found that the saving in working expenses effected by the best appliances of the kind will more than pay any reasonable interest on the excess in outlay, while there will also be less stoppage for repairs. The form of the engine is of importance where there is perfect freedom of choice—i.e., ample space. Mr. Le Van says that "undoubtedly the horizontal engine" is the best form, and the beam engine the worst, for the first-named costs less, can be driven at a higher speed, and involves a smaller outlay for foundations and house. He admits that the best forms of vertical engine approach very closely to the horizontal, but where machinery is to be driven he considers that the balance of advantages rests with the latter form, especially in the case of large powers. As to type—whether condensing or non-condensing—it is necessary to take into account the first cost of the two, and the running expenses for water and fuel. Where a sufficient supply of condensing water is available at a moderate cost, the extra economy of a well-constructed condensing engine will fully warrant the additional outlay; but Mr. Le Van excepts very small powers and cases where the exhaust steam can be utilised for other purposes. He acknowledges that with high pressure a non-condensing engine can be made to approximate closely to the economy of a condensing engine, but in such a case the extra cost of the stronger boiler will go far to balance the additional cost of the condenser. The compound engine is left out of the question by Mr. Le Van, but the argument which applies in the case of automatic cut-off v. simple slide-valve engine also serves in this case. An automatic expansion valve engine costs more than a plain slide-valve, but if it yields the same horse-power with a smaller consumption of fuel and lubricant, and it is also lighter on repairs, it will be economical to use the more costly machine, especially in the case of large powers. Much, however, depends on the cost of fuel in the locality, and the extra price paid for the automatic cut-off, or for the compound engine. Suppose an engine requires five pounds of coal per hour per horse-power, and it develops one hundred, it will need 500lb. per hour or 5,000lb. per day of ten hours. An improvement which would effect a saving of one pound of coal per hour would mean an economy of one fifth of the annual coal bill, and exercise a small but appreciable effect on the demand for fuel, for the economy is 1,000lb. a day — very small compared to millions of tons, but an important item when multiplied by the number of engines which could have the improvement adapted. If the cost of 1,000lb. of coal per day would pay the interest on the extra outlay for the engine, and no more, it would be worth while making it, for there would be less wear and tear in the furnace, and a smaller boiler would suffice. If the engine runs day and night, the outlay might be doubled; but if it stops at intervals, and does not work altogether ten hours a day, the saving would not be so great. The interest on the first cost runs on, but it is only so much per day, so that engines working night and day usually pay the cost of improvements in a very short time where fuel is dear. Gas-engines, though costing more, power for power, than steam-engines, are more economical wherever the work is intermittent, and are preferred in America for hoists and grain elevators. Mr. Le Van concludes his paper by pointing out that it is worth while for any steam user to consider the subject in all its bearings, and he gives an instance of a flouring mill in Philadelphia which formerly had two engines of 70 horse-power, which used 40lb. of water per indicated horse-power, and 5¼lb. of coal. Such a performance, we need scarcely say, was very bad; and it is not surprising that one engine of 140 horse-power with automatic cut-off used only 3lb. of coal and 30lb. of water per indicated horse-power, effecting a money saving of nearly 5,000 dollars per annum. Even this automatic engine is not remarkable for its economy, for there are many in this country which can show a better duty than 3lb. of coal and 30lb. of water. Unfortunately, there are many also which are quite as wasteful as the first-named engine; but their owners have only to go into a few figures to discover that it would be wise economy to put down modern contrivances and recoup more than the interest on their outlay by the saving effected. The question is of rather more importance in this country than it is in America.

PRACTICAL NOTES ON PLUMBING.—LV.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 310.)

Atmospheric Jack, or Suction-Pump: Action of.

LET us now examine the theory of pumps generally.

Writers up to the present time have boldly asserted that all pumps are both pneumatic and hydraulic; but when they say that *all* pumps are so, the assertion is not correct—which I will prove before I conclude this work. At the same time, I entirely concur with those who have written "whoever understands the one, will be at no loss to understand the other." Without some knowledge of the science of pneumatics, it is next to impossible to understand hydraulics. However, I do not intend to teach pneumatics generally, but I shall explain here just sufficient of this branch to enable you to understand the principle of the suction-pump. I use the word *suction* because it is universally understood by plumbers, and it is common amongst them to call a jack-pump a suction-pump, and vice versâ. In fact, it is very rarely that you meet with a pump without a suction-pipe in some shape or form. All jack and plunge-pumps, also most of the lift-pumps, have a suction pipe. The term, "suction," in relation to all pumps is generally accepted and commonly used by plumbers; hence the reason why I use it.

Fig. 293 is the suction-pipe leading to the source of water supply. B is the sucker-valve, opening upwards, so called because the weight of the water from below always tends, as it were, to suck this valve through its seating, which will shortly be explained. W is the working barrel, so called because this is the chamber wherein the bucket G is made to work. I is the outlet water way, leading either to a cock or spout, and after into a cistern, or otherwise. Upon the upper part of this water-way, at V, is a valve-seating, of course opening upwards. One of the tail valves, A, B, E, or C, Fig. 287, will answer here; but as you progress you may be surprised to find that, for the real action of this pump, the valve is not required. Q is an air chamber, which should be at least 10 times the capacity of the working barrel, or of the water lifted at each stroke. But for my part I go further, and make the size of the air-chamber in proportion to the height of the column of water lifted, as the higher it is lifted the more will the air within be compressed, as follows:—

Suppose the air-chamber to be full of air. Now suppose it to be pumped half-full of water: it follows that the air has been compressed to one-half of its original bulk; and, therefore, its spring is twice as great as at first, and will resist a column of water in proportion. Here the pressure of the air in the water, and internal parts of the air-chamber, will be 15lb. on the square inch, and will be equal to the pressure at the bottom of a column of water 30ft. in height. Now, suppose the air to be compressed to two-thirds of its original bulk, its spring will be three times as powerful as it was at first, and will force the water twice 15lb., or 30lb., to the square inch, or up a pipe 60ft., known as two atmospheres. Compress the air to one-fourth, then the water will rise three atmospheres, or 90ft., and so on, according to the following table :—

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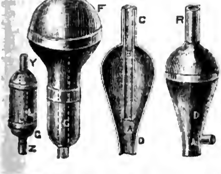
Table of Air-Chambers.

Height of water in pipe.	Spring on the elasticity of air.	Air compressed in bulk.	Number of atmospheres.	Height of water in chamber.
30	2	= $\frac{1}{2}$	1	$\frac{1}{2}$
60	3	= $\frac{1}{3}$	2	$\frac{2}{3}$
90	4	= $\frac{1}{4}$	3	$\frac{3}{4}$
120	5	= $\frac{1}{5}$	4	$\frac{4}{5}$
150	6	= $\frac{1}{6}$	5	$\frac{5}{6}$
180	7	= $\frac{1}{7}$	6	$\frac{6}{7}$
210	8	= $\frac{1}{8}$	7	$\frac{7}{8}$
240	9	= $\frac{1}{9}$	8	$\frac{8}{9}$
270	10	= $\frac{1}{10}$	9	$\frac{9}{10}$

If you examine the figure 270 in the Table, you will see that the air is compressed into a very small space. Now, the useful effect of the air in the chamber is reduced to a minimum, nine-tenths of its capacity being filled with water. Now, to make the air-chamber work with proper effect more air is required within it—which air, in reality, forms a cushion, whose elasticity prevents the sudden strains, jerks, or blows (known as the rattling) upon the bucket, valves, and sides of the pipes or pump. The following method is the one I some twenty-five years ago adopted, and I believe that I was the first to do so. Having the water within the rising main, and the pump properly charged, open the cock C, Fig 293, and pump air into the air-chamber; or from a stop-cock, say, at U or at A, Fig. 294, pump the air-chamber full of air: when the chamber is full, the air will bubble through the rising main. The pump will now not only work with a more continuous flow, but if worked by hand and lever, it will work easier. Of course, simply because the cushion of air is increased (though under the pressure of the column of water within the pipes) to its original size. In long suction or rising mains, especially with single-barrel pumps, owing to the continual stoppages and re-starting of the water column, the concussion is very noticeable, and may always be stopped by the use of the air-chamber.

FIG. 294



These air-chambers are nothing more nor less than closed vessels, often having the end of the rising main terminating near the bottom, as at S, Fig. 293; or, in other words, having no outlet whatever, more than one-third of the diameter of the rising main above its bottom. Suppose the rising main, R, to be 3in., then its end may be brought to within 1in. of the bottom. *But take care that this pipe does not come against the top of the valve when the valve is up;* otherwise the pump will work exceedingly hard, on account of the great friction of the water when passing through a partially-closed aperture. N is the rocking standard, which allows the handle to be lifted, and which, if not movable upon the joint Z and P, would prevent the handle being worked. Now, suppose the barrel W to be full of water, as shown by the water lines, and the bottom valve B to be holding it up, the bucket fits the sides of the barrel quite truly,—and notice this, that the greater the pressure upon the bucket the tighter will it fit the sides of the barrel, simply because the bucket has an outside casing of stout leather, which expands laterally with the pressure. The outer edges of this leather are slightly bevelled, as shown at A, Fig. 291. In the centre of the bucket is the flap-valve K, which opens upwards, and allows the bucket to descend freely. On pulling the bucket up the flap-valve J K instantly closes, and the cup-leather expands, because the weight of the column of water above the bucket has been lifted off that below; and if the valve B was perfectly closed, or a stop-cock wiped on the suction-pipe and closed, there would then be a perfect parting of the water below and the bucket. Suppose there to be 1in. of water below the bucket and the top of the valve B, and that the bucket be lifted 9in., then there would be an empty space of the 9in. This is a truly empty space, void of all matter or air, and is called a vacuum. Now let go the handle of the pump: the bucket will then go back, but will the vacuum still be in the barrel of the pump? The answer is, Yes! It will now show itself at I, below the outlet valve; and the water that was at the point I will, by gravitation, fall back upon the bucket. Open the cock H, and what will be the effect? Air will rush into the barrel to fill up the empty space or vacuum. But suppose, instead of opening the cock H, the cock C had been opened below the bucket, would the air then have rushed in and opened the flap-valve J K? Yes! Now turn off the cocks, and again fill the barrel as before; then close the suction-pipe (which does not exceed 27ft.—5ft. or 6ft. would suit better). Now pull up the bucket, and another vacuum is produced. The top valve V will prevent the water or air returning, and you may now work the bucket freely up and down the barrel. You know that when the cock H was opened that the air rushed into the barrel. Now place the end of the suction-pipe (which is now shortened to, say, 2ft. or 3ft.), into water, and open the stop-cock on the suction-pipe. The consequence will be that water will rush up the suction-pipe instead of air. But why? Simply because the end of the suction is covered with water, and no air can get into the pipe. (Should the pipe be too large for the water to show itself in the barrel, perhaps a few strokes of the handle will fetch it: or, for the purpose of illustrating this action, a small compo. pipe may be used, whose length is in proportion to the size of the barrel.) Now the barrel is full of water, as also the suction pipe, open the cock F, and air will rush in, and allow the standing water within the suction pipe to descend. But why? Simply because the air is allowed to press with the same force on the surface of the highest point of the water inside the suction-pipe as on the bottom and the outside. Turn the cock F off again, and lengthen the suction-pipe to 34ft., and let the water be *drawn* (which is an ordinary plumbers' phrase) vertically this distance. Pump away as before. No water can be obtained. But why? You have the vacuum as before, when the suction-pipe stop-cock was turned off, now the water is standing in the suction-pipe, and within 1ft. or so of the barrel or valve B. To prove this, shut off the suction-pipe stop-cock, whose distance from the valve B is, say, 5ft.; let F be fixed 3ft. from the valve B: open the cock F, and you will find a slight rush of air enter the cock, after which the column of water runs out; but not with the kind of cock shown at F, because this cock answers the purpose of a cistern to a barometer, and prevents the air entering only to the degree of one common atmosphere. An ordinary ground-in bib-cock, as at C, will admit the air, and afterwards allow the water to run out. (Notice. It often happens that you, a plumber, have to turn off the water from a cistern whose pipes are fixed vertically, and so arranged that they should drain themselves empty. You turn off the stop-cock near the cistern, and open the bib-cock below, which, if of the screw-down kind, such as the Rotherham, Brighton, or the diaphragm pattern as at F, the water will be held up to the height of 30 to 33ft. above the cock; but should there be a cock on a higher level, then the highest cock, if opened, will allow air to enter the pipe, and the water imprisoned within the pipe to fall to the cock below.) You have seen that the water will only rise up the suction-pipe to the height of 30 or 33ft. Why is this? I must say that it would not rise 1in. were it not forced up. You know that when you had a vacuum in the barrel the air rushed into it on opening the cocks H and C. Then there was a proof that there must be pressure upon the outer side of the pump barrel. This pressure is at all times pressing upon every part of the world's surface to the extent of 15lb. to the square inch, more or less.

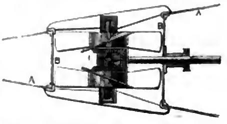
(*To be continued.*)

ERICSSON'S STEERING PROPELLERS.

An invention intended to provide more effectively for directing vessels of all kinds, either when under way or disabled, has been patented in this country on behalf of John Ericsson, of new York. The invention consists in the employment of one or more screw propellers in a transverse passage in the hull of a vessel near the stern or bow, and through which currents of water are, by the revolution of the propeller or propellers, caused to flow in such free and unobstructed manner as to produce the turning or change of direction of the vessel.

The invention further consists in the combination within a transverse propeller cylinder having a free and unobstructed inlet and outlet of two screw propellers of opposite pitch, and an engine or engines for so producing their rotation that one will rotate in the opposite direction to the other.

The accompanying figure is a horizontal section, illustrating the invention with two propellers. A is the hull of the vessel, in the sides of which near the stern, where the vessel is very narrow, there are provided opposite circular openings, into which are inserted and secured the ends of the open-ended hollow cylinder B, which forms an unobstructed straight passage directly through the vessel in a transverse direction below the water line. Within this open-ended cylinder B are arranged the screw propeller or propellers, the shaft or shafts of which are concentric with the cylinder B, and with the openings provided in the sides of the hull. The external diameter of the propellers is so nearly equal to the internal diameter of the cylinder B that they will just turn freely within the cylinder. The journals of the shafts are supported in journal boxes on a skeleton framing as shown.



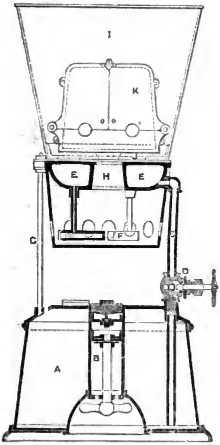
When two propellers are used, they are to have separate shafts, so that they may be capable of turning in opposite directions, and the blades of one are to be pitched in the opposite direction to those of the other. To drive the propellers there is a shaft, which passes from the interior of the vessel A into the cylinder B through a stuffing-box provided on the cylinder. This shaft may be horizontal or inclined, and may be driven by an engine provided within the vessel A separate from the engine or engines by which the ordinary propulsion of the vessel is effected. The shaft is furnished within the cylinder B with bevel gearing, which gears on the propeller shaft, so as to turn the two propellers in opposite directions at the same time.

When the main shaft is set in motion, it gives motion to the propellers, and so causes a current of water through the open-ended cylinder B from one side of the vessel to the other, and so moves the stern of the vessel sideways in one direction or the other, according to the direction in which the shaft is turned, and so causes the vessel to swing as on a pivot to point its head in the direction desired. This operation may be effected either while the vessel is being propelled forward or backward by the ordinary means of propulsion, or when the ordinary means of propulsion is rendered inoperative by accident, or while its operation is purposely suspended temporarily. It may be remarked that while the single propeller may be sufficient for vessels of many kinds, the two propellers of opposite pitch, geared to turn in opposite directions, as shown in the figure, will be more effective, as being capable of drawing in and forcing a greater volume of water through the open-ended cylinder B at each revolution of the shaft.

The inventor describes a few modifications, especially in the method of applying the motive power, and he points out that the propeller or propellers may be used for ordinary purposes instead of a rudder by connecting a steering-wheel with the stopping, starting, and reversing gear of the engine which drives the shaft conveying power to the propellers.

PORTABLE FURNACES WITH LIQUID FUEL.

AN improved portable furnace using liquid fuel, which is capable of melting lead, tin, Babbit, and other easily fusible alloys, has been patented in this country, by Mr. W. S. Cooper, of Philadelphia. Besides its use as a metal melting furnace, it can be employed for heating plumbers' and tinsmiths' irons, where gas and coal fires are not available. The engraving shows the furnace in sectional elevation.



In the stand or lower part is a reservoir A containing the combustible fluid, which is raised to the burner by means of the expansive force of air pumped into it by an air-pump B placed in any convenient position in the stand. The burner is suitably connected to the top of the stand, and above is fixed a shield which conveys the flame around the vessel containing the metal or other material to be melted or heated. On the top of the stand or oil reservoir is mounted the upper part of the construction which forms the furnace proper, the vessel being let down into it from above. A door is provided in the sill and near the bottom, through which irons or other articles to be heated can be inserted. The fuel is admitted to the burner by a valve, so constructed that it can be regulated to give at all times the same precise feed, and provided with an indicator to show the amount of fuel the valve is set to deliver. Air is pumped into the reservoir until sufficient pressure has accumulated to force the liquid fuel up the conduit pipe C through the controlling valve D, and thence to the retort E, where it is converted by its own heat into a gas, and from thence it passes to the burners F. The burners and retort are supported on the top of the stand or reservoir A, by means of studs or bolts G to which they are securely fixed, and above the burner may be fixed a shield to distribute the flame around the vessel containing the metal to be heated. The burners F may be left exposed, or they may be covered as shown, holes being left for the supply of air to promote combustion, the flame in either case passing up the opening H, in the centre of the retort. A movable cowl I, is placed on the top of the retort, and surrounds the pot containing the lead during the time of melting. The pot rests on the supports J. A door, K, is placed in the side of the cowl through which to introduce the plumbers' or other irons to be heated at the underside of the pot that holds the solder, both objects being accomplished at the same time. The furnace may be made of any size, and any number of burners can be placed in the larger retort. Where it is required for melting lead, or making the joints for street mains 12 to 20 burners may be employed, the number being determined by the amount of metal to be fused in a given time, and when used for this purpose the air-pump reservoir and retort are preferably made separate; and the air may be forced into the reservoir by any ordinary air-pump placed at a distance from the retort and burners.

The handle for carrying the furnace is hinged to the side by a connection containing a locking motion which holds the handle rigid when in use, and which prevents the furnace from tipping over through the same being placed below the centre of gravity when a quantity of metal is in the melting vessel in the upper part or furnace proper. The amount of fuel consumed is regulated by a valve D of peculiar construction, in which the valve is held to its seat by a screw or cam, and when open the fluid passes through a series of holes of regulated diameter. In the valve D the spindle is fitted and packed in a screw and opened and closed as is usual in steam-valves. The lower end of the spindle is hollow, and provided with four or more holes of equal or different diameters, through which the fluid passes. This hollow part of the spindle is accurately fitted into a tube or hole through which the fluid passes, so that all the fluid must pass through the holes, and the flow is regulated by the number of these holes which are exposed. A shoulder is formed on the spindle above the holes which is forced down against a seat when the valve is closed.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.*

By Prof. Oliver Lodge.

(*Continued from p.* 154.)

THE coatings of both plates being now fully formed, the one all peroxide, the other all metallic lead, the gas which is liberated against their surfaces is no longer absorbed, but begins to rise in considerable quantities, at the same time that by making the plates into a gas-battery the free gas adds distinctly to the electro-motive force of the cell. The fulness of the cell can therefore be told in these two ways—a greater escape of gas and a higher opposition electro-motive force than usual.

The proper or "ohmic" resistance of the cell is now a minimum, however, for three reasons—because the conducting surfaces, the front surface of the peroxide and the front of the reduced lead, are as near as they can possibly be; because the acid in the solution is as concentrated as it can become, that which had been absorbed by the lead having been restored; and because the cell will have been warmed by the charging current. The cell is therefore in all respects at its very best, and it can give a tremendously powerful current for a few seconds if called upon.

But suppose it is not called upon for a current, but simply allowed to stand idle for a time, what will happen to it? First, of course, it will cool, and thereby slightly increase its resistance; but more important than this, the gas which is clinging mechanically to the surface of the plates will collect in bubbles and gradually rise, thus lowering the electro-motive force from its abnormal value. The gas which first escapes, however, will be the oxygen; a large quantity of hydrogen will remain half alloyed with the lead plate, more especially perhaps if it is amalgamated, and accordingly the electro-motive force, though it loses its abnormal value, retains a perfectly satisfactory one.

No further change of importance need be expected to be noticed after the lapse of several minutes or even an hour; but if the cell is set aside for a day or two a more serious change sets in. The front surface of the lead loses some of its hydrogen and is liable to be corroded slowly by the acid, a slight scum of insulating sulphate being produced; and these changes, though they go on with extreme slowness in a good cell with its terminals properly insulated, yet are exceedingly weakening when they do occur, because they lower the electro-motive force and increase the internal resistance at the same time. A plate well saturated with hydrogen, however, will resist the formation of any such scum for a considerable time, and I see no reason why it should form in any quantity for a week or so, provided there is no leakage between its terminals. I apprehend, however, that a temporary short-circuiting of the full cell before setting aside, whether for the purpose of testing or for other purposes, would have a detrimental effect by diminishing the store of hydrogen; and that a cell so treated would not bear standing idle quite so well as a perfectly full one.

The main part of the change which occurs during standing seems to take place at the + plate. Here the peroxide is in contact with and supported by a plate of metallic lead, and the peroxide is sufficiently porous to allow some of the acid liquor to penetrate to the junction of the two substances; hence there is here a complete battery, and accordingly a certain amount of local action sets in, some of the lead becoming oxdised and sulphated, while some of the peroxide gets partially reduced. If this action goes on to any general extent it is most disastrous, for the effect is to establish a non-conducting film or layer, of sulphate and lower oxides, between the lead plate and the rest of its perodixe coating; and it may sometimes happen that the coating is thus completely detached from the plate so as to become quite useless. But suppose it only gets detached in patches, the internal resistance will thus be increased, and the storage capacity will be diminished almost by the total amount so detached, but the electro-motive force would not be likely to be diminished until the effect of the local action had extended itself through the whole *thickness* of the peroxide. After a long time it probably would so extend itself, and thus the peroxide would get reduced by mere standing without any current having been demanded from the cell.

Messrs. Gladstone and Tribe have called attention to this local action, and pointed out one reason why it goes on more slowly than might at first sight have been expected, viz., that the crust of sulphate formed on the lead protects it by its insulating power, and only permits deeper portions to be acted on by reason of its porosity. Another reason why the action is not at all rapid is that the surrounding mass only permits a very insignificant amount of circulation in the liquid, so that it soon gets exhausted of its acid, and is only slowly replenished by diffusion. Still, the local action does go on more or less rapidly, and it is, so far as I know, the main cause of the loss of power of the cell while standing. Moreover, the differences noticed among different cells seem to depend very greatly on the facilities which some seem to offer to this action, and to the consequent greater or less detachment of the peroxide coating. Why the coatings detach themselves in some cases more readily than in others is by no means clear; but it may happen that a too rapid evolution of gas, caused by a too powerful changing current, might mechanically effect a separation between the plate and its coatings. It must be remembered, however, that the coatings may easily become electrically detached by an insulating film—especially in patches—and yet their mechanical adherence may remain almost unimpared.

The naturally occurring cure for these evils would be either to support the peroxide on carbon, or other such non-attackable substance, or else to use no support at all, but to make the plate wholly of peroxide. But though the use of carbon would do away with local action, scarcely any form of carbon can resist the action of nascent oxygen, and accordingly its surface crumbles during charging, and the powder makes a worse barrier than ever to good conductive connection between the plate and its coatings; in fact, the coatings are liable in time simply to drop off. The use of peroxide alone looks hopeful, but when the cell is discharged and the peroxide reduced, the plate will no longer be a conductor, and it does not appear probable that such a cell could ever be charged up again. Moreover, the difficulties of making good and permanent contact with such non-metallic substances are considerable, and their use would therefore be very inconvenient.

ON THE ADHESION OF BELTS.

A WELL-KNOWN American writer on belts and belting, Mr. W. B. Cooper, submits the following as a simple explanation of a mechanical phenomenon the cause of which is not at first apparent. All the explanations in the text books are technical, and consequently not popular. The law governing friction between surfaces is that it is directly related to the pressure with which they are brought together regardless of the *extent of surface in contact*. If a belt is passed over a fixed pulley and attached to a weight, it is well known that the power necessary to raise the weight by drawing upon the other end will increase if the portion of the belt in contact with the pulley is increased, and to such a degree that if several turns are made around the pulley, the power required bears no comparison to the weight raised, so great has the friction become.

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* From the *Engineer*.

To explain this, let us imagine the portion in contact with the pulley to be divided into a number of sections; now, when sufficient power is applied to raise the weight, it is clear that, commencing at the weight end, the first section requires to move it a power equal to the weight, plus the friction between itself and the pulley; the second section will have a larger coefficient of friction on account of its being brought into closer contact with the pulley; this results from the fact that the resistance to be overcome is the weight, plus the resistance of the first section. Thus it is manifest that the last section has to overcome the weight, plus the sum of all these increasing coefficients of all the other sections. This explains the cause of the ability to transmit so much power by a belt coming in contact with only half of the periphery of a pulley. This phenomenon is made possible by the convexity of one of the surfaces and the flexibility of the other. A number of shoes attached together would operate in the same way as the belt. Where the surfaces are of such a character that the friction is at a maximum between certain pressures, it is clear that, where those pressures are exceeded, the width becomes an important factor, as it alters the pressure per inch between the surfaces; in other cases it is immaterial. The same would, of course, be true regarding the area of contact of inflexible surfaces.

TRANSITS AND ECLIPSES.

On Friday last a paper on "Transits and Eclipses, and the Information to be obtained by observing them," was read before the Bath Literary and Philosophical Association by Mr. Philip Braham, and illustrated by a number of drawings and experiments.

Mr. Braham said the subject they had to discuss that evening was one of the grandest that could possibly exercise the human mind, and every statement must receive careful consideration before it was accepted as a fact. It must be remembered the science of astronomy commenced with speculations, and the first astronomers were really astrologers who went in for noticing the general configurations of the planets, to augur the future or immediate effect on human fortune. But he now wished to engage their attention simply to facts and not to fiction at all. Probably many of them had at some time wondered how it was that when one pulled out the plug from a washing-basin that contained water, the water, instead of going away perfectly level, showed a depression in the centre, and towards the last there was a spiral motion. Such a thing was so ordinary and so commonly known that they did not take much notice of it, and supposed it was so because it was so. The spiral motion might possibly be right-handed or it might be left-handed, or it might be but as circumstances or accidents determined. He wished them that evening to follow him beyond the realms of our immediate solar system and to soar into the far distances that are only revealed to us by the telescope. It is perfectly well known that our immediate neighbour is so far distant that it puzzled the imagination to realise the real distance. It is known perfectly well that our nearest neighbour does not produce any effect upon us by the light it emits, under a period of 36 years, and light travels at the rate of 180,000 miles per second. But they would soar beyond those into distances visible only by the aid of some of the finest telescopes made. He would now project upon the screen some of the unformed systems, which were known as nebulæ. The lights were here turned down, and Mr. Braham projected upon the canvas several representations, from careful drawings by some of our greatest astronomers, of nebulæ, pointing out, at the same time, various features in each. He showed how in each there were visible lines, which showed a tendency to concentration, becoming more and more distinct in each successive representation until the last showed an almost definite centre. They had in this last a greater condensation, an absolute appearance of solid matter, which they did not detect in the other nebulæ. After portraying a ring nebula, Mr. Braham showed a spiral nebula, and another in which the concentration had advanced a stage further, and there appeared to be a bright particle of light towards the centre. They had gone definitely from certain systems of nebulæ, where the indefinite lines could scarcely be detected as lines, to nebulæ where they were formed definitely, and the lines of bright light were shown to be in a spiral direction, just as in the bowl of water the motion when it began was scarcely noticeable, but gradually came into a circular motion of a powerful character. For the sake of brevity he would say that these spiral systems, and these indefinite systems, had concentrated themselves into one mass. He would now enter into the question of centrifugal force. He would cast upon the screen the representation of a ring nebula, and also another nebulous mass. That mass had, without doubt, been thrown off from the great central mass. He would shortly experiment with a liquid and show that by centrifugal force various-sized spherical masses separated from the large mass. He had before him a vessel of water, and in it he would deposit some material that was of about the same density as the water, and project all on the screen, if possible. Mr. Braham then deposited some nodules of material of the same density as the water in the latter, the projection showing clearly on the screen. He then rested one of them on a looped wire suspended from some machinery placed above, and caused the wire to rapidly rotate. He then pointed out how the nodule gradually altered in shape, and threw off first small, and then, as its motion became more rapid, large spheres, in agreement with his suggestion respecting the action of the rotating mass in the illustrations previously shown. The successful experiment, which was repeated, and which again illustrated the speaker's contention, was received with applause. Mr. Braham proceeded to say that that was a small experiment, but was typical of the big experiments that occurred in Nature. That which he had exhibited was but an illustration of what was a fact throughout the entire universe; a fact that produced these spheres on one of which we are now living. It was impossible from our very circumstances to obtain nebulæ perfect, but it was known by the spectroscope as well as by the telescope that these masses of gas did exist, and, also, there were meteors that were continually dropping into the earth; and were it not for the friction of the earth's atmosphere which caused them to ignite, they would fall and be very disastrous to all animated nature. In our own solar system, instead of the gaseous spectrum overcoming the solid spectrum, the contrary was the case, and one of the values of observing a total eclipse was that we were able to so obliterate the continuous spectrum from the solid body of the sun that the gaseous spectrum was visible. In our own solar system we had the sun as a centre, with the planets revolving about it; the sun was a mass of matter in an incandescent state, and the temperature was so high that metals such as iron were there in a state of vapour. At a certain distance from it was Mercury, next came Venus and then the Earth. Mr. Braham then placed small globes at various distances from the large globe which represented the sun, and explained the relative movements of the various bodies, and their relations to one another. The centrifugal force which sent the earth revolving was not sufficient to carry it beyond the attraction of the sun, and there it revolved until a satellite—the moon—was thrown off. The moon had its definite object again, and its object was to slow, to put a drag, as it were, upon the action of the earth, and the consequence was that the rotation of the earth was slowed down to its present rate, and it was still gradually slowing. The moon revolved about the earth, and always showed the same side towards the earth, and in consequence we never knew what the greater portion of the other side was. The moon passed at certain definite times between the earth and sun, and thereby we had on a certain portion of the earth an eclipse of the sun. Then supposing the moon moved in its orbit round and came to the opposite position, the earth stood in the way of the moon receiving light from the sun, and thus there occurred an eclipse of the moon; all eclipses of the sun were accompanied by an eclipse of the moon. After explaining by globes how, by the inclination of the orbit of the moon, eclipses of the moon were not so frequent, the speaker proceeded to refer to the transit of Venus. If the orbits of the earth and Venus were parallel and if they were moved together during the entire revolution, Venus would be between the earth and the sun. But during the entire revolution the earth went slower than Venus, and the consequence was Venus gained on the earth. But the orbit of Venus was not parallel to the earth's orbit—it was tipped up, and they would now notice that Venus and the earth were not in a line, and therefore, although the point of the orbit of Venus was in the same direction as the orbit of the earth, still Venus could not eclipse the earth, because Venus was at a point of its orbit that was not at the node. He would suppose that Venus had come, got down to the node, and then the earth and Venus were together, and Venus was seen on the surface of the sun. Therefore, there was only one particular point in the two paths of the planets at which there could be a projection of one upon the sun—that was, when there could be a transit of Venus. He spoke now as he had spoken some eight years ago, on the 9th Dec., and many predicted then that in eight years time a transit would occur as he had explained. That would mean that the earth had been eight times round the sun and Venus more than eight times, and they had now come back to the particular point, and were in a position similar to that occupied by them in 1874. The next of these transits would would occur in 2004. The question was one that excited interest, especially now, as on the 6th of December next a transit would occur. They would ask how it was that the mere question of the passage or apparent passage of a planet over the sun could excite the attention and emulation of civilised nations. England, France, Belgium, Italy, and all civilised countries had sent out individuals to various parts of the earth where this phenomenon was visible, on purpose to observe as accurately as they could the least distance between Venus and the sun, as it appeared, and also to note the time—and that was the great point—the time when Venus first of all touched the sun and last touched it. The speaker then showed how by means of these observations the diameter of the sun could be ascertained; and how, having its angular measurement and its diameter, the distance of the sun could be discovered. According to Kepler's third law, the square of the periodic times was equal to the cube of the mean distance from the sun; that law was perfect, but the thing was this—the distance was not known; and although we could map out all our planets—the inferior as well as the superior—to a certain definite proportion, yet, not knowing our own distance from the sun, we were unable to fix the exact scale of our solar system. In consequence, great trouble and pains were being taken to fix within a very small percentage of error the distance to and from the centre of the sun. Mr. Braham then showed that the globes he had made use of to illustrate his lecture were not of the proper proportion, nor were the distances observed proportionate; but he had been compelled to make use of these so as to make them visible. If the models were to scale, taking the sun as a sphere 1ft. in diameter, then Mercury would be represented by a grain of mustard at a distance of 43¼ft.; Venus a small pea at a distance of 83ft.; the Earth a pea a size larger at a distance of 115ft.; Mars a grain of mustard seed at a distance of 175ft.; the Asteroids a number of grains of sand scattered around a circle from 250ft. to 300ft.; Jupiter a plum, 598ft.; Saturn a slightly smaller plum, 1867ft.; Uranus a grape, 2206ft.; and Neptune a grape, 3450ft., or over half a mile away, with a moon nearly as big as itself. Since the last transit of Venus, Mars was discovered to have two moons. In the case of Neptune there was one big moon; and in the case of Uranus there were four moons, but the latter rotated at right angles to the ecliptic, and moved also in an action opposite to that which would be expected. In fact, Uranus was a puzzle at present, but he had no doubt some physical reason would be found to account for the apparent anomaly. There was one peculiarity in the solar system to which he must call attention—and really this was an interesting subject. Mercury was inclined seven degrees; the sun rotating on its axis was also inclined a little over seven degrees, so that he thought there was no doubt that Mercury, being a late planet thrown off by the sun, had an orbit nearly parallel to the axis of rotation of the sun and was gradually being drawn into the line of the ecliptic by the attractive force of the other members of the solar system. In conclusion, Mr. Braham said the study of astronomy gave one great scope in understanding that there was more in existence than existence got credit for, and that by investigation of these facts we could arrive at something that was satisfactory, and that gave us farther scope for thought and questioning, and however much we might attempt to force the barrier and by imagination attempt to stem the tide of facts, we could only remain waiting, watchful, and persevering, and look through nature up to nature's God.

DYNAMO-ELECTRIC MACHINERY.

On Monday night Prof. Silvanus P. Thompson delivered the second of the Cantor lectures for the session 1882-3 on Dynamo Electric Machinery in the hall of the Society of Arts, Adelphi. Dealing with the dynamo in practice, he said that the first point to consider was the forms of combination used for producing either constant strength in the current or constant electro-motive force in the circuit, with the view of rendering the action of the dynamo purely automatic, so that the removal of lamps from one part of the circuit should not in the least affect any other part. Turning to various points in which theory had been put into practice in different descriptions of dynamo-electric machines, he commented on the forms of the magnets, the pole pieces, the armatures, and the commutators used. He then pointed out the essential difference between a continuous current machine and an alternate current machine, and the peculiar arrangements of the more interesting types, such as those of Edison, Brush, and Gülcher, and the distribution of potentiality on the commutators of dynamos he had particularly examined, and he deduced thereby several important consequences with reference to the construction of armatures and field magnets. He might observe that science had now advanced so far that it could point out how machines could be constructed with a full knowledge of what their actual performances would be. The subject of the concluding lecture is the dynamo as a motor.

Copper wires transmitting electric currents of high electro-motive force gradually become brittle.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE December meeting was held at the Society's rooms, Burlington House, on the evening of Friday, the 8th inst., Mr. E. J. Stone, president, in the chair.

The President having referred briefly to the death of Prof. Challis,

Mr. Knobel read a paper by Mr. David Gill on "Photographs of the Great Comet (b) 1882, obtained at the Royal Observatory, Cape of Good Hope." Three photographs were exhibited which were taken with a Dallmeyer's rapid portrait lens attached to the declination axis of an equatoreal. No. 1 was taken on Oct. 19th, with an exposure of 30 minutes; No. 2 on Oct. 20, with an exposure of one hour, and No. 3 on Oct. 21, with an exposure of 40 minutes. In photograph No. 3, which is the most perfect, the stars are slightly elongated in the direction of the comet's motion. The photograph shows the sharp termination of the tail at a distance of some twenty degrees from the head with a luminous tuft projecting from the centre of the tail which has been noticed by so many observers

A communication was also read from Mr. Ellery accompanying a photograph of the comet taken at the Melbourne Observatory. This photograph was taken with an ordinary camera not equatorially mounted, and the motion of the comet produced a streak of light upon the plate.

A communication from the Rev. T. W. Webb was also read, inclosing observations of the comet made by Mr. J. T. Stevenson in New Zealand. Mr. Stevenson described an anomalous tail of faint light which extended from the head of the comet in the direction of the sun. The axis of the anomalous tail was not quite parallel with the axis of the brighter tail extending in the opposite direction.

An extract from a letter of Dr. Schmidt, of Athens, was also read. Accompanying the letter was a drawing of the great comet, and a companion comet or nebulosity, which he had observed on October 9th, 10th, and 11th. The companion object was an irregular-shaped patch of nebulous matter, without any defined nucleus; and Dr. Schmidt, in his letter, suggested that it might be a portion of the corona which had been detached by the comet during its perihelion passage, when it was moving at a rate of 250 miles a second.

The Astronomer Royal said: This is an extract from a private letter of Dr. Schmidt's to a friend in England. The drawing has already been published in the *Astronomische Nachrichten*; but it is not very well printed, and I thought it would be of interest to get an original copy of the drawing for the Society.

Mr. Common stated that he had observed the anomalous tail stretching towards the sun which was mentioned by Mr. Stevenson. In October, the head of the comet appeared like the nebula in Andromeda, with a luminous patch in the middle. Afterwards a luminous patch was visible further down towards the tail, and later still it became brighter at another point, so that it was difficult to select any part of the comet and speak of it as the nucleus. There were certainly several nuclei, and their brightness varied from time to time. On the 17th of September, about 2½ hours before the comet was seen to disappear at the limb of the Sun, it had the appearance of a bright planetary disc, with a very short parabolic tail. I did not measure the diameter of the nucleus, but I compared it with the size of a spot upon the Sun, which I have since learnt was 47" to 50" in diameter; this does not agree with the observations made at the Cape. Mr. Finlay gives the diameter of the comet's head as 5". When I saw the comet again the nucleus was like a planetary disc intensely white and bright. Later in October it became a hazy object like a candle seen through a fog or through horn. After that it grew longer, and there were two decided nuclei in it. At the beginning of November the two nuclei were separated by a distinct dark space. One day I thought it had become triple, but there can be no doubt about the two nuclei.

Mr. Knobel said: We have received a communication from Mr. Eddis, of Grahamstown, Natal, in which he distinctly mentions the two nuclei in the head of the comet. It was a letter accompanied by newspaper extracts which could not be printed in the notices, but we shall no doubt receive a communication from him which can be printed.

Mr. De la Rue said: Permit me to make a few remarks which may be of a certain amount of value at the present moment. I have had three opportunities of making naked-eye observations of the present comet, and my impression of it was that it was of the apparent size of Donati's comet of 1858, but not so bright. Some very successful photographs of this year's comet have been shown, and I wish to make a remark with respect to them which may be of interest in showing the great advance which photography has made since 1858. In Vol. XXX. of the Memoirs, I have given an account of an attempt which I made to photograph Donati's comet. If we had then had chemicals as sensitive as those which are now employed we should no doubt have succeeded in obtaining an image of the comet; but I failed to do so with exposures of three minutes.

The President: Mr. Gill's photographs have been obtained with exposures of 30 minutes, 40 minutes, and an hour.

Mr. Johnson stated that the accounts published in the Cape papers referred to five distinct patches of light as having been seen in the nucleus separated by faint bands.

Mr. Ranyard said: With regard to the spurious tail referred to in Mr. Webb's letter as having been observed by Mr. Stevenson, there seems to be very satisfactory evidence for its existence. It is shown in Professor Schmidt's beautiful drawing. The axis of this spurious tail, which extended towards the sun, appears to have been not quite parallel with the axis of the brighter tail, which streamed away from the sun. I should like to point out that this spurious tail is not necessarily due to matter passing away from the comet's head in the direction of the sun. There are facts which tend to show that it is not improbable that the matter of this spurious tail was more distant from the Earth than the head of the comet, and that the comet's nucleus was seen by projection upon the faint end of a long tail, which curved backward in the plane of the comet's orbit. When we consider the position of the Earth in October and November, relatively to the plane of the comet's orbit, this will be more evident. The Earth passed through the plane of the comet's orbit about the middle of September, and at that time a curved tail lying in the plane of the comet's orbit would, as seen from the Earth, have appeared to be straight, but from certain directions the head of the comet might be seen by projection upon the end of the tail, and so the head would appear to be in the midst of a tail, which was bright on one side, and faint and broad on the other. The plane of the comet's orbit is inclined to the plane of the Earth's orbit at an angle of 38°, so that when the Earth is 90° away from the node of the comet's orbit, we should look down at the plane of the comet's orbit from a point 38° above the plane. In October, and the beginning of November—that is, within 45° of the node—we should see objects in the plane of the comet's orbit projected at a much more acute angle than 38°; and the end of a curved tail, seen in projection from a position not very far removed from the direction of the comet's radius vector, would appear as overlapping the head of the comet and slightly above it, making a small angle with the brighter part of the tail, just as it is shown in the drawing. All observers have noticed that the south side of the tail was the most intense, and some have described it as being like the Greek letter γ, with a hook of fainter light on the northern side at the end of the tail. This is just the appearance that should have been observed, with a scimitar-shaped tail, seen in projection from a point not far from the plane of the comet's orbit.

Mr. Knobel said: This is not the first comet which has had a tail which appeared to be projected towards the Sun. Encke's comet, which I observed in 1873, had such a tail. It was very nebulous and was not bounded by any definite lines.

Captain Noble said: He had observed the comet on November the 9th, at 16h. 45m. The nucleus appeared elongated as if seen through a cylindrical lens, and the axis of the nucleus did not correspond with the axis of the tail.

The President read some telegrams announcing that successful observations of the transit of Venus in South Africa and New Zealand had been made. From the information that was already to hand he hoped that there would be sufficient observations to give a satisfactory determination of the Sun's distance.

The Astronomer Royal said: That the Society must congratulate Mr. Stone on the success which had attended the arrangements on which he had bestowed so much time.

The President said: I have had a notice put into my hands stating that Mr. Lockyer wishes to call the attention of the society to an important eclipse which will take place next year.

Mr. Lockyer said: I hold in my hand the American Ephemeris for next year, which shows that a very important eclipse will be observable in May from two islands in the South Pacific. It may interest some of the Fellows of the Society to know that the Solar Physics Committee at their last meeting sent in an application to the Science and Art Department, pointing out the extreme importance from several points of view that observations of that eclipse should, if possible, be secured. First of all, because the duration of the eclipse will be 5¼ minutes, and secondly, because it will occur at a time of maximum solar activity. I am very anxious that the Astronomical Society should be acquainted with these facts, because I suppose, in case the Government should consider it desirable that observations should be secured (and of course it is impossible to procure them without Government aid), it would be important that some members of this Society should gird up their loins and volunteer to make these observations. I believe it is quite settled that the French Government will send out an expedition, perhaps two expeditions, and one is naturally anxious to have an English expedition if possible. The Americans are much nearer, and their National Academy of Science is taking active measures to secure observations, so there will be an American party there, and *raison de plus* that there should be an English one. If our Government, after mature consideration, think that observations should be made, then it is possible that a communication will be made to the Astronomical Society or to the Royal Society asking for volunteers, and it is on that ground that I venture to bring the matter before you. Any gentleman who is inclined to go to the South Seas will, I believe, have a most pleasant expedition; and if any gentleman is anxious for an opportunity to observe the solar atmosphere or the intra-Mercurial planet, he should send in his name, for in all these matters it is not possible to make the arrangements long before the event, and when the Government agrees there is generally an ugly rush and a working against time, which is the most killing work of all.

The President: Possibly Mr. Ranyard has something to say on this subject.

Mr. Ranyard: I am not prepared with any remarks. I can confirm what Mr. Lockyer has said with regard to the foreign expeditions. There will also be one Italian astronomer; possibly two. There will probably be an American private expedition. I have received a letter from an American gentleman, saying that they hoped to charter a vessel from San Francisco, and that they will be happy to receive any English astronomers who feel inclined to join them, and, of course, pay a share of the expenses. There is no doubt that it will be a pleasant expedition, and there seems to be a good chance of fine weather, and the sun will have a good altitude during the five minutes of totality.

The President: As far as I understand Mr. Lockyer, he wishes that any gentleman who desires to take part in such an expedition, should send in their names to say that they will be ready.

Mr. Lockyer: I think it most important that they should do so.

The Rev. J. Howlett read a paper "On the Solar Spots of April and November, 1882," and showed large drawings which he had made, by projecting the image of the spot on the screen in a darkened room. Mr. Howlett also mentioned that he had succeeded in observing the transit of Venus. Immediately after the ingress of the planet upon the Sun's limb he observed a ligament which extended for twelve seconds of arc between the planet and the Sun's limb.

The President: I have no doubt that Mr. Howlett is under the impression he saw the ligament which is ordinarily observed, but the weather appears to have been cloudy, and I think it very likely that what he saw was the tremulous motion of the planet caused by the Earth's atmosphere. If he saw a ligament extending for twelve seconds of arc, that is lasting for four minutes of time, he saw a ligament such as no one else has seen.

Mr. Howlett: I have a witness. My wife saw it; but wives are sometimes prejudiced in one's favour (laughter).

Mr. Christie: In regard to the sunspots which have been very remarkable this year, and in four instances have coincided with magnetic storms, the two great outbursts of sunspots in April were accompanied by two magnetic storms. Again, in October, two other outbursts were accompanied by two magnetic storms, and again, in November, the sunspot was accompanied first by a very remarkable magnetic storm, and then by a secondary storm. This seems to add very considerably to the proof of a connection between magnetic storms and such great solar outbursts.

Captain Noble: I would ask, whether the correspondence between solar disturbances and magnetic storms is not as old as Sir Edward Sabine? In the Transactions of our Society, there is an account of a remarkable disturbance which was observed by Mr. Carrington and our former secretary Mr. Hodgson, and was absolutely coincident in time with a very remarkable magnetic disturbance.

Mr. Christie: I think Sir Edward Sabine only showed a general connection between sunspots and magnetic disturbances throughout the year; this is not the same thing as showing a connection between particular spots and magnetic storms.

Mr. Ranyard: I think there can be no doubt about the general connection between the periods of maxima and minima of magnetic disturbance and sunspots, but the connection between individual outbursts is a different thing. In the one or two instances which I have examined, I have not found such a connection; for instance, there was no magnetic storm corresponding to the great thirteen-minute prominence observed by Professor Young, or to the great prominence figured in last year's *Comptes Rendus*. With regard to the invitation which Mr. Lockyer has given to the Society, such an invitation might be interpreted rather indiscriminately. I do not think that a great number of drawings and general observations of eclipses are now needed, or that it would be worth while for the Government to send out an expedition to the other side of the world to make such observations. In 1871 a great deal of money was expended in sending out observers to India, who were instructed to make as many drawings of the corona as possible during totality, in order that they might see whether there was any change taking place in the corona during totality. Naturally there was a good deal of difference between the drawings, but we have now got past the era of drawings. What we want are photographs of the corona, and specially contrived spectroscopic and polariscopic observations, and I do not think that it would be worth while to send out, at Government expense, observers who are not prepared with some such special observations.

The meeting adjourned at ten o'clock.

AMATEUR MECHANICAL SOCIETY.

THE annual conversazione of the Amateur Mechanical Society was held on the 6th inst. at the Suffolk-street Galleries, Pall Mall. Splendid specimens of ornamental lathes and other apparatus were displayed, in addition to many really fine works in ornamental turning by various members of the society. Holtzapffel and Co. exhibited a fine lathe with ornamental and spherical rests, a very full and splendid case of ornamental drills and cutters, also grinding and sawing machines, and other articles. No eulogy can be too strong for the beauty of the workmanship of the articles exhibited by Messrs. Holtzapffel, and their entire freedom from meretricious "shininess" or toyshop display commanded the unreserved admiration of critical judges. But many of the scientific amateurs present expressed regrets to see Messrs. Holtzapffel and Co. still exhibiting mandrel-noses of the old pattern with their bases cut away and weakened by a deep ring at their junction with the mandrel face, and screwed to the obsolete pitch of 9·45 to the inch. "Quem Deus vult perdere prius dementat," and it almost seems as if Messrs. Holtzapffel, by adherence to obsolete patterns, and by repelling such suggestions as their clients would make, had determined to throw away their long-established leadership in ornamental lathe apparatus. A grand lot of splendid lathes and tools were exhibited by Mr. Evans, who evidently aspires to the leadership which Messrs. Holtzapffel seem not anxious to retain. Mr. Evans has adopted the Kennan modification of the spiral apparatus, which puts the change-wheels at the back of the lathe-head, instead of at the front—as still done by Messrs. Holtzapffel. This is undoubtedly a great improvement when the slotted wheel-arms are affixed—not upon the lathe-bearers, so as to require the shifting of the lathe-head to the right, but upon the back of the lathe-head itself, and, therefore, requiring no such displacement as with the old system was such an objection. By the Kennan arrangement Mr. Evans enables his clients to keep the spiral apparatus always in place, ready for connection with the slide-rest screw, without in any way interfering with the ordinary uses of the lathe. He also enables his lathe to execute spiral work upon the elliptic cylinder, while by an additional improvement of his own he adapts the Hooke joint so as to enable the spiral work to be done upon the elliptic or circular cone. Again, Mr. Evans has, upon reflection, had the courage to throw over the obsolete "ornamental lathe threads," and formally adopt the principle of aliquot threads, with a mandrel-nose of ten threads to the inch, as some time since was advocated in the columns of the ENGLISH MECHANIC by Dr. Edmunds. We congratulate Mr. Evans upon having been the first to announce this important advance, and have no doubt that his enterprise will be appreciated by scientific amateurs.

As to the remaining question—i.e., that of the angle and cross-section of the thread—that should undoubtedly be settled in conjunction with the Amateur Mechanical Society, whose council have for some time had the question before them at the instance of a general meeting of the members of the society, held last May, and who, having passed a resolution recommending the aliquot threads, have deferred the question of pitch and cross-section until the members at large and the leading ornamental lathe-makers have been consulted. For Mr. Evans alone to anticipate their remaining action, and introduce a new cross-section thread that no other maker would follow, would be to inflict further complications upon amateurs, and it is to be hoped that he will not precipitately commit himself to such a course. The Council of the Amateur Mechanical Society, containing as it does such eminent scientific amateurs as Mr. Boord, M.P., Colonel Sandeman, Dr. Edmunds, and others, whose opinions will necessarily have weight with the members of the Society, is an eminently suitable medium for the settlement of this question with the advice and concurrence of the leading ornamental lathe-makers. Mr. Hines, of Norwich, showed some finely-made tools and steel forgings. Messrs. Churchill showed all the charming new devices of our American cousins, including a really beautiful 2in. miniature lathe, for watchmakers, dentists, microscope-lens makers, amateurs, &c. In point alike of design and execution, this lathe was a perfect gem. A simple and convenient amateur's work-bench, and some new carpenter's tools, were exhibited by Thos. J. Syer. Fletcher's unrivalled gas-heating laboratory apparatus, and miniature furnaces, for melting small ingots of any metal from lead to steel, in a few minutes, were exhibited by Mr. J. T. Mayfield, his London agent.

SCIENTIFIC NEWS.

THE Transit of Venus has been successfully observed at nearly all the appointed stations, except Brisbane, and at such important places as Jamaica, the Cape, and New Zealand, appears to have been all that could be desired. It should not be forgotten that observations at one station, however good, are useless without corresponding observations at opposed stations—that is, so far as the determination of the sun's parallax is concerned. The French, German, Belgian, and American observing parties appear to have had a fair measure of success, and there is reason to believe that a mass of valuable data will be obtained for the determination with greater accuracy of the sun's distance. Besides the purely technical observations, a large number of good photographs have been obtained at many stations. Some good views of the transit were obtained in this country; but we are quite unable to find room for even a tithe of the letters we have received. A curious phenomenon was observed by Prof. Langley and others in the shape of a small patch of light near the limb outside the sun when the planet was half-way on the sun's disc; this patch being totally distinct from the luminous ring seen surrounding the planet by many observers. Spectroscopic observations disclosed some unknown or unrecognised lines, and there is a suspicion of a watery vapour in the "atmosphere" of the planet. The phenomenon noticed by Prof. Langley appears to be the only new feature of the transit of 1882—a phenomenon which was also noticed by "R. H., Glasgow," who writes that a bright gleam of light was very noticeable round the eastern limb of the planet when half on the disc of the sun, but it remained for little more than a minute. The black drop was well seen by many observers; but the Rev. C. Farris, of the Armagh Observatory, did not see it. Dr. Dreyer, the astronomer, observed the whole circumference of Venus, with a fainter shade-like object filling the interval between the cusps, exactly as was seen in 1874. When this shade broke a "fine line of light could be seen separating Venus from the sky outside the sun." From Street, co. Westmeath, Mr. Wilson writes that there was no appearance of anything like the black drop, but when the planet was projected on the corona it was surrounded by a thin ring of white light. Mr. W. F. Denning, using a 4in. reflector, saw the planet surrounded by a reddish annulus, while over the central region a patch of white light was distinctly seen. Near the interior margin of the planet the disc was very black. No trace of a satellite seems to have been seen. As soon as the observers return full accounts of the phenomena will be published; but, so far as the British expedition is concerned, the object has been gained, and as the Americans have been equally successful, a comparison of the results with those of other nations will doubtless give a satisfactory answer to the question as to the sun's distance.

The latest determination by MM. Schulhof and Bossert, of the orbit of the comet of 1812, points to a probable return to perihelion in 1884; but it is possible that it may occur next year, when two other periodical comets are expected—viz., D'Arrest's seen last in 1877, and Tempel's last observed in 1878. The former has a period of about six and a half years, the latter one of about five and a quarter.

The death is announced of Prof. von Bischoff, the distinguished biologist. He was born at Hanover in 1807, and having studied medicine, he became a lecturer on pathological anatomy at Heidelberg, whence he migrated to Giessen as professor of physiology. He was, however, attracted in 1854 to Munich by the King of Bavaria, and remained there until his death.

Mr. G. J. Symons, F.R.S., is preparing to issue to all observers of rainfall known to him, blank forms for the entry of their records during the present year. The staff of recorders now exceeds 2,000, but Mr. Symons believes there are many who keep records of rainfall who are unknown to him. He, therefore, invites communications from all who have accurate records, or who will undertake to keep them, and offers to supply a copy of the rules adopted by British observers, and all necessary blank forms. His address is 62, Camden-square, N.W.

The rumours of an important discovery in connection with the production of the metal aluminium appear to be based on the fact that a patent has been obtained for an improved method of preparing alumina. Aluminium can be manufactured from alumina, we know—it cannot be obtained from anything else—but the difficulty is to "manufacture" it. The preparation of pure alumina is a step, however, and it may be that someone will discover a method of easily converting it into the metal.

The Committee of the Society for Psychical Research find some difficulty in obtaining permission to investigate the "haunted houses," and it is notable that the only ghost stories last Saturday were narrated second-hand. Psychoscopy is progressing, however, and it is reported that certain "sensitives" are capable of reading thoughts correctly, once for every four and a half trials. That was the result of five hundred experiments.

A process of coke-burning, in which the volatile products are seized in large proportion and condensed, is attracting much attention in the north. It is the invention of Mr. John Jameson, of Newcastle.

A series of experiments with the water-cartridge, for blasting in coal-mines, has been recently conducted at Adderley Green Collieries, Longton, by Mr. Macnab, under the auspices of the North Staffordshire Institute of Mining and Mechanical Engineers. The experiments were, we understand, considered highly successful.

From Paris, Kentucky, comes a report of the finding of the remains of a gigantic mastodon. From the head to the bones of the tail it measures 40ft., and the hind quarters stand 23ft. 8in. high. The jaw is 12in. thick, and the teeth are in good preservation, some weighing between two and three pounds. Other details are given, but no doubt Prof. Marsh will shortly report on this giant.

Experiments have been recently made by M. Allard with regard to the range of sound from various instruments: a large and a small bell, a cornet with compressed air, a steam-whistle, a vibrator-trumpet, and a siren-trumpet. His figures show that the intensity of sound decreases in air much more quickly than according to the law of the square of the distances. This is attributed to the reflecting and dispersing power of the air (not being homogeneous). Apart from the influence of wind, a given sound may have, it was proved, very different ranges, varying, *e.g.*, from two nautical miles to 15 or 20; the acoustic transparence, doubtless, varies within certain limits. The work of production of sound grows rapidly for small augmentations of range. The differences of range within an octave (supposing the work done in producing the sound exactly the same) are hardly perceptible.

A French translation of the late Prof. Balfour's work on embryology has appeared.

A chair of "Electro-technik" has been established at the Electrical High School at Darmstadt, by the Grand Ducal Government. The Professor appointed is Dr. Kittler, who took an important part in the recent electro-technical experiments in Munich.

A simple domestic application of electricity is described by M. Laugé in *La Nature*. It is an arrangement whereby a timepiece in one room gives the hours not only there, but in any other rooms of the house, causing bells in these latter to be struck. Any timepiece will do if it strike the hours. The negative wire of a Leclanché element, the circuit of which includes the electric bells, is attached to a metallic piece of the works of the timepiece; the positive, suitably insulated, is placed a little above the stem of the hammer. When the hammer rises contact occurs, and the bells in the other room are struck simultaneously with that of the timepiece. The system could be applied to clocks of towers and spires.

We observe that several theatre fires have occurred lately in America. By an ordinance of the Police Commissioners of Boston, the proprietors of every theatre in that city are required to protect the stage and all other combustible parts of the building with automatic sprinklers, and the same week, curiously, the Theatre Comique, in Providence, having caught fire just before the morning performance, was saved by automatic sprinklers, and with so little injury even to the scenery that the performance was not stopped. On the other hand, in the recent burning of the Park Theatre in New York, an automatic fire-extinguisher, which should by itself have flooded the building with water, is said to have failed to act. The Alhambra Theatre in New York (about a month before the London one) has been burnt down; the conflagration lasted only about 30 minutes. We note also the burning of the Arlington Variety Theatre, in Baltimore.

Of the 4,339 patents taken out in Germany last year, 1,199 were of foreign source. Of the remainder, 1,947 were from Prussia, 408 from Saxony, 170 from Bavaria, 106 from Würtemberg, 103 from Baden, &c.

To keep silver and silver-plated articles from getting dim, as they are apt to do after standing a long time without being used, especially in rooms where the coal burnt holds a good deal of sulphur, they are sometimes (according to *Wien. Techn. Bl.*) first heated, then painted over with collodion considerably diluted with spirits of wine, the application being made with a fine brush. The layer soon dries, and is transparent and invisible; it fully protects the silver, and it can be removed, when necessary, with hot water.

The village of Friedrichshagen, near Kopenick (which is about 22m. N.E. from Potsdam), where many Berliners reside in summer, is to have an electric railway soon. This will connect the present station with the part of the locality situated on Lake Muggel.

In the system of electric illumination of trains, recently adopted on the Eastern Railway of France, there is a Grammo machine (driven by the locomotive) and accumulators. M. Tommasi has introduced an "automatic interrupter," the action of which is to break all communication between the Grammo machine and the accumulators, when the speed of the train descends below the normal. Further, if the lamps are lit at such a time, or when stoppage occurs, the automatic apparatus substitutes the accumulators for the machine, or reciprocally; the moment of change is not perceptible. When the train is running without the lamps being lit, the Grammo machine charges the accumulators exclusively; when the train is lit, the machine feeds both the lamps and the accumulators. It is only when the illuminated train slackens speed or stops, that the accumulators supply the current required by the lamps, and this is restored when the train has resumed its normal speed. Thus the accumulators are not so cumbrous as if they had sufficient capacity to feed the lamps during the whole journey. There is a Swan lamp in each compartment. The train is lit by the guard on entering a tunnel. The cost for an ordinary train of 36 lamps is about 12 francs a day, whereas the lighting with oil cost 36fr. and was very imperfect.

Two German physicists, Dr. Hagen and Dr. Hertz, have been lately testing the pressure of mercury vapour at various temperatures. The numbers obtained by both appear to show that those of Regnault, which have passed into all textbooks, are considerably too large. Between 80° and 100° the Germans' numbers agree, but below and above those limits there are differences. It seems to be established that at ordinary atmosphic temperatures, the elastic force of mercury vapour is less than $\frac{1}{100}$th of a millimetre; a result which is important for the construction of barometers, Geissler tubes, &c.

It is noteworthy that the last five years' (1876—81), increase of population in France, amounting to 766,260, belongs, to the extent of five-sevenths, to the towns. The 47 towns, with a population of 30,000 and upwards, and forming more than a sixth of the nation, show an increase of 561,869. This indicates a continued depopulation of the country districts, through the attractive force of the large towns. The total population of France, last year, was 37,672,048; that of Paris, 2,269,623.

A curious fact, which strikingly illustrates the antiseptic properties of copper, was observed in Dalecarlia, Sweden (according to M. Margat) in the eighteenth century. In 1719, there was found, in a copper-mine of Falin there, the body of a young man, named Matts Israelson, who had perished 49 years previously. This body was in such a state of preservation that it was recognised by an old woman who had been at one time engaged to Israelson. For 21 years this new kind of mummy was kept in a glass case; but in time it was decomposed, and had to be buried.

A recently-published work by M. Maxime Hélène, entitled *Les Nouvelles Routes du Globe*, treats of the canals of Suez, Panama, Corinth, and Malacca, the tunnels of St. Gothard, Mont Cenis, Arlberg, Simplon, Mont Blanc, and the Pyrenees, the Channel tunnel, and the interior sea for Africa. The work having been dedicated to M. de Lesseps, that eminent Frenchman, in a letter of acknowledgment, says, *apropos* of the two schemes last mentioned: "I think, sir, we must hasten to fill the interior sea of Africa, and to pierce the Franco-English tunnel, if we would not leave to next century, with the glory of achieving these necessary works, the right of astonishment at our hesitations, and perhaps at our prejudices."

The poison and poisoning-apparatus of the scorpion have been recently made an object of study by M. Joyeux-Laffuie. The former, he finds, is very active, though not so powerful as some have represented. A drop of it, either pure or mixed with a little distilled water, rapidly kills a rabbit, when injected into the cellular tissue. Birds are as easily killed with it as mammals. One drop suffices to kill seven or eight frogs. Fishes, and, aboveall, molluscs, are much more refractory. But, on the other hand, the articulata are wonderfully susceptible; the hundredth part of a drop will immediately kill a large crab. Flies, spiders, and insects on which the scorpion feeds, are quickly affected by its bite. The poison soon paralyses the striated muscles, suppressing spontaneous and reflex movements. In all animals there is first excitation, then paralysis. The author regards the scorpion's venom as a poison of the nervous system, not a poison of the blood, as M. Joussel de Bellesme asserts.

For rapid preparation of oxygen, Herr Voracek recommends pouring oxygenated water on a small quantity of permanganate of potassium. Even at ordinary temperature the liberation of gas is abundant. This preparation offers no danger compared with that by means of potassic chlorate; it may be done in a medical phial. One may also easily get oxygen in the cold state by using bioxide of barium. You mix a saturated solution of bichromate of potassium with an equal volume of nitric acid (D = 1·2) and pour, e.g., 100 cubic centimetres of this mixture on 15 grammes of bioxide of barium. A liberation of oxygen at once takes place, which may be increased by stirring the mixture. The bichromate may be replaced by permanganate; but the former is preferable, because of its lower price and greater solubility.

Resources of Algiers.—Algiers abounds in deposits of copper, silver-bearing lead, zinc, and especially iron. The Mokta mine yields 1,800 tons of iron ore per day. Materials for construction, building stones, lime, plaster, marble, &c., are abundant. Salt is found almost everywhere. Mineral springs are very numerous. The number of workmen employed in the mines already exceeds 3,500. The principal agricultural products are cereals and dry legumes. The cultivation of tobacco has increased largely since 1867. The greatest future expectations are based upon the culture of vineyards; the extent of land devoted to vines already exceeds 20,000 hectares (49,423 acres). The public works have already reached considerable importance. There are 10,506 kilometres (6,528 miles) of highway, and 1,282 kilometres (796·6 miles) of railroads under construction.

MESSRS. H. AND E. J. DALE have succeeded to the business of Mr. F. J. Cox, which they will carry on at 26, Ludgate-hill; they have now a large stock of electrical apparatus and other scientific appliances, and have added cabinet-work and dynamo machines to their regular factory productions.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

THE TRANSIT OF VENUS.

[20825.]—THE following notice is scarcely worth insertion, being, I need not say, of no scientific value whatever; but it may, perhaps, be admitted as a memorandum of what was seen here of one of the most interesting, as well as uncommon, of astronomical phenomena. From an apprehension that trees would intercept the view, I decided not to attempt to use my 9⅓in. mirror, which, as I have no sufficient darkening apparatus, would have given me no great advantage over a very perfect little achromatic of 2¼in. aperture, by Bardou, of Paris. With a moderate power, the solar image was projected on a piece of cardboard with as much distinctness as could be expected at so low an altitude; and we were fortunate enough to witness, in a temporary clearing, the first external contact as a very minute notch in the limb, and to watch the advance of the planet with the greatest interest, till the approach of clouds obscured everything. We were, however, again so fortunate as to see pretty distinctly the internal contact: but all further view was intercepted till Venus had advanced her own diameter from the limb, when for some little time we watched her progress, and had a beautiful, though not uninterrupted, view. The inky blackness of the planet was most striking, and it appeared to be surrounded with a very feeble brightness, extending, perhaps, for a radius of the disc all round it—an observation in which my wife fully concurred. But clouds soon deprived us of all hope of witnessing the progress of this beautiful spectacle. **T. W. Webb.**

Hardwick Vicarage, Dec. 8.

SUNSPOT AND AURORA-BOREALIS.

[20826.]—IT may interest some of our readers to know that some interesting observations of the late large sunspot and auroral display have been made by my brother at Bushey, Herts. I send some of the most interesting facts, but the full account is too long for insertion. I shall be happy to send a full account to anyone who will write to me by post.

Whilst observing the sunspot through smoked glass on November 16th at 1 p.m., he saw several luminous elliptical-shaped objects floating across sun's disc from N.W. at 4 p.m., "magnetic needle much deflected." On following night there was a grand auroral display. "Brilliant bluish white light visible all night." On November 16th, at 6.5 p.m., there appeared a fish-shaped luminous mass, increasing in size as it approached the zenith, after which it disappeared in the W. "At this moment needle gave a great dip." At 4.45, on November 17th, "sky like a vast conflagration." At 5 a.m., "magnetic storm considerable." The magnetic storm was at its height at 5 a.m., Friday, 16th, and did not "entirely disappear till the following Tuesday." On Saturday, 17th, from 11 to 12, sunspot "visible without dark glass; at 11 a.m., something white went across sun's disc." As I have now taken up much valuable space, I must now end this account.

W. H. Gaze.

Firle-place, Lewes, Thursday, Dec. 7th.

THE PERIHELION PASSAGE OF THE GREAT COMET.

[20827.]—WITH your permission, I should like to make a few remarks on what has been written on comet *b*, or the great comet of 1882.

From the report of the meeting of the Royal Astronomical Society, the Fellows assembled, after having full particulars laid before them, appear to have thought it strange that the comet was not seen in transit across the Sun's disc, either as a dark or bright spot; and seemed to throw doubt on an observation of Pastrof's on the supposed transit of the comet of 1819. Now, I do not see why Pastrof should not have been right, in spite of observers not being able to see the Comet *b* in transit; and under all the circumstances stated, I should have been very much surpised if they had done so. Mr Elkin stated that he saw the comet disappear in the Corona, and afterwards proved that it passed between the Earth and the Sun. Such being the case, where did it get to? From the various calculations of the orbit, this comet appears to have passed so near the body of the Sun that it is supposed to have grazed its surface. Now, if this be so, this comet must have passed through the photosphere, and also at a considerable distance beneath the surface; and this being the case, it is no wonder that the different observers could not see it in transit, or, indeed, until it had passed round the Sun.

I now wish to ask "F. R. A. S.," or any other astronomer, What would be the effect on the photosphere of such an immense body as the comet passing through it at the tremendous speed that it did? We can very well suppose that it must have created a great commotion therein. And this brings me to the second question I wish to ask, What connection have comets or cometary bodies passing through the photosphere with sunspots?

In your contemporary the *Echo* of the 18th Nov., a F. R. A. S. gives an interesting account of a great sunspot traversing the disc of the Sun; this would be one month later than the time that the comet was seen to enter the photosphere. Now, can this passage of the comet have made this big hole in the Sun's surroundings? For, if this has been the effect, the periodical return of sunspots may be accounted for by the passage of comets (unseen by us), or by large amounts of cosmical matter falling into the Sun.

I should much like to see a comparison of the sunspot years and what may be supposed great comet years, if anyone has a list of such years.

San Tsze.

A FINE METEOR.

[20828.]—A large meteor was seen from Wallasey, near Birkenhead, by Mr. E. T. Churton, to-day, Monday, Dec. 11, at 5h. 45m. As far as I can learn, it appeared a little to the west of Saturn, and travelled some 45° to the west. It was extremely red, and looked like a bright star followed by a flame, and attended by a long train of sparks, fading away on each side of the train. It moved slowly, remaining about half a minute visible. At the end of its course it seemed to dip down and then disappeared. The weather was foggy. The meteor must have considerably exceeded a star of the first magnitude in brightness.

West Kirby, Dec. 11. **T. E. Espin.**

SUNSPOTTERY.

[20829.]—In "F.R.A.S.'s" occasional references to this subject we have an example of extremes begetting opposite extremes. That fraud, the "Solar Physics Committee," is doubtless an abiding thorn in the side of all right-thinking astronomers and meteorologists; but whether "F.R.A.S." takes the right way to get it extracted is questionable. *Some* connection between the state of solar activity and those terrestrial conditions which depend upon solar radiation can hardly be doubted. That this connection has been grossly exaggerated by a few interested persons is a fact; but is it altogether wise to attempt to counteract the evil by another exaggeration—namely, denying the connection altogether?

Permit me to remark that "F.R.A.S." does not strengthen his cause by confessing ignorance of meteorological literature. Prof. Archibald's contributions to it, though not very voluminous nor startling in any way, exhibit a sound all-round knowledge of the science (much more so than those of some "eminent" meteorologists whom I could name), and his name ought certainly to be known to all students of the subject. Then Mr. E. J. Stone *has* identified himself with the sunspot question, having published a paper on "A Remarkable Correspondence between Temperature Fluctuations and Sunspots" (see *Proceedings* Royal Society, Vol. XIX., p. 392). This was in 1871, when he was Astronomer Royal at the Cape of Good Hope. Whether he has changed his views since then I do not know.

I trust that "F.R.A.S." will pardon me for thus finding fault. I am at one with him in the desire to see the Brompton sham exposed, but fear that his valued contributions are sometimes marred by over-much zeal. It is to the credit of the English Mechanic that its columns are open to the expression of every shade of opinion. So much I fear cannot be said of the representative organ of British science, for *Nature* has done more to disseminate sunspot humbug than all other journals put together. **J. A. Westwood Oliver.**

4, Bellevue-terrace, Springburn, Glasgow.

OPTICAL GLASS—OPTICAL TOOLS—TO "OUR" IRONFOUNDERS.

[20830.]—It seems necessary that I should offer a few more remarks on optical glass, in continuation of the tables published in Section XII. of my essay. "Prismatique" will, doubtless, have some observations to make in his next article also. Optical glass may be had either in "plate" or in "disc." "Plate" is not used for the best class of work. Messrs. Chance supply plates "in slabs from 6in. to 12in. square, and from ¼in. to 1in. thick." It is of two qualities, the first only of which is "warranted." With reference to the discs, they observe:—

"Glass of the best quality is guaranteed free from veins and well annealed, and of a quality suitable for telescopes; and if found defective, it will be exchanged. Discs of the second quality are only warranted to be *well annealed*; but are not usually perfectly free from veins and bubbles." Those who require information as to price must consult the price-list issued by the firm.

M. Edmond Feil has hitherto published the refractive index for the D ray only in each of his glasses; but he informs me that he is now preparing a more extended list of indices. As he has kindly promised to send me a copy when ready, I hope to be able to give it in these columns for the benefit of "our" readers.

To quote from his list:—

"Discs of the best quality are guaranteed free from defects. Up to 3·7in. in diameter, they have facets on the sides; above 4·25in., they are polished on the faces."

An experimental prism of the same sort of glass accompanies each disc. The thickness of the discs is reckoned as being about one-tenth of the diameter. A greater thickness entails an increase in price." Optical "plate" may be had, unpolished, or polished on either two or four *edges*.

M. Feil manufactures very many sorts of optical flint and crown, some of the former having a very high refractive and dispersive power. The density of his flint-glass ranges between 5·500 and 3·000; while that of crown varies from 2·960 to 2·435. So that there is, practically, with one or other glass, a continuous series of refractive powers from 1·5 to 1·82.

I do not know who is M. Feil's agent in London. Perhaps "Prismatique" will tell us this.

Mr. Caplatzi, of Chenies-street, informs me that some time ago he purchased part of the stock of a working optician, and, amongst this is a considerable quantity of optical glass. As he will, doubtless, be able to sell small quantities of this at a much less rate than it costs new, I think our amateur opticians will be glad to know of it, as it will enable them to try experiments at a very little cost. I know nothing of the quality of this glass, but Mr. Caplatzi thus describes it:—"I have, of one sort or other, at least 500lb. of Feil's glass, crown and flint plates, 3in. to 6in. square. Of discs, I have only small ones, 2in. to 2½in. diameter. About one gross pairs 1½ to 2½ are ground, but not polished." From this it would seem that most of the glass is of the kind generally used for cameras, terrestrial o.g.'s, lanterns, &c., and therefore very useful to the amateur lens-grinder. When he considers himself qualified to attempt the construction of a first-class astro. o.g., the best plan is to obtain from the makers or their agents discs of glass of guaranteed quality. But it would be unwise for a *beginner* to do so; and, therefore, I think the above remarks may prove of some service. May I ask "Prismatique" to say a few words on this matter?

I have recommended Mr. Caplatzi to ascertain the density of his glasses: probably, some of them may agree with the densities specified by "Prismatique" in his last article.

Before I conclude, I should like to offer a hint to some of "our" ironfounders. "Prismatique" has given me data for the radius of the tools for two kinds of o.g.'s. It would be an easy matter to make patterns of these in pairs for common foci and diameters. Thus, taking the second and simpler plan of o.g., two pairs of tools are required: one set might be made for 2¼in. aperture and 30in. focus, and another for 3in. aperture and 48in. focus. Tools would then be readily obtainable, either in brass, ordinary cast, or malleable cast-iron. "Prismatique" will perhaps say whether this hint is likely to be serviceable, and, if so, specify the radii and diameters of the tools likely to be most useful? I do not think it is advisable to have a hollow boss at the back to be screwed on the mandrel, as few amateurs have means to do this well. A small iron or brass chuck, of cylindrical form, could easily be made to screw on the nose of the lathe; and if a square and slightly taper hole were cast in it, and a corresponding projection on the back of the tool, a set-screw would keep the latter in place for turning. One chuck would thus answer for several tools. The plan may not be either simplest or best; perhaps some correspondent can suggest a better.

December 9th. **Orderic Vital.**

REFLECTORS VERSUS REFRACTORS.

[20831.]—Having had some experience with reflectors, I would advise Mr. Jobson to have one if he is desirous for higher powers at the minimum of expense. A reflector is a little more trouble than a refractor, and to those who take a pleasure in such things, far preferable; the ease in observing is very much in its favour. I have had a 6in. silver-on-glass Newtonian for many years; it is out in the garden in all weathers, taking ordinary precautions against the mirrors becoming dewed, and should at any time they become so, simply allowing them to dry again before covering up. It is always ready, and I have enjoyed many happy hours with it. I silver the mirrors once a year myself, selecting a warm, sunny day; then dead-blacking the interior of the tube, and set up again for another twelvemonth.

During this summer we have had most wretched weather for the telescope, the atmospheric disturbance preventing good definition; this would account for the unsatisfactory definition experienced—Saturn looking more like a round pudding boiling in a dish; of course, all details were invisible. The last two months the definition has been much better between the intervals of fine weather, the details of the planet coming out with wonderful beauty—the principal division in the rings, the crape ring, and copper-coloured belts making a grand show. Jupiter was a splendid object on the night of the 30th; I saw the eclipse of the II. Satellite, and the light faded away in the most gradual manner. I may mention that the flat now in use I obtained from a piece of plate-glass; I got cut 60 suitable pieces of nice white-looking plate-glass, ground them in shape on a grindstone, then taking off the polish on one side; I put the telescope at one end of a long garden, and on a post at the other end I pasted upside down a short advertisement cut out of a newspaper. I tried each of these pieces with a power of 150 diameters; I obtained six only that I could read with. I silvered the six pieces, and tested upon a star; I obtained one only that showed a clear star disc. I would not advise any one to try that mode of obtaining a flat, unless he is in the possession of great patience, a most amiable temper, and don't swear under any circumstances. **Francis Martin, R.N.**

Shrub Cottage, Fairfield-road, Old Charlton, Kent.

[20832.]—Referring to letter 20782, page 295, I do not think Mr. Jobson ought to hesitate for a moment in choosing a 6in. or 6½ (as is usually made) reflector in preference to a 4in. refractor. My experience is as follows, and Mr. Jobson is quite welcome to it if he finds it helps him out of his dilemma. Like Mr. Jobson, I commenced with a 3in. refractor, and although the views of celestial objects which it gave were pleasing at the time, yet I soon became aware that its performances were confined within a very narrow limit: it had shown me sufficient, however, to make me long for a larger aperture; without much hesitation, I determined for many reasons on securing a reflector, the aperture of which was 5¼in. and the maker Mr. Calver—this cost me little more than half as much as a 4in. refractor, to which I think it was but little, if any, inferior. The result was most satisfactory—the field it opened to me was larger beyond all comparison than that afforded by the 3in. refractor; indeed, so much pleasure did I enjoy in its use that at the end of about two years I disposed of it to secure a larger aperture by the same eminent maker. This was an 8½in. mirror with flat and accessories, which I mounted myself in the equatoreal form, and thus secured at a cost of little more than £20 a telescope equal in its performance to a refractor costing many times that sum: the difference in cost between equal apertures of refractors and reflectors is such in itself sufficient, other things being equal, to settle the question in favour of the latter form. As to the merits of the performance of the reflector, my own opinion is that they are in the definition they afford of the lunar and planetary surfaces superior to refractors of equal aperture in favourable atmospheric conditions—it is only when we come to the measurement of close double stars that the reflector yields somewhat to the refractor, but this branch of work is not one in which amateurs are at all likely to enter or excel. There is another advantage, and one by no means of small importance—namely, the great ease and comfort enjoyed in observing with a reflector, as compared with the cramped and awkward position of one using a refractor of any decent focal length. As to performance, I would just mention that with my 8½in. stopped down to 3½in. with an eccentric stop, I can readily see the 12 mag. *comes* to Aldebaran in bright moonlight; also with a 4½in. stop it shows the two 13-magnitude stars forming the debilissima of ε Lyræ. Mr. Webb mentions that it required attention to see the former with his 3$\frac{7}{10}$ refractor, and the two latter stars were only seen with much difficulty under suitable conditions. Now a 6½in. or even less aperture of a reflector will show more than these to the trained eye.

My 8½in. telescope has been dismounted now for some time back; otherwise I should have had much pleasure in exhibiting its performances to Mr. Jobson. **Walter Goodacre.**

221, Seven Sisters'-road, Finsbury Park, N.
5th Dec.

COLOUR.

[20833.]—I HAD not time to finish what I had to say on this subject when writing letter 20823, p. 322. I propose now to satisfy Mr. Calton (provided he is to be convinced) that my definition of a primary green is not "vague," as be says.

He has already been informed that we can obtain a *pure yellow* light, with which every thing appears either black or yellow, lowered by absorption. That is to say, no colour can be sent back from any surface except yellow, because no other colour is present in the light; but such surfaces as absorb without reflecting will be black; and there will, of course, be the two actions united in all except white or yellow, surfaces.

But yellow is not the only monochromatic light at the disposal of science, and I wish to commend one in particular to Mr. Calton's careful attention. He says *green* is a compound colour, always due to mixture of blue and yellow. Of course, a yellow monochromatic light pleases him, because yellow is, according to him, a primary colour. Presently, I will give him a blue one. Just now, I offer him a *pure green light*, having nothing but green in it, and from which no ingenuity can extract either blue or yellow, because neither of them are there. If he obtains a *thallium* salt and burns it in the spirit lamp, he will perceive a clear green flame, and by that flame he will see neither blue nor yellow, but always green or black. Let him look at that flame with a spectroscope, and be will find it consists of light belonging to only one part of the spectrum of white light; it will give no spectrum except one clear, bright green line, which will serve as a very exact definition of that hue of green. I may say that, under some circumstances, some other feeble lines are said to be developed, which, however, are possibly due to impurities. Sodium and thallium are the only substances, so far as I can remember, which give these pure, single lights. But salts of indium give a spectrum consisting of a single bright blue line, and a violet line. A mixture of indium and sodium in the flame might, therefore, render a green surface visible as green. I am not quite sure of this, and have not the salts at hand, or I would try. But if it did, this green would be a compound green, while that of thallium would be a primary.

Lithium gives us a red and yellow light.

Strontium gives a red flame, which is a mixture containing several shades of red, with yellow and blue.

Potassium gives a violet-red, which the spectroscope resolves into two red and a violet band.

It should be understood that these colours are definite and reproducible, and that whenever the spectroscope breaks a light up into distinct stripes, each such stripe means a distinct primary colour, not reducible into any other colours. If we mix two or three of the above salts, we obtain a flame which will be coloured to the eye according to the proportion of the salts present, though sodium is so powerful that a little of it prevails. But the spectroscope always separates them out into their individual components.

A very beautiful scientific mode of tracing out the development of colour by light is to examine by the spectroscope a platinum wire gradually heated by a growing electric current. Step by step we generate the spectrum. First, red appears; then yellow, line by line; then green (before any blue is produced), and so on.

I mentioned that the spectrum of light is really an octave; and there is a very curious fact attending this which Mr. Calton will, no doubt, consider as confirming his views. Beyond the visible spectrum on each side are invisible rays, which do not affect the retina as *light*, but are convertible into light, and which do produce other measurable effects. Now, the analogy of sound tells us that the ultra-violet rays are an octave of red; and though we cannot see them, the blue passes into colours which are approximations to red, but red of a different order from the visible red. **Sigma.**

DIE-ENGRAVING—SAW SHARPENING.

[20834.]—I HAVE again to thank "Gamma" for the valuable information in his letter. The compositor must get the credit of making me smell the rose! I think most of my difficulties are now removed, until I actually begin work, and then, no doubt, they will appear again. The dies sold by makers of embossing presses referred to are, I suppose, the blanks; but as I live very far out of the world, and do not often get into it, I have to make most things for myself. I am able to work steel pretty fairly, and intended making my own blanks, punches, and gravers, so that I should have been glad to know shape and some particulars about the dies. Are they best of square or round steel, and what depth?

The method of perfecting a difficult punch is very ingenious, for of course the parts most difficult to finish in the punch will be most easily got at and improved in its impression. In doing a rose-leaf or small spray with few leaves, would "Gamma" say if it would be most easily done with the graver, or with a punch made to the outline—be here, too, the easiest and simplest way of going about it?

There are one or two mistakes in my letter on saw-sharpening, but I think not such as to cause any difficulty in carrying out my directions. In the woodcut the teeth should, of course, be represented of the same width, and not every second one broad. The fault, I know, was mine, and not your engraver's. Secondly, in speaking of the position of the hand, I have said it should be lowered 30° from the perpendicular. It should be 30° from the horizontal.

The American saw, with double set of teeth, is little better than a toy. It is certainly not a workman's tool; the blade is too narrow to give stiffness. The teeth *are set* on both edges. The coarse tooth is the ordinary M tooth, i.e., with the faces of the M filed at right angles to the saw blade, and the central or sloping sides of the compound tooth filed to chisel edges. Each M is regarded as a single tooth, and is set with a single stroke of the hammer, both points being set to the same side.

Fredk. Carre.

SOFTENING STEEL.

[20835.]—I HAVE read, at various times in the "E. M.," a number of able instructions on the working of steel in tool-making, &c.; but I do not remember seeing mentioned a mode of softening this substance, which I have practised for a number of years, and found invariably successful. The plan is—heat your steel to a dull-red heat, hold it in some dark or shady nook or corner until you can just see the least possible tinge of redness, then cool immediately in water at the ordinary temperature, and you will be able to file or turn it with very little difficulty. I have tried this plan on steel from the smallest sizes up to 1in. diameter with success; beyond that I have not gone. I do not claim that this way is better than, or as good as, some that have been given for annealing steel; but there are times when the delay of the ordinary process is extremely inconvenient—as in the filing of turning tools of a particular shape—re-annealing steel when the skin is taken off, &c., and then this mode answers admirably. **Artizan.**

WHITWORTH STANDARD SCREW THREADS AND GAUGES.

[20836.]—WE notice a communication, "Standard Screw Threads and Gauges," in your issue of the 8th inst., page 321, No. 20819, signed "B. S. W." We send you by this post two copies of Vol. I. of Sir Joseph Whitworth's Papers on "Mechanical Subjects." If you will kindly forward one to your correspondent "B. S. W.," we think he will find all the information he requires.

Sir Joseph Whitworth and Co., Limited.
Ashton-road, Openshaw, Manchester. Dec. 11.

[We have forwarded the copy to "B. S. W." as requested, and would call the attention of all mechanics to these "Papers," Vol. I. of which has been recently published by E. and F. N. Spon, in London, and by T. J. Day, in Manchester. It contains the papers on "True Planes," "Screw Threads," and "Standard Measures," and should certainly be in the hands of all mechanics and tool-sellers.—ED.]

TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

[20837.]—THE French *savants* are perpetually discovering something that every one knows. This time, however, it appears to be an Italian. It appears by the article under the above heading, p. 309, that Prof. Govi has been a long time engaged with the subject, and is deeply impressed with the importance of the "discovery." It seems, also, that Bichat took to working it out in 1875. Why, dear me! I knew all about it 25 years ago; and it seems to me a matter so self-evident, that anyone fairly acquainted with electrical facts and principles must regard it as an obvious fact. At all events, the early experimenters with coils found it out.

I suspect that the new discoverer is misled by a very common error—viz., the notion that there is such a thing as static electricity; whereas the phenomena so called are not those of electricity, but of strains produced by electricity. Frictional electricity there is; but it is simply the same thing as that derived from a battery, only it is developed at a high potential, small in quantity, and in a very great resistance. But whenever we see a spark, we see dynamic electricity; and every motion produced means electricity in motion, not static. The electricity passing from a Holtz, Voss, or frictional machine, passes as a current, may be stored in a condenser, and again issues as a current, and this current is identical in properties with equal current from any other source. That it will excite an induction coil is no discovery. That an induction coil, into the fine wire of which a current is passed, will excite alternating currents of larger quantity is no discovery. The facts are not only self-evident, but have been published over and over again.

What is amusing, however, is that the discoverer hopes to be able to separate the reverse currents of induction. Well, if he happens to see these remarks, I will tell him how to do it. I did it myself many a year ago. All that is necessary is to provide a rotating axis with toothed rings of metal and springs resting on them, such as I described long ago in these pages. One pair of springs and ring breaks the main current to the coil. Another is appropriated on the principles of the commutator of magneto-electric machines to the ends of the induced wire, so that the circuit is closed in one way at the moment of "make" in the inducing circuit, and the other at that of break. Nothing is easier than to obtain two distinct currents of uniform direction or to convert the alternating into one direct current. It requires no "regulating suitably the resistances in the induced circuit" to eliminate one of the currents. We can collect them both, and keep a galvanometer needle perfectly steady with them. **Sigma.**

MEDICAL REPLIES

[20838.]—RUPTURE (48841).—This infirmity is due to an opening between the muscular fibres of the abdominal walls—sometimes a congenital defect, which is repaired during further growth if a properly-fitting truss be always kept on—sometimes in consequence of violent strains with the legs in an awkward position—sometimes due to riding with a long stirrup and bumping the saddle—sometimes due to violent coughing in emaciated and weakly asthmatics. This opening allows a loop of intestine to be forced out of the abdominal cavity to form an external tumour containing the fold of intestine, covered only by the lining membrane of the abdomen and the skin. The rupture is then said to be "down." If the intestine be allowed to remain protruded from the abdominal cavity it may swell or it may fill with feculent matter and become "irreducible"—*i.e.*, not returnable into the abdomen. In this state strangulation is apt to occur, followed by sickness, pain in the abdomen, and a rapidly fatal termination. In other cases the intestine or other contents become adherent to the sac or to the neck of the aperture, and the rupture remains always down or permanently "irreducible." The subject of aperture is of great importance to working men, and the treatment is as follows:—1. Those who have such a sense of weakness in the groins, that on straining they find a tendency to swell there, should consult a medical man to know whether the bulging is premonitory of a rupture, and if so, they should wear a light double truss, which can be buckled up a little tighter on any occasion in which they have before them heavy work or a shaking cough. This will give comfort and support, and will prevent actual splitting of the muscular wall of the abdomen. Such a truss need not be worn at night, but should be taken off on getting into bed, and put under the pillow, to be replaced in the morning, *before rising from bed*. 2. Those who already have become ruptured should wear a truss, so fitted as to stop the bowel from coming through the opening, but not to thrust its pad into the opening when the strain is relaxed. The spring, therefore, needs to be fairly rigid so far as further yielding goes, but not to force itself into the opening, and to move through a small arc rather than a large one. The pad should be so large as to take its bearing well upon the sides of the opening, and not merely upon the hole. Such a truss should be worn at all times, except when in bed, and even then it should be worn if subject to a shaking cough. In case the rupture slips down beside the truss, the patient should *at once* lie down, draw up the knees, and having loosened the truss, so apply the hands as to slowly compress the sac, and push the intestine back into the abdomen, generally by a force applied upwards and backwards, and slightly outwards in relation to the patient's body. Such force should be gentle, steady, unyielding compression, giving the element of *time* full play, the abdominal wall being, meanwhile, kept perfectly relaxed. After a few minutes a sudden movement and collapse of the sac will be felt, which indicates that its contents have slipped back into the abdomen, and are again safe. The complete return of the contents being assured, the truss should be securely replaced before the patient rises. In the event of the rupture having been neglected and not being reducible by the patient, the instant aid of a gentle-handed and skilful surgeon should be obtained. This being neglected, and the protruded intestine being allowed to remain outside the abdomen, more and more intestine continues to descend, fæcal matters drain into the dependent loop, gradual strangulation and swelling is caused by the neck of the sac acting like a tight piece of string round a finger, and mortification of the intestine and death follow, unless the surgeon perform what is called "the operation for hernia," i.e., cut down upon the neck of the sac, and divide the strangulating ring without damaging the tense intestine which fills it, and then return the inflamed intestine into the abdomen to recover itself. This operation is a most delicate and dangerous one, and ought only to be done by a very skilful operator. After the operation the opening is, of course, left larger than before, and more liable to a larger descent of the bowel. It is, then, more than ever necessary in the patient to wear an accurately-fitted truss, and to avoid violent strains. 3. In cases which have been operated upon—or which have been neglected—the opening becomes so large that it is impracticable to keep the intestine up, and often it becomes adherent to the inside of the sac, and thus permanently irreducible. Such ruptures are a serious infirmity, and they debar the sufferer from active exercise. They can only be assisted by what is called a "bag truss," a device consisting of a ring to support the neck of the sac, and a bag to prevent the sac being further distended. But beyond debarring the patient from active physical exercise, and making the patient liable to stoppages of the bowels, they need not interfere with life, and Gibbon, the Roman historian, suffered from an enormous irreducible hernia of this sort while he wrote his "Decline and Fall of the Roman Empire" in his beautiful garden at Lausanne, overlooking the Lake of Geneva. 4. In cases of congenital rupture a truss also should be carefully kept on until the opening grows together, which, when it is the result of mere arrest of development, generally takes place if the opening be not kept open by the continued descent of the bowels. "Anxious Parent" should, therefore, assure himself that he has the child correctly fitted with a truss, and if he has any doubt about this he cannot do better than go to Coxeter, the surgical instrument maker to University College Hospital, in Gower-street, or to some other able and reliable mechanician for trusses. In many cases of rupture the danger and inconvenience of wearing a truss for life can be prevented by means of a surgical operation which consists practically of sewing together the sides of the muscular opening through which the bowel escapes from the abdomen, and, owing to recent improvements in abdominal surgery, this operation is now a very promising one in properly-selected cases. It should not be done in congenital cases until all chance of natural closure has been lost, nor in cases where the whole muscular wall of the abdomen is emaciated and weakened, as often is the case in asthmatic patients. In all ruptured patients the bowels should be kept acting regularly every morning after breakfast.

Chilblains (48862) occur in delicate people of weakly circulation, and in children who are not properly clothed, or not properly fed, or unduly exposed to cold. Remedies: Clothe child efficiently with flannel down to its wrists and toes, and fit with broad-soled comfortable boots. Give it the fat bacon and oatmeal-porridge and milk diet already referred to so many times. Get the child such fair out-door exercise as will keep its circulation going, and keep it in health. When indoors at rest, let the rooms be properly warmed. Children thus treated will never get chilblains, which are nothing but mild frost-bites. If from neglect of the above points chilblains have occurred, they will have to run their course. In mild cases they inflame, and are tender for a time, and are gradually resolved if the above precautions be assiduously attended to. If not, or if the frost-bites have killed some of the tissue, then suppuration and discharge of the dead tissue will have to occur before they get well. In the first case, rub them gently thrice a day with a very little "opium liniment." In the second, poultice and treat like an ordinary boil.

The Sphygmograph (48879) is an invaluable aid to researches upon the pulse, but is an expensive and delicate instrument that will be of no use to an amateur. It is a small clockwork motion by which a slip of smoked paper is traversed horizontally upon its edge, while a spring is projected vertically by every rise of the pulse-wave, and a delicately-adjusted point is made to describe upon the slip of smoked paper a complicated tracing which represents the two co-ordinate motions, i.e., the horizontal movement of the paper, and the vertical rise of the artery under the passage of each pulse-wave. Assuming that casual disturbances of the pulse have been properly eliminated by the operator, a mere inspection of the tracing will enable a skilled expert to predicate many facts about the heart's action, and the reactions by which it is counterpoised—i.e., the elasticity of the arteries and the condition of the capillary circulation—which are of great importance and significance in disease. But just as a skilled workman will tell the qualities of a piece of steel by a few rough tests quite as well, and perhaps better for his purpose, than a chemist by the result of an elaborate chemical analysis of the steel, so a skilled clinical physician will tell, with the tip of his finger on the patient's wrist, all that he can learn about the pulse. But for purposes of student instruction and graphical representation, the sphygmograph is of great value. A very simple experimental sphygmograph may be made by rigging up a piece of fine black indiarubber tube to represent the artery; an elastic ball or pump to represent the heart; and a current of liquid to represent the blood. Upon the tube, through which the current is pumped, there must be fixed a spring or clip, just tense enough to yield to a certain extent at every stroke of the pump. To this spring attach a tracing-point for marking a piece of smoked paper or glass, which is traversed at right angles to the movement of the point. The curvilinear tracings represent the pulse-wave. As the tube beyond the spring-clip delivers its water at one or other level, the vertical co-ordinate element at the curve will vary, and alter the character of the curve. In the horizontal co-ordinate, one variation will be produced by the sharpness or slowness of the pump-stroke; another by the number of strokes which is given by the pump for each unit of horizontal travel of the paper. Liquids that are viscid, or saline, or aqueous, or alcoholic will all give different curves, other things being equal; and so will alterations of temperature, which increase or diminish the elastic reaction of the walls of the tube. Thus the tracing accurately represents the summation of the co-ordinates; but its analysis demands much skill and caution, and is often an insoluble problem. In the animal pulse there are the elements of agitation, mental excitement, &c., to be added to the above, and all conspire to vary the character of the curve. Still, the sphygmograph is a most valuable instrument of research, not only in the animal pulse, but in many other problems connected with pneumatics, hydraulics, steam-engines, &c. Dr. Dudgeon's sphygmograph is the cheapest and best instrument for the pulse at the wrist.

Rheumatism (48845) and Children's Diet (48860) are large subjects of wide and general interest, and I will find time to write something that will be useful upon each topic in an early number.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

"MAKE YOUR OWN GAS."

[20839.]—An advertisement with the above heading appears in your issue of December 8th. As I have already had inquiries and complaints respecting this, I must ask your readers to note that I make no apparatus corresponding to the description given, and I know nothing whatever of the apparatus specified. **Thos. Fletcher.**

Museum-street, Warrington.

SAND-BLAST PROCESS FOR FILES.

[20840.]—Will you allow us to give our experience of this process, as applied to worn files. Your correspondent "E.H." is certainly right in attributing its occasional failure to the large proportion of broken teeth in a file, as ordinarily worn. Our object in writing is to point out that, as the use of the process becomes more understood, care will be taken to avoid this.

It will be discovered that it does not pay to wear a file down to the point that is now common. We have had proof of this with regard to the gun trade in this town. In that trade the men find their own files, and they have not been slow to discover the value of the process. They use their files with care, and it is quite common for us to sharpen a gunsmith's file three, four, or even five times before it needs recutting. We have hundreds of these workmen on our books, and they are unanimous as to the great saving effected by the process.

G. and P. Hookham.

Licensees for the Counties of Worcester, Stafford, and Warwick.

TO "M.D., F.R.C.P." AND C. FRANK.

[20841.]—I notice with very great pleasure that our valued and able contributor, Mr. Sprague ("Sigma") has taken up the "Voss" induction machine. He gives us last week a description of one form, and promises us an explanation of the principles on which it acts. I intended to do this myself, but I am glad that an abler pen than mine has undertaken the job; and I look forward with interest to his future papers, in which I hope he will give in detail the object of the various parts, with their arrangements. The general principle, I think, is sufficiently evident to all. Perhaps, also, "Sigma" will give us any experience he may have had in other forms of the machine, single and multiplate. In the mean time, I would ask those to whom I have promised a description of my multiplate arrangement, to wait, as I am now about one, which will be described when finished.

Swansea. **A. R. Molison.**

BREAD.

[20842.]—Many people like home-made bread, and I see a good many communications about it, but in most the goodness or badness of the flour is forgotten. This makes a deal of difference in the rising and stiffness of the dough; and there is another thing of still more importance—the degree of warmth in which the dough is. Without these two things are attended to, you will have no really good bread. And then there is another thing, we learnt years ago from an old woman, which is a very frequent cause of the bread not turning out well. Most servants, after the dough has been in the oven a few minutes, open the door and look at it to see if it is rising well. This almost always causes the dough to fall. I am going to speak of a common-sized loaf—the dough should be put into the oven made hot enough, and the door closed for ¾ of an hour; it may be looked at and turned then; the door should again be shut, the warmth kept up for another ¾ of an hour, when the bread will be beautifully done if the heat has been right.

Edwd. Thos. Scott.

THE SLIDE-RULE.

[20843.]—On looking over last year's volume of the English Mechanic, I find several letters in regard to slide-rules, and on p. 527 Mr. Thomas Dixon made an instructive communication as to the capacities of such instruments. I have lately been much interested in this subject; but find that none of the slide-rules now made answer for the purpose of obtaining the logarithms of logarithms (for instance, to calculate the functions of the form, $\sqrt[n]{\left(\frac{p}{q}\right)}\;m$). I have thoroughly searched the literature relating to this subject, and have discovered that in the Philosophical Transactions of the Royal Society of London for the year 1815, Dr. Roget described a slide-rule, by means of which the above calculation could be made in one operation. It seems, however, that, for some reason or other, instruments of this kind were not constructed until about the year 1845; and nowadays Dr. Roget's slide-rule can scarcely be found, except in a few museums. I have seen one of these instruments, which is about 22in. in length, and is stamped with the name of "Cary, London," as the maker. On inquiring, however, of this firm, I was informed that the rule is not now made, and that even the patterns by which it was cut appear to have been lost. I have also inquired at various antiquarian shops, but so far have been unsuccessful; whilst I have advertised in the English Mechanic, and other papers, for one of these instruments, but without result.

If Mr. Dixon, or any other reader of the English Mechanic, could give me his views as to this slide-rule, and could also give a hint as to where it may be obtained, I should feel greatly obliged. Personally, I believe the instrument is of great scientific value, and well worth re-introducing.

Alb. Kapteyn.

7, South Villas, Camden-square, S.W.

LEGAL REPLIES.

[20844.]—The Petroleum Act—License (48822).—The Petroleum Act, 1871, gives the local authority of the district the power to grant licenses; but it provides that the cost of a license shall not exceed 5s. The difference mentioned in this question is doubtless arrived at by the costs charged by the clerk to the justices on granting the license: a matter which requires looking into and reforming generally.

Will — Executors — Legatee (48843).—The date of the death is not given in this question, though that is the most important point; for an executor is allowed a year to get in the estate and pay the debts before he can be made to pay any legacy. As the estate is being wound up, it may be that there is not enough to pay the debts of the deceased, and if so, there would be nothing even for the residuary legatees. The querist cannot compel the executors to give him an account; but he can bring an action in the Chancery Division, or the proper County Court, if the estate is under £500, for its administration; but he may have to pay the costs himself, and he had better consult a solicitor upon all the facts. An office-copy will may be obtained at Somerset House for 6d. per folio of 72 words.

Contract – Alteration — Penalty (48844).—This is not a question which can be safely answered without a fuller knowledge of the facts. *Primâ facie*, I should say that, by the alterations, the contract, as to time, was put an end to, and so the penalty was gone. The point really is, whether or not the parties, in agreeing to alter the original plan, entered into a new contract which was to include the old penalties. This may or may not have been done, and it would be a question of evidence, upon which I am not in a position to advise. But a contract to pay fines for delay must be expressly proved, and here I do not think this could be done.

Will—Debt—Real Estate (48848).)—The real estate of the testator B. is liable to pay his debts after the personal estate has been exhausted, although it is not so stated in the will. The trustees must, therefore, sell so much of the real estate as may be needed to pay the balances of the legacies to the sisters, and if they will not do so they can easily be compelled by an administrative action at the suit of the sisters in the Chancery Division, when an order will be made for that purpose, and they will probably have to bear the costs.

Building Society—Withdrawal (48868).—It does not appear whether or not this society is registered or incorporated under the Act of 1874. But in any event I hardly know how to advise the querist, who is not likely to get his money much, if any, sooner by taking legal proceedings. He might probably bring an action for the sum he wishes to withdraw upon the expiration of the notice, but I do not think he can do anything else.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

A SCIENTIFIC QUERY.—TO PROF. HUNTINGTON, KING'S COLLEGE; T. B. HUNTINGTON, CIVIL ENGINEER; OR ANY OTHER METALLURGIST, CIVIL ENGINEER, OR CHEMIST.

[20845.]—ANY man having spent only a few hours in the study of chemistry, knows that oxygen combines with metals in different fixed proportions, and that the combined bodies possess various properties, concording with the proportions, in mathematical equations, of the ponderous chemical constituent elements thus combined. It is also well known that the combination of the same ponderous elements, differing only in their respective proportions, produce, without the introduction of any dye, differently-coloured substances, and that their imponderous colours correspond to the respective proportions of the ponderous chemical constituent elements combined, which undeniably proves that such ponderous elements contain *chromatogenic imponderous constituent elements in colours*, in fixed proportions, adequate to the colours produced. What do these chromatogenic imponderous constituent elements of colour consist in? What are they made of? By which one of the ponderous substances are they brought in the combination? Which are their mathematical proportions and equations? What relation is there between the proportions of the ponderous chemical and the imponderous chromatogenic constituent elements? What proportions of each are required to produce each colour? That there is a law cannot be denied, since the phenomena are always the same in same circumstances. What is that law?

In order to give an absolute precision to my query, I will take the combinations of three bodies with oxygen—manganese, iron, and chrome, and indicate the various proportions of such combinations and their colours—

Mn 2 = 55 = blue + red.
Fe 2 = 54 = red + red.
Cr 2 = 53 = green + red.

COMBINATIONS.

Mn_2O_2; Mn_4O_5; Mn_2O_3; Mn_3O_4; Mn_2O_6; Mn_2O_7.
Fe_2O_2; Fe_6O_8; Fe_2O_3; Fe_6O_7; Fe_4O_6; Fe_2O_6.
Cr_2O_2; Cr_6O_8; Cr_2O_3; Cr_3O_4; Cr_2O_6; Cr_2O_7.

MANGANESE AND OXYGEN.

Mn_2O_2 = green.
Mn_4O_5 = violet red.
Mn_2O_3 = red.
Mn_3O_4 = blue black.
Mn_2O_6 = green from blue indigo red.
Mn_2O_7 = blue, black, and green.

IRON AND OXYGEN.

Fe_2O_2 = green.
Fe_6O_8 = green.
Fe_2O_3 = red.
Fe_4O_6 = red.
Fe_2O_6 = red.

CHROME AND OXYGEN.

Cr_2O_2 = inconstant.
Cr_6O_8 = red.
Cr_2O_3 = green.
Cr_6O_{11} = red.
Cr_2O_6 = red
Cr_2O_7 = green.

Will the above-named savants, or any other kind reader of the ENGLISH MECHANIC, explain the above, say what are the chromatogenic elements, give their mathematical equations, say why red or green is produced by quantities quite different of both combined bodies with oxygen, such as, for instance, Fe_2O_3; Fe_4O_6; Fe_4O_6, producing red, and Fe_2O_2, Fe_6O_8 producing green? Will they indicate the respective proportions of the same, pertaining to each one of the combined bodies, so as not to be contestable, and to be demonstrable all over the world, according to physical laws? I am told, and indeed I am sure, that it is simple, easy, and perfectly known. Such an answer, I have no doubt, will please and interest many besides

Un François Curieux.

NITROGEN.

[20846.]—WILL Mr. Allen (or any of your chemical readers) give me his opinion whether the gas which I procure in the manner stated below is nitrogen, or some gas not hitherto named or isolated.

I take 100 grains of burnt alum, obtained by calcining alum in an iron pot, until the water of crystallisation is driven off, and it is reduced to a friable powder, and 130 grains of chloride of calcium (such as is commonly used for desiccating gases), which I also heat in a crucible until it is sufficiently dry to enable me to pound it in a mortar.

I mix the two together as quickly as possible, and introduce them at once into a pint clay retort, which I put into an ordinary grate having a good draught, so as to bring the retort to a bright red heat. I connect the retort with the pneumatic trough by two pieces of glass tubing and a piece of rubber tubing. The retort and tubing might contain a litre of air.

Several different gases are evolved; sulphurous and sulphuric acid gas, chlorides of iron, silica, and aluminium—all these are soluble in water and are dissolved by the water in the pneumatic trough; but besides these I get three litres of permanent gas. I experiment with the litre last collected only.

The gas has a disagreeable smell like cabbage-water; it is insoluble in water and potash; it is not combustible, nor will it support combustion; it will not combine in any proportion with oxygen, nitrogen, or chlorine. It does combine with hydrogen slowly if the spark from a small induction coil is passed through the eudiometer for five minutes. Under these circumstances, the mixed gases contract in volume about one-third; on adding oxygen in proper proportion to combine with the hydrogen added, and passing the spark, explosion takes place, water is formed, and the gas resumes its original volume.

I find by experiment that nitrogen behaves in an exactly similar manner.

If a gas gives none but negative reactions, it is usual to pronounce it nitrogen. It has always seemed to me rather a hasty conclusion; and I doubt this gas being nitrogen for the following reasons:—

I can find no ammonia and no nitrates in the chloride of lime and burnt alum from which I obtain the gas.

Excluding one litre as containing the air in the retort and tubing, two litres of the gas are obtained from the material used, which is a large quantity, and can scarcely be accounted for by the supposition that some accidental impurity is present. Although I have followed with scrupulous care the directions in Bunsen's "Gasometry," I cannot succeed in making nitric acid from the gas.

I have tried to weigh the gas against nitrogen; but from want of proper apparatus and want of skill, have found the difficulties too great for me to overcome. The results were so contradictory as not to be worth recording.

The oxygen and hydrogen I have used in my experiments I have obtained by the electrolysis of acidulated distilled water, and the nitrogen by burning phosphorus in air. I should mention that if too large an induction coil is used, the spark will crack the eudiometer.

Ill-health has prevented me from continuing the investigation, even if I knew in what direction to experiment.

E. A. W.

JERK IN RAILWAY TRAINS.

[20847.]—I DO not wish to contradict any correspondents who have written on the above subject, but it appears to me that the querist has hardly explained what he wishes to know. He says on p. 161, "We all know that when a moving body, say a train, is brought to a standstill, the tendency of any loose body, such as a passenger, is to continue the motion, and consequently a jerk is felt *in the direction of motion or towards the engine.*

"Almost all constant passengers by train must have noticed that when a train is brought to a standstill in the usual way by the application of the brakes, that at the moment of stoppage the passenger experiences a jerk, *not in the direction of motion, but in the direction of the guard's van.*"

It appears to me that, according to the above-quoted query, two opposite effects take place at the same moment. Some correspondents have explained the cause of the forward jerk, whilst others have explained the cause of the backward jerk, and as all were *supposed* to be explaining one and the same thing, their theories of course do not agree.

Now I maintain that it is the jerk which tends to throw the passenger in the direction of the guard's van which is felt when a train is brought to a standstill, and this is caused, as explained by Mr. Stretton, by the carriages righting themselves. A jerk in the opposite direction cannot also take place at the same moment; that is, of course impossible. Certain it is, that the carriages do right themselves when fitted with the brake, and therefore this must be the cause of the jerk. A jerk tending to throw the passenger towards the engine does not take place at all, at least, I have never experienced it. I have travelled a good deal on the Metropolitan Railway, and have always felt the jerk, but that threw me towards the guard's van, and was, doubtless, caused by the carriages righting themselves.

Many readers will say that the carriage righting itself would throw the passenger towards the engine; but, curious as it seems, this is not the case. The jerk will send the passenger in the direction of the guard's van, and the reason is simply this:—When travelling in a carriage the tendency of the passengers is to lie away from the direction of motion. When the carriage is brought to rest the passenger is, of course, still in this position, and a jerk in the direction in which he is leaning would make him go still further in this direction, even enough to topple some people over. If the passenger was standing in the position of equilibrium, or leaning towards the engine, the jerk would send him in the direction of the engine. This, I think, most of your readers will understand. As a matter-of-fact, this jerk does take place almost immediately after the train has been brought to a standstill, and it causes the passengers to tumble about the carriage, and if they are in the act of alighting, it sometimes results in injury to their person.

As to the question as to whether the train is to be considered "in motion" when the jerk takes place, I must leave that to other and more able correspondents than myself. I may, however, just say that the train has stopped when the jerk is felt, and this the passenger can always maintain, whilst the railway companies can say it was "in motion," which is equally true.

Fliegender Schotter.

"J. L.'s" ARTICLE ON LATHE-PLANERS.

[20848.]—"J. L." says he does not intend to continue the discussion. Is it because he sees he has a bad case? However, before I follow his example, I must correct more than one mistake in his last letter. If he recollected his own article and what I have written on it, he would find that there were *two* forms of head referred to, and that it is a poor sort of answer to give to my objections to what we may call "J. L's. Planer" (provided "E. P." does not dispute the appropriation), that they do not apply to what for distinction we may call "F. W. G.'s". Yet this is all the answer "J. L." gives in his last, for I have not criticised "so severely," or, indeed, said anything against this form, except that "J. L." had not improved it, and had placed it at the wrong end of the bed.

What my criticisms were severe on was "J. L.'s" form—namely, the *bridge form*, which he in the article commends more than once as *the superior and more efficient* form, and which, as applied to *small cheap* V-edged lathe-beds, I think he will find few anxious to dispute the honour with him of being its inventor, so that he may safely take the credit of it.

I have said, that if the illustration given of this bridge arrangement is not a caricature, it is "a small, insignificant, and generally useless attachment." These words I am not afraid to repeat in the connection in which I used them. Adding this further, that as "J. L." now admits, "it would be far more difficult to arrange than the other," it is strange he should still recommend it when there is nothing to compensate for the extra trouble. For, let us recollect what has been proposed is that the saddle of a 3in. lathe is to be converted into the planer-table, and as the greatest length which can be planed *is limited by the length of the table*, we really get no advantage, or not the advantage which was promised. Thus the tiro, if not led into the ditch, has been led into difficulty and expense, and has little more than his experience for reward; and it is but poor solace that he can say he was told, "It is more desirable that the head should straddle the lathe-bed."

There is one other very unaccountable misunderstanding of my objections to the "J. L." form of head. In the original drawing No. 2 there are four *square* bolt holes, into which the tenon of the slide rest has to be fitted, which are described thus:—"I have also shown, on the cross plate of this second planing head, Fig. 2, a *series of bolt holes, by means of which the slide-rest can be shifted bodily, so as to bring the tool over other parts of the work.* This will practically lengthen to any desired extent the cross traverse" (the italics are mine). Now my objection to this was:—"If the slide-rest is to be fitted into the four holes so as to be of any use, it will be more than any amateur, who would put up for five minutes with such a botched contrivance, would be able to accomplish." And in my last letter, while repeating my assertion, I have added by way of explanation, in italics, "*while planing the same surface*"; for the shifting of the rest is evidently spoken of as enabling you to plane a wider surface.

Yet "J. L." writes as if I referred to the "F. W. G." or Northcott form of head, and says he sees no difficulty in an amateur fitting the tenon to the hole—as neither do I; but I do see the difficulty of what I said and what he proposes—fitting the four holes to the tenon in such a way that *continuous* planing can be done, as we were led to believe was the advantage of this arrangement. Private letters from friends are not always trustworthy testimony; nor is a lathemaker, who gets the job put into his hands, much better. What would be to the point would be an approval in these columns of what is *peculiarly* "J. L.'s" proposals coming from one or other of those writers who really know what they are writing about, and in whom all have confidence. Then intending amateur makers would know whether I have pointed out imaginary defects, and whether they would be safe in paying no heed to them.

It must not be forgotten, too, that the proposal which I found fault with *was not the fitting up* this "F. W. G." planer head *on a lathe*—even on a 3in. centre one, for, spite of the "apathy" said to exist, I felt there was a place for combinations on a lathe-bed; but I objected to an amateur being advised to get one of these small cheap V-edged lathe beds and make this the foundation for a *separate planing* machine. This the amateur is more than once advised to do, though we all wished to think it was not so. It was with reference to this proposal that I said it would be far better to get a regular set of castings for a small planer, and that these would be more easily put together than the cheap-and-nasty affair proposed, and I see no reason to alter my opinion. **Fredk. Carre.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48226.]—**Truss.**—Of course if "Truss" can change his for another, it will be best, and the shortest way, but it seems he wishes to do it himself privately. If so he can easily manage it by taking off the leather round the spring, and then grinding the steel thinner till it is weak enough by trial, using plenty of water, to keep the temper right.—Edward Thos. Scott.

[48395.]—**Astronomical.**—1. See "A Cheap Substitute for an Observatory" (Vol. XXXIV., p. 256, letter 19420), by H. L. Baldwin. 2. Incurable, I fear. 3. See letter 20779, p. 234, of present volume. By the way, have your ever tried a music-stool?—A Young Astronomer.

[48403.]—**Lantern Ghosts (U.Q.)**—Let "Magician" inclose his lantern in a box with a mirror at other end. This reflects the picture from the lantern through a hole in the top of the box, and throws it on to the smoke of incense from a chafing-dish. In this way he can raise any ghost he likes to paint on his slides.—A. G. P.

[48443.]—**Tension of Coil-Spring.**—If "Jimbo" will refer to p. 413, No. 615, he will find formulæ and illustrations concerning the strength of coil-springs, from which, I suppose, he will be able to work out the tension when loaded.—T. P.

[48447.]—**Bichromate Crystals.**—Potassium dichromate is obtained by heating chrome iron ore and reducing to powder. It is then heated to bright redness in mixture with chalk and carbonate of potassium, frequently stirring while a current of air passes. Any calcium chromate is decomposed by lixiviating with water, and the yellow solution being drawn off is supersaturated with nitric acid, and after separating any silica by filtering, the crystals of potassium dichromate are obtained on evaporation, and can be purified by recrystallisation in the usual manner. I suppose I need not tell your correspondent that unless he goes in for the manufacture on the large scale, he will find it cheaper to buy from those who manufacture it as a business.—Poggendorf.

[48449.]—**Electrotyping.**—No building tool at all. If plaster is used for the mould, or wax of such a consistency that it is poured on to the type, the latter is surrounded by a rim of metal, higher than the type. The usual thing is guttapercha, which is softened and laid on the prepared type, and then put into a press. For the best work the plaster process is preferred.—Nun. Dor.

[48451.]—**Galvanic Belt.**—Make it up of strips of thin copper and thicker zinc, connected together at their ends, and separated by fold of cloth or canvas. Moisten with salt and water, or water slightly acidulated with oil of vitriol.—T. P.

[46460.]—**Fontainemoreau's Alloy.**—If this querist would say what the alloy consists of, he might obtain an answer.—J. T. M.

[48464.]—**Pain in Heel.**—May be rheumatism, or may be gout, or may be only some trifling ailment which would yield to bathing in hot water and rest.—C. K. T.

[48472.]—**Harmonium Pedals.**—It is never an easy matter to add pedals to a harmonium that has not been planned out for them; but I think your correspondent will find the usual plan the best—tapes and pulleys are simply an abomination. The plan is to run stickers up the back, which actuate levers pressing on the keys just behind the stop-board. The pedals themselves are spread to full scale, and lift away, the ends merely resting in the ends of the permanent levers fixed at the bottom of case. If these latter are straight it will be seen that the levers at the top must in the case of the top notes be at an awful angle for smooth working, so it is usual to divide the skew between the two. Set out then the pedal levers to run about half-way of the difference between the top pedal and the corresponding key on the manual, and put the rest on the top levers; stickers run up at the back and connect the two sets, which are both centre swung, and the top ones bear on the keys by means of a clothed button and screw. You will find two good plans on pp. 202 and 272, Vol. XXIV.—Henri Etienne.

[48479.]—**Protecting Zinc from Sulphuric Acid Fumes.**—The only way would be to lacquer or varnish it.—T. J.

[48481.]—**Yawl.**—There was published a few years ago a most exhaustive treatise on small boat sailing and rigging, chiefly reprinted from articles written for the *Field*, with plans and drawings (of both hull and rigging), of every type of pleasure-boat and small craft to be found round the various ports and harbours of the United Kingdom, showing their various capabilities and special adaptation to the class of work and character of water met with, from the canvas fishing-boats of the wild, rocky, west coast of Ireland, to the strangely-shaped "coble" to be found on the East Coast, Tyne, and Tees; in fact, just the book for "S. S." to get and study. Of course, much depends upon the class of work which a boat has to do; and all can only speak of their own experience. As far as mine goes, some 10 years on the Mersey, I can strongly recommend the standing lug, as having served all the various purposes I required, and I cannot for a moment see how "Robinson Crusoe" can think a "spritsail lies 'closer' to the wind." The simplest answer to "R. C." is to ask, Why are not "sprits" used in racing craft, and "lugs" abolished? There are no finer craft afloat than our Mersey New Brighton Sailing Club boats, about 23ft. long, and originally sailed with spritsails, which were soon abandoned for the "standing lug"; and a beautiful sight it was to see some eight or ten of these small craft (six hands aboard) racing in the reaches of channel outside our port. A few of the best of these boats were last year decked over, given a counter, and now race with the 5-ton yachts, but are cutter-rigged. The port craft—river-gigs or "speculators"—on the Mersey are all "sprit-rigged," and are about 25ft. by 5ft. 6in., and carry from 8 to 14, all told; crew, mostly four. These boats are quite open, square-sterned, and answer their purpose admirably, and very often they encounter very heavy weather here; but the "river-police" boat has of late years cruised under "standing lugs," since they were seen to be so handy in the N.B.S.C. boats. The fault of the sprit-rig is the heavy long spar (sometimes longer than the boat itself); the difficulty of "spritting" the sail when it is blowing; the risk of driving end of sprit through boat when lowering sail; and last and chiefly, the difficulty of reefing, except in a very small degree; whereas a lug can be reefed at pleasure, down as small as you like, if care be taken to have the angle made by the "luff" and "foot" 90°. Nothing is better than a bamboo for the yard, and I used spruce for mast and boom. The mast must have a "traveller," well described in aforesaid book, as used by the N.B.S.C. and elsewhere. Extra sails are a nuisance, both in setting and in lumbering up a boat. I greatly sympathise with sailors who execrate the Dutch frau who first invented "stun'-sails." Latterly I have had my sails big, and reef them down when required. On my small boat, 16ft. over all, I had a mainsail of 100 sq. ft., and a mizen of 30 sq. ft. With this spread I could outsail any "river-gig" I ever encountered, and go windward of them, in spite of their extra size and "sprits." Lead, in any shape, is the best ballast, as being most compact; but it is expensive. I used pig-iron "kentledge"; but the rust is very nasty, spoiling clothes, &c. Never use "yokes"—they are bad every way. The proper plan is a steering-bar led into boat, connected with "port" side of rudder-head—exactly the principle adopted in steering tricycles. The less cordage or running-gear the better; the halyards and sheets are quite enough to look after.—Cæsar.

[48496.]—**Enlargement of Bowels.**—I do not know what is meant by this question; but charcoal cakes are eaten because they are supposed to absorb the gases of fermentation produced by the food not digesting property.—Trigonum.

[48506.]—**G.E.R. Engines.**—Will "Busybody" allow me to correct him *in re* the above? The cylinders are inside, and both cylinders and steam-chests are cast in one piece. The radial leading-wheels are 4ft. diam. The wheel-base is 17ft. 6in. equally distributed. The Joy valve-gear enables the crank axle journals to be made 9in. long by 7¼in. diam., and the crank-pins 8in. diam. by 4¼in. long. The crank arms next frames are 4¼in. thick, and those inside 4⅝in. thick. The exhaust ports are very large, being 4½in. wide by 11⅝in. long. Can anyone say if the valves are of the Allen type or the ordinary valves?—Guide York, U.S.A.

[48533.]—**Angles of Pyramid.**—The fraction $\frac{6}{10}$ or ·6 is arrived at by dividing the altitude by the base in a right-angled triangle, the altitude being the side opposite the angle we are dealing with; hence the fraction represents the tangent of the angle, and not the sine. Referring to a table of tangents, it will be found that ·6 is the tangent of 31° very nearly, the double of which, or 62°, will be the angle contained between two contiguous sloping edges. If half the base, divided by distance from apex to middle of base, were the sine of half the angle at apex, it would be true for any height of pyramid. Now, suppose the height to be lowered till it comes to nought, the pyramid becomes a flat square crossed by diagonals; half angle at apex is then 45°, the sine of which would be 1, which is absurd, whereas we know that 1 is the tangent of 45°.—M.I.C.E.

[48600.]—**Speeding.**—Multiply revolutions of engine per minute, diameter of driving-pulleys, and teeth in driving-wheel together for a dividend; diameter of driven pulleys and teeth in driven wheel together for a divisor; quotient is revols. per minute required: in this case, 50·625. The punctuation makes "Scotia's" query somewhat obscure. Should not the semicolon be put after "12in. pulley" instead of after "on this shaft"? I have so construed it. Will it interest "Scotia" to know that, in working out the above, I used fourteen figures only?—R. G.

[48600.]—**Speeding.**—I should like "Scotia" to look over his query to see if he has put it right, as I find that the 16in. pulley must be a driven as well as a driver; and if so, is the 30-teeth pinion driven by the 12in. pulley on the same shaft? If it is so, then your 80 teeth spur-wheel makes about 50 revs. The way to find it is to multiply all the drivers together by the speed of your first shaft; then multiply all the driven together, and divide the former by the latter for the answer.—D. Woodhead.

[48613.]—**Strain on Chain or Wire.**—Every uniform chain hangs in a catenary; the principal properties of the catenary may be thus stated:—From the lowest point C draw C O vertical downwards, and of length c (to be determined from the "data). Draw O M N horizontal through O.

(1) Draw from any part P of the chain a vertical, P M, then tension at P is weight of a length P M of chain.

(2) If S be length of chain from lowest part C up to P, then $PM^2 = S^2 + C^2$.

(3) $PM = \frac{c}{2}\left(e^{\frac{OM}{c}} + e^{-\frac{OM}{c}}\right)$ where e is the base of Napierian logarithms and equals 2·71828.

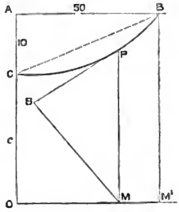
(4) $S = \frac{c}{2}\left(e^{\frac{OM}{c}} - e^{-\frac{OM}{c}}\right)$

(5) Draw M S perpendicular to tangent at P, P S = arc C P.

In present case we are given A C = 10ft.; A B = 50ft;

hence, $BM' = C + 10 = \frac{c}{2}\left(e^{\frac{50}{c}} + e^{-\frac{50}{c}}\right)$

This equation cannot be solved exactly; but noticing that, to a first approximation, length of chain C B = 50ft., we have $BM'^2 = (c + 10)^2$



$= c^2 + 50^2$ ∴ $c = 120$, and tension at B = weight of 130ft. of chain = 12 × 130oz. = 100lb. approximately. The value of c correct to two places of decimals is 123·36 when exact value of tension = 12 × 133·36oz. = 100·02lb. If wire be of inappreciable weight, it will hang in two straight lines, one of which is dotted in figure, and we have 2 tension × cos. A C B = weight

$$\therefore \text{Tension} = \tfrac{1}{2} \cdot \frac{CB}{AC} \cdot 100\text{lb.} = \frac{\sqrt{50^2 + 10^2}}{10} \times 50$$
$$= 50\sqrt{26} = 254{\cdot}95\text{lb.}$$

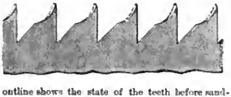
—F. B. B.

[48643.]—**Photography.**—Your formulæ and method of working seem to be about right, though it does not necessarily follow that a plate is sufficiently sensitised when the bath solution flows freely over it. What does the film look like? Has it a bluish-white, skim-milk sort of appearance, or is it a cream colour? If the former, leave it in bath until it acquires more of the latter tint. I should not use quite so much nitric acid in bath, the quantity named being sufficient for a pint of solution. Any retarding effect, however, which the excess may have will be counteracted by warming your developer. The exposures you give would probably be amply sufficient, working out-of-doors, but whether so in the house is doubtful, unless you can place your sitters pretty close up to the window. If, however, attention to the preceding hints does not enable you to produce satisfactory results, you can easily settle the question by exposing a plate or two on some still object, giving longer exposures. Sorry I did not happen to notice yours in time to reply last week.—W. Robinson, Jun.

[48662].—**Painting Iron Tank.**—I have had a large cast-iron tank in use for 30 years; it is painted outside, but has never been painted inside, nor do I ever intend to paint it inside: it only requires to be brushed down when the cistern is being cleaned: it does not rust, and if it did, it would not injure the water.—Another Tank.

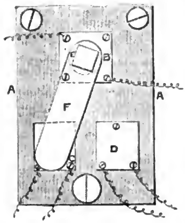
[48671.] —**Micro-Photography.**—I have no doubt "Density" will find the difference between the achromatic and actinic foci vary with the conjugate focal distance; but I know of no rule by which the change can be determined. Experiment alone is reliable in delicate matters of this kind.—O. V.

[48672.]—**Sand-Blast Files.**—In answer to "Nun. Dor.," new sand-blast files are forged, ground, cut, and hardened by the usual methods, and afterwards treated by the sand-blast or "Liquid Grindstone," as the process has been appropriately styled. If an ordinary file be closely examined, the teeth will be found to have very dull and imperfect cutting edges; but by means of this "liquid grindstone," they are made remarkably keen and durable. In this process, very fine sand, in a state of fluid mud, is driven, with great velocity, by jets of steam, against the back of the teeth; the effect being to grind away the burr or curl, produced by the chisel, giving them sharp and well-supported edges, as shown in the following illustration:—The dotted outline shows the state of the teeth before sand-blasting. This burr or curl on the teeth of ordinary files is quickly broken off when used upon wrought-iron and steel, leaving them blunt and ragged, and liable to "pin" and scratch the work; but with sand-blast files, the teeth are much less liable to break, and consequently have no tendency to "pin." To show the improvement upon new files, I would mention a trial made, some time since, at the works of Beyer and Peacock, Manchester. A fitter was given a new file, which had been sand-blasted upon one side only, and instructed to make 50 strokes alternately upon two blocks of gun-metal, which had previously been weighed, using always the same side of the file on the same piece of metal. Upon weighing the blocks, after 500 strokes had been made with each side of the file, it was found that the unsharpened side had cut away 1oz., while the sand-blasted side had cut away 3oz.—E. H.



[48695.]—**Medical.**—As it is doubtless out of the question for "E. R. B." to go to New Zealand to be cured of his chronic rheumatism, I will tell him how I got rid of the horrible torments of that same complaint. It was by striking at the root and cause of the disease—namely, impure blood. I began to live on the simplest possible food, such as is easily digested: oatmeal porridge, brown bread, fruit, and every variety of vegetables well cooked. It took some months to reach the complaint, but the cure is complete and permanent, and the diet more wholesome, more nourishing, more digestible, and therefore, more enjoyable than ordinary food. To attack the symptoms with flannel, warmth, and medicines may alleviate pain a little, but will not cure you.—Chime.

[48718.]—**Electric Switch.**—"F. W." will find this a very effective and easily-made switch. I have several at work, and I may state we have upwards of 4 miles of electric signals at work in the pit. I have never known them to fail, and only an authorised person can alter them. A is a piece of hard dry wood (beech I have found answer well), 4in. by 4in. by 1½in.; B C D are brass slates screwed on to the wood and wires attached; there is a hole through the top plate and an iron pin goes through and is screwed up, so that it turns very stiff; there is a square hole in the pin E, on which the brass arm F is fastened, so that to turn the current, one must have a key to fit. If "F. W" will publish his address, I will send him one.—Harold Van Burg.



[48722.] —**Engine Query.**—There are two ways in which I can account for your engines sticking at their centres. I should say either that you try to make them do too much work, or that you have too much lead on your valves; in which case, especially if you expand your steam much in the cylinder, there would be a certain amount of back, pressure on the piston. If this resistance is more than can be overcome by other piston, which is then at mid-stroke, the engine will, of course, come to a standstill. It is impossible to say for certain what is wrong with your valves without seeing them, or a diagram taken from the engine; but if the stoppage is caused by excess of lead, this can be remedied by putting the eccentric sheave further on the crank-shaft. An excess of lap may cause the engine to stop, because then there would be an amount of compressed steam below the piston whose pressure might be greater than that above it. The lap can be reduced by taking it off the inside of the slide valve on both sides, if engine stops at both centres. I have frequently seen crane-engines sticking at their centres: it seems to be a peculiarity with them.—H. B. G.

[48727].—**Rancid Butter.**—Don't think it can be done. I asked a lady friend of mine who has considerable experience in that line, if she had any information to impart on the subject—you are welcome to her reply. Butter becomes rancid very easily, and from many different causes—exposure to air, putting it on unclean or tainted dishes, has got a bad taste, and a worse smell. Asked if it was good for anything, and was told that it was once instrumental in helping the escape of an imprisoned "vezeer" from a room on top of a tower by putting some of it on the head of a beetle and tying a silk thread to his leg, and sending him up wall to window, when there quickly followed a stronger thread—a string—and then a stout rope;—was it good for anything else, yes, she admitted that is was sometimes sold by the unfortunate owners, to grease cart-wheels with. You might try the following. Wash thoroughly in warm water, and then put it into new sour milk, and give it a thorough kneading and washing. If that does not sweeten it, I don't think anything else will.—Scotus.

[48728.] — **Hot Air.** — For drying purposes I should recommend a large quantity of air at a low temperature, in preference to the plan you are now trying.—H. B. G.

[48732.]—**Indicator Diagrams.**—These diagrams show an excessive waste of steam and loss of power, owing to faulty arrangement of the valves; they being altogether late, which is the cause of so much back-pressure on the piston. Put your valve forward, so as to steam at proper time, and you will find your engine working much better, owing to your steam being cut off before end of stroke, and your exhaust opening and closing sooner.—D. Woodhead.

[48732.]—**Indicator Diagram.**—In both diagrams your exhaust closes far too soon—in fact at about ¼ stroke—while it opens too late, especially in the right-hand one. In this diagram too, the cut off is later than in the other. With these exceptions the diagrams are fairly good. You do not seem, however, to exhaust freely, as with steam of only 45lb. pressure, there ought almost to be a vacuum beneath the piston.—H. B. G.

[48733.]—**Brittle Brass Wire.**—I once bought some thick brass wire, No. 2, from an ironmonger, in whose shop it had been hanging in a coil for years just over a gas-burner; it had become of a dark colour externally, and on hammering broke into pieces. I suppose it had absorbed sulphur from the impure burning gas, which had caused it to become brittle, sulphur having that effect upon metals. I cannot suggest any remedy, but should suppose the wire to be useless.—W.

[48735 and 48739.]—**Patents and Patent Law.**—"Quæsitor" asks whether valid patents can be taken out by minors. There seems no reason whatever why they should not be so obtained, but subsequently the question might arise whether the minors could dispose of the patent rights without the intervention of the guardian or guardians. "Yesallaw" asks a knotty question indeed. If as patentee wishes to file a disclaimer, which he may do any time within the duration of the patent, this is advertised in the journal of the Commissioners, in the *London Gazette*, and in such other paper or papers as the law officer may direct or approve of. The object of the advertisement is to give those who are interested in the matter notice, so that they may take steps to prevent leave for filing the disclaimer being granted. If no one objects, the law officer would generally assume that no one will be injured by the disclaimer. That no claims are given in the specification would not in itself invalidate the patent, though it would render the position of the patentee, should he sue an infringer, very difficult, as he would lie under the imputation of having been grasping, and desirous of unfairly limiting the use of known parts of his apparatus or process. But now comes the most difficult part of the question. Does the subsequent insertion of a claim by a disclaimer and memorandum of alteration remedy this defect? Well, this depends so much on particular features of the case that none but the best counsel would say (having the full facts before him) what decision the Courts would be likely to come to, and even the best counsel would probably not undertake to speak too positively. What has been done before the disclaimer was filed would scarcely affect the patent, unless *mala fides* on the part of the patentee could be proved; but it might be possible to show (but this is very doubtful) that the claim had a tendency to widen the rights under the patent, and this, which, if proven, would have been a good objection at the time the disclaimer was proposed, would perhaps be of some use in upsetting the patent. I may mention that all suits about patent rights are very expensive, tedious and uncertain, and none but those who have a very great interest at stake, and ample funds wherewithal to fight, ought to engage in them.—Polyglot.

[48741.]—**Lever.**—In the lever given fixed at one end, and with a weight of 140lb. on the other; the pressure at a point one foot from fixed end is 1,400lb.—H. B. G.

[48742.]—**Bricks, Tiles, and Kilns.**—I beg to inform "E. H. E." that Mr. Dobson's book contains particulars as to glazed tiles and kilns, firing, &c.—F. Everitt.

[48746.]—**Corrosive Sublimate.**—Water is the best solvent for this substance.—J. M.

[48746.]—**Corrosive Sublimate.**—Get Waterton's "Travels in Guiana," published in cheap form, at 6d., by Macmillan and Co.; it contains directions to make the solution required, and full particulars of its application to preserve "fish, flesh, and fowl."—Scotus.

[48751.]—**Water-Power.**—It is a good idea to use your steam for driving barn machinery; but unless the latter is very light, I fear you will not have sufficient power for the purpose. The pressure of water at the bottom of a 6ft. fall of 6in. dia. would be 108lb., and since the velocity which a body attains in falling through 6ft. is about 8ft. per sec., the power exerted by the water at bottom of fall will be, theoretically, 864ft.-lb. per sec. Practically speaking, you will not get much more than 500ft.-lb. per sec. The turbine wheel is the best where there is plenty of water; but in this case you will have to employ an ordinary water-wheel of the breast kind, since there is not enough water for the undershot, and not a high enough fall to work the overshot advantageously. This form requires a fall equal to its diameter, but a breast-wheel only wants one equal to its radius. Of course, when you have decided the diameter of wheel you will have, you must subtract the radius from the 6ft. fall to obtain the new power exerted, by which you can also find the speed you will get.—H. B. G.

[48756.] — **Screw Propellers.** — From your question I do not understand whether you wish to know how to ascertain the pitch and angle of blade of a screw propeller already made, or for one you wish to design. In the first case, to find pitch and angle of blade of an existing propeller, the best way is lay it upon its boss on a flat surface, say the ground, then measure the height of boss, provided the blades commence and end at each side of boss; after this measure the length of blade which is on the boss, and with these two measurements drawn to any scale form a triangle by joining their extremities by a line at right angles to that showing height of boss. Then in this triangle the hypothenuse will show the length of blade at the boss in one revolution. The side representing height of boss gives the pitch, and the other side is circumference of boss. As all these are to the same scale it is easy enough, knowing one, to find the others. The angle contained by hypothenuse and side showing circumference of boss, is the angle the blade forms with the centre line of screw-shaft. In the second case, if the pitch and angle of blade are required for a propeller to be designed, the speed of engines and of ship must be determined first, and dividing the former into the latter, both in same units of speed, gives the pitch required less 15 per cent. for slip; and having got the pitch, form a triangle of pitch, circumference of boss, and length of screw in one revolution, and the same angle as above is the angle of blade with the centre line of shaft.—H. B. G.

[48756.]—**Screw-Propellers.**—Under this heading I notice, in the last number of the ENGLISH MECHANIC, a copy, word for word, of an article taken from p. 47, of "Rough Sketching for Marine Engineers," written by myself. The barefaced plagiarist who dubs himself "Hartlepool," might at least have the decency, when he copies wholesale from books, to acknowledge from whence it came, and not endeavour to pass it off as his own.—JAMES DONALDSON, Consulting Engineer, 26, Drury-lane, Liverpool.

[48759.]—**G. W. Goods Engines.**—The majority of the engines, cabs, 5ft. driving wheels, and are painted very dark green, with stripes of black edged with white, and framing reddish brown, with narrow stripes of red. Some are built by the company at Swindon and Wolverhampton, and others have been built by Fairbairn, Stephenson, and Beyer, Peacock, and Co. No. 37, &c., are stationed at Wolverhampton; 80, &c., at Pontypool; 421, &c., Warwick; 407, &c., at Hereford; 603, &c., at Oxford; 1194, &c., at Reading. No. 59, &c., have brass domes and weather-boards with sides; 444, &c., green domes and cabs; 1057, &c., brass domes and cabs; 407, &c., domes and weather-boards without sides; 245, &c., green domes and cabs of the G. N. R. style; 316, &c., have raised fireboxes, no cabs, and steam levers and safety-valves the same as those of "Sultan," "Lord of the Isles," &c., on the broad gauge. No. 316 is now at Wolverhampton undergoing repairs. No. 55, "Queen," a narrow gauge, 7ft. single wheel, inside cylinder express engine, has lately had its driving splashers blocked, and the company's crest placed on each. It is stationed at Paddington, and runs (together with 1000, 1117-1131, 157-166, &c.) between Paddington and Wolverhampton, and is one of the handsomest of the company's engines, looking, to my eyes, quite one-fifth as handsome as a L. & N. W. R. "Large Bloomer." "Tay," "Ethon," and "Xerxes" are, or were until lately, some of the broad-gauge goods engines which have 5ft. driving wheels, and 16in. by 24in. cylinders. I will send a sketch of a narrow-gauge goods engine next week, or the week after.—PROMETHEUS.

[48764.]—**Engine Query.**—The size required for a cylinder to develop ¼-h.p. depends entirely upon the pressure of steam and number of revolutions desired per minute, and in the calculation by which I have obtained my answer, I have assumed mean steam pressure to be 10lb. above atmosphere, and the speed to be 150 revolutions per minute. Under these conditions ¼-h.p. can be indicated with a cylinder of 2in. bore and 2in. stroke, but I think with no smaller size. The flywheel necessary for this engine will be about 9in. dia., and with a sectional area of rim of 3 sq. in., and weight of rim will be about 21¾lb.; in fact the whole weight of flywheel may be taken as approximately 25lb.—H. B. G.

[48765.]—**Algebraic Question.**—The reason why "T. W." and "J. L." could not arrive at the proper solution to the question from Chambers's "Standard Algebra," is from the fact—in my opinion—that the question contains some misprints. It stands thus:—

$$\frac{3^4+4^3}{2^5\times 9^2}+\frac{5^4-15^3}{12^3+16^4}-\frac{3^5+5^2-11^2}{3-4^3\times 3^2}=2.$$

But suppose we write it as follows:—

$$\frac{3^4+4^3}{2^5+9^2}+\frac{5^4-15^2}{12^2+16^2}-\frac{3^5+5^2-11^2}{3+(4^2\times 3^2)}=2$$

then

$$\frac{81+64}{32+81}+\frac{625-225}{144+256}-\frac{243+25-121}{3+(16\times 9)}=2$$

$$2 + 1 - 1 = 2.$$

During the course of my mathematical reading I have found so many misprints, that, when in difficulty to bring out a proper result, I immediately look for "errors" in the question. I could show an edition of a book, once used as a class-book, that is full of errors. I have another book, published by an eminent firm, that has an error upon about every third page. Again, I feel a pleasure in stating that Todhunter's works, published by Macmillan, is free from these troublesome defects. I have read most of these works, and never remember finding but one error, and that was in the differential calculus, where "sin." appeared for "cos." or the reverse. If the questioner would like to know how I found out the misprint in his question, I may say that finding that the middle term equalled 1, and that the first term was positive and the last negative, I assumed that the positive term must be 2 and the negative term 1 to make the answer correct. Then, searching for the errors I soon found them out. In the third term please to observe that the brackets are necessary in the divisor, for the statement $3 + 4^2 \times 3^2$ is ambiguous, for it may be either $(3 + 4^2) \times 3^2$, or, as used, $3 + (4^2 \times 3^2)$, which are very different to each other.—EPURA.

[48775.]—**Recovery of Silver.**—The silver might be recovered by boiling the cinders in nitric acid diluted with water; but this would not be a very nice job, and as possibly some of the silver may still be in the form of chloride, about the best plan I should, under the circumstances, adopt, would be to pound up the cinders to a fine powder, then add a little of a mixture of carb. of potash and soda, and fuse portions at the time in a crucible, as you were doing, only don't be a "clumsy manipulator" again.—EXPERIMENTER.

[48775.]—**Recovery of Silver.**—"A Clumsy Manipulator" had better treat his cinders with nitric acid, diluted with about twice its weight of water, employing, if necessary, a little heat, which will dissolve the silver. This solution, which contains the silver in the form of nitrate, should be separated from the cinders, and as much common salt added to it as will be sufficient to throw down the whole of the silver as chloride. "A Clumsy Manipulator" can then proceed to reduce this, as in the case of his "residues"—barring, of course, the breaking of the crucible, which is not at all essential to success.—E. G. T., Plymouth.

[48775.] — **Recovery of Silver.** — The best method to recover the silver from the cinders would be to pulverise the ashes and coal in a mortar, transfer to any suitable vessel, add water to form a paste, and then allow a stream of water from a tap to enter the vessel with sufficient force to keep the light powdered ash in suspension and to be carried off with the overflow. This will leave you a residue sufficiently concentrated to be reduced in a crucible by the ordinary methods—carbonate of soda, with a little borax and nitre, would be the best flux.—M. M. S.

[48775.]—**Recovery of Silver.**—"A Clumsy Manipulator" does not say in what state the silver existed—whether as metal or the white chloride. Better crush the cinders to powder, and treat with nitric acid. This will dissolve out the metal. Wash well, and then treat with strong ammonia, which will dissolve out all the silver salts that are not reduced, and which will be precipitated by addition of nitric acid. By these two methods you will get all the silver originally present.—J. M.

[48776.]—**Caustic and Carb. of Soda.**—Why not test for total alkali, then precipitate the carbonate with CaCl, and test filtrate for caustic? I have not tried the alcohol method, so cannot say anything about it from experience. N.B.—I prefer the use of CaCl in place of BaCl, as it works better.—EXPERIMENTER.

[48780.]—**Crank-shaft.**—I cannot account for the bearing heating under the circumstances given in any other way than the following. After two years' use the bottom brass of the bearing next the flywheel must have worn a good deal, and possibly to keep the shaft from shaking in its place, you have tightened the cap, and thus brought the top brass down hard on the shaft, which occasions the heating. You either want a new bottom brass, or to pack it up a bit.—H. B. G.

[48781.]—**Pumps.**—The most probable reason of your pump making such a thumping noise and shaking the suction pipe so every time the suction valve closes, is because the valve has too much lift, and draws more water than can be well discharged through delivery pipes and valves. A lift of even ⅜in or ¼in. would cause these annoyances, which will be stopped, I think, by decreasing the lift of suction valves.—H. B. G.

[48782.]—**Watch-Repairing.**—Had the same accident happen with me too. The hair-spring is fastened to collet on balance-staff with a very small pin. Use an eye-glass and you see it. Take a fine drill or sewing-needle and insert point in smallest end of hole and shove out pin, and end of spring will fall out too. If too much is not broken off spring, take end of inner coil and bend about an ⅛ of an inch inwards, and at right angles to coils; insert this in widest end of hole, and put in pin and you will have it fastened on again. It is rather a delicate job, and I doubt if you will manage it. As to regulator falling off, jewel cover is usually fastened down with screws, and keeps the regulator down. See if jewel cover is not loose.—SCOTUS.

[48788.]—**Pianoforte Bridges.**—The shape of piano-bridges is rather an effect than a cause, and entirely depends upon the different lengths of the strings. In old-fashioned semi-cottage pianos the longest steel strings were already too short, and to have curved the lower bass bridge would not have left sufficient vibrating length for the covered strings, so there was nothing for it but to continue in a straight line to the end. The reason that bridges take the form of curves is because the strings are necessarily so close together. If "Apollo" will mark two lines, one double the length of the other, at 6in. apart, and rule ten lines of evenly-graduated lengths between them, he will find the ends describe a curve more or less sharp, according to the length of the lines chosen. The hollow curve of the bass bridge is not theoretically correct, but is unavoidable with the limited space at command. In olden times, a piano was too mysterious an article to be closely criticised, and people were more easily satisfied; at present, it is only in pianos of the cheapest description that straight bridges, with their consequent wretched basses, would be tolerated.—W. H. DAVIES.

[48789.]—**Scented Soap.**—Try nitro-benzole.—EXPERIMENTER.

[48801.]—**Projectiles.**—
Equation to 1st projectile—

$$y = x\,\text{tan.}\,a - \frac{gx^2}{2v^2\,\text{cos.}^2\,a} \quad (1)$$

Equation of 2nd projectile—

$$y = x\,\text{tan.}\,a_1 - \frac{gx^2}{2v_1^2\,\text{cos.}^2\,a_1} \quad (2)$$

Solving for x in (1) and (2) we have the horizontal distance from the origin of the common point of the trajectories—

$$x\left\{\frac{g}{2v^2\,\text{cos.}^2\,a}-\frac{g}{2v_1^2\,\text{cos.}^2\,a}\right\} = \text{tan.}\,a - \text{tan.}\,a_1.$$

Let t and t_1 be the times of flight from the origin to the common point. Horizontal velocity of 1st projectile $= v\,\text{cos.}\,a$, ∴ horizontal distance traversed in time $t = vt\,\text{cos.}\,a = x$. Similarly, horizontal distance traversed in time t by 2nd projectile $= v_1t_1\,\text{cos.}\,a_1 = x$.

$$\therefore\ t - t_1 = x\left\{\frac{1}{v\,\text{cos.}\,a}-\frac{1}{v_1\,\text{cos.}\,a_1}\right\}$$

$$\text{But } x = \frac{2v^2v_1^2\,\text{cos.}^2a\,\text{cos.}^2a_1\,(\text{tan.}\,a - \text{tan.}\,a_1)}{g(v_1^2\,\text{cos.}^2a_1 - v^2\,\text{cos.}^2a)}$$

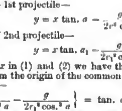
$$\therefore\ t - t_1 = \frac{v_1\,\text{cos.}a_1 - v\,\text{cos.}a}{v\,\text{cos.}av_1\,\text{cos.}a_1} \times \frac{2v^2v_1^2\,\text{cos.}^2a\,\text{cos}^2a_1\left(\frac{\text{sin.}\,a}{\text{cos.}\,a}-\frac{\text{sin.}\,a_1}{\text{cos.}\,a_1}\right)}{g(v_1^2\,\text{cos.}^2a_1 - v^2\,\text{cos.}^2a}$$

By reduction, we have—

$$t - t_1 = \frac{2vv_1\,\text{sin.}\,(a - a_1)}{g(v\,\text{cos.}a + v_1\,\text{cos.}\,a_1)}$$

—W. J. EVERETT.

[48801.]—**Projectiles.**—Let A be the point of projection; Ay, Ax, rectangular axes in plane of path of projectile. Then, co-ordinates of any part



P are A N = x, N P = y. Now, for first projectile horizontal velocity = v cos. a, and initial vertical velocity = v sin. a.

Then, x = A N = $v\,\text{cos.}\,a,\ t$ .... (1)
Also, y = N P = $v\,\text{sin.}\,a,\ t - \frac{1}{2}gt^2$ .... (2)

∴ Eliminating t between (1) and (2) we get

$$y = x\,\text{tan.}\,a = \frac{gx^2}{2v^2\,\text{cos.}\,2a}$$

as equation of first parabola. Similarly, equation of path of second projectile is $y = x\,\text{tan.}\,a_1 - \frac{gx^2}{2v_1^2\,\text{cos.}^2\,a_1}$. The abscissas of the points of contact of these parabolas are
$x = o$, and $x =$

$$\frac{2\,(\text{tan.}\,a - \text{tan.}\,a_1)}{g\,(v_1^2\,\text{cos.}^2\,a_1 - v^2\,\text{cos.}^2\,a}\ v^2\,v_1^2\,\text{cos.}^2\,a\,\text{cos.}^2\,a_1$$

Therefore, if t_1 and t_2 denote the times at which each projectile reached the second point of intersection, since $t = \frac{x}{v\,\text{cos.}\,a}$, $t_1 - t^2$

$$= \frac{2\,(\text{tan.}\,a - \text{tan.}\,a_1)}{g\,(v_1^2\,\text{cos.}^2\,a_1 - v^2\,\text{cos.}^2\,a)}v^2\,v_1^2\,\text{cos.}^2\,a\,\text{cos.}^2\,a_1$$

$$\left\{\frac{1}{v\,\text{cos.}\,a}-\frac{1}{v_1\,\text{cos.}\,a_1}\right\} = \frac{2v\,v_1\,\text{sin.}\,(a - a_1)}{g\,(v\,\text{cos.}\,a + v_1\,\text{cos.}\,a_1)}.$$

—MIDE.

[48801.]—**Projectiles.**—Let x be time required for the first projectile, and y the time required by the second, to reach the common point; then in x secs. the first will have reached the height $v\,x\,\text{sin.}\,a - \frac{1}{2}\,g\,x^2$, and the second, in y secs., will reach the height $v\,y\,\text{sin.}\,a - \frac{1}{2}\,g\,y^2$; and since they thus both attain the same point, $v\, y \sin. \alpha - \frac{1}{2}\, g\, y^2 = v\, x \sin. \alpha - \frac{1}{2}\, g\, x^2$. In the same way, $v\, x \cos. \alpha = v\, y \cos. \alpha$. Thus we have two equations, from which we can find the values of x and y, and hence the value of $x - y$, which will be found to be the required expression.—Tam O'Shanter.

[48801.]—**Projectiles.**—Let x, y be the horizontal and vertical spaces described by either body in reaching the common point in their paths. Let $t\ t_1$ be the times taken to reach this point. The horizontal velocities are $v \cos. \alpha$, $v_1 \cos. \alpha_1$, and are const. The vertical velocities are $v \sin. \alpha$, $v_1 \sin. \alpha_1$, initially.

$$\therefore\ v \cos. \alpha\, t = x = v_1 \cos. \alpha_1\, t_1 \ \ldots\ldots\ldots\ldots\ (1)$$

$$v \sin. \alpha\, t - \tfrac{1}{2}\, g\, t^2 = y = v_1 \sin. \alpha_1\, t_1 - \tfrac{1}{2}\, g\, t_1^2 \ \ (2)$$

Let $t_1 = t + X$, so that X is the required interval; then—

$$(v \cos. \alpha - v_1 \cos. \alpha_1)t = v_1 \cos. \alpha_1\, X \ \ldots\ \text{from (1)}$$

$$(v \sin. \alpha - v_1 \sin. \alpha_1)t = v_1 \sin. \alpha_1\, X - g\, X\, t - \tfrac{1}{2}\, g\, X^2 \ \ldots\ \text{from (2)}$$

Eliminate t from these by transposing $g\, X\, t$, and then dividing one equation by the other.

$$\therefore\ \frac{v \cos. \alpha - v_1 \cos. \alpha_1}{v \sin. \alpha - v_1 \sin. \alpha_1 + g\, X} = \frac{v_1 \cos. \alpha_1}{v_1 \sin. \alpha_1 - \frac{1}{2}\, g\, X}$$

whence $X = \dfrac{2\, v\, v_1 \sin. (\alpha_1 - \alpha)}{v \cos. \alpha + v_1 \cos. \alpha_1}$. It is immaterial whether we have $\sin. (\alpha_1 - \alpha)$, or $\sin. (\alpha - \alpha_1)$, since it only alters the *sign* of X.—F. R. B.

[48803.]—**Locks.**—In reply to the first part of this query, I think "B." will find that about two-thirds of the desks fitted with hook-locks may be opened and shut without the key by merely pressing the side of the lid so as to disengage the hooks from the slots in which they catch: of course, this strains the hinges. This defect I have effectually cured in the case of my own desk by driving a stout pin (a wire nail with the head off does capitally) into the top of the front of desk, and making a hole in the lid to correspond with it.—E. G. T., Plymouth.

[48807.]—**Influence of Climate on Neuralgia.**—It is a well-known adage that "extremes meet." This is an illustration of this rule, for the effect of heat and cold upon this complaint are very similar. I have tried hot countries, and find that very severe neuralgia is the immediate results of exposure; but in some cases the ailment is more amenable to treatment than when it is caused by exposure to cold. If "Gamma" goes to a hot country, he will have to carry some quinine about with him, with the same persistency that he has hitherto carried an umbrella in England; he must never go out without it. I have found it necessary to take it each day before going out. Some missionaries who have lived in Africa have told me that healthy subjects in that part have to do the same. If "Gamma" goes to a hot country, let him select, above all, a dry one, and he may derive some benefit.—H. Barnaby.

[48810.]—**Force of Blow.**—The moments of the two forces must be same, and therefore 30cwt. × 7in. = 15 cwt. by its distance, which is 14in.—H. B. G.

[48819.]—**Casting Blowpipe Solder.**—Make a ladle out of a piece of sheet iron 3 or 4in. diameter, and instead of a spout to pour from, make a hole at about one-eighth of an inch diameter at about half an inch from the edge you would pour from. Put a flat piece of sheet-iron two or three feet long upon a table, take melted solder in the ladle, and inclining it allow the solder to flow through the hole on to the sheet-iron. If the ladle be held in one place the result is, of course, a round pool of solder, but if it be steadily carried along while the solder is flowing from the hole, the thin "sticks" are formed that "Northener" requires, the thickness of which depends upon the size of the hole and the velocity with which the ladle is moved. If new lead and pure tin in equal weights are combined they will form a bright solder, but if either constituent is increased materially, the surface assumes a dead appearance on cooling. I know of no addition that would make it brighter. Tin 8, lead 8, bismuth 1, make a very fusible solder, but rather dull on the surface.—Gas-Manager.

[48819.]—**Casting Blowpipe Solder.**—This is cast in marble moulds. Your moulds probably get warm, and, in consequence, the fused metal becomes oxidised while cooling. Try rubbing the surface of the liquid metal in the mould with a piece of dry, soft wood, just before setting. This reduces any oxide that might be formed, and also clears off any impurities the metal may contain, which crystallise out before the solder sets.—**M. M. S.**

[48819.]—**Casting Solder.**—The mould used for casting narrow thin sticks of solder is made by bending sheet-iron into V-shaped grooves and closing up the ends. If the metal is good and not overheated, it will always come out bright.—Thomas Fletcher, Museum-street, Warrington.

[48820.]—**Smell from Gas-Stoves.**—This is caused partly by bad construction of the burner as regards form, and partly by the gas-jet being too large. It may be remedied, to some extent, by hammering up the tip of the gas-jet so as to reduce the gas supply, which at present is too large.—Thomas Fletcher, Museum-street, Warrington.

[48821.]—**Citric Acid.**—This preparation, though easy to an experienced chemist, is often spoiled by an inexperienced operator. A calico filter should be used instead of filter-paper. The following is the best method of making it:—Take of lemon-juice 4 pints; beer yeast, 2 fluid oz.; prepared chalk, 4½oz.; sulphuric acid, 2 fluid oz. and three dr.; distilled water a sufficiency; mix the lemon-juice with the yeast, and let it stand for two days at a temperature between 60° and 70°. When fermentation has ceased, separate the clean liquid from the lees, boil it, and while hot add the chalk by degrees till there is no more effervescence. Collect the deposit on a calico filter, and wash it with hot-water till the filtered liquor passes from it colourless. Mix the deposit with 2 pints of distilled water, and gradually add the sulphuric acid previously diluted with a pint and a half of water, applying for half an hour sufficient heat to produce ebullition and constantly stirring. Separate the acid solution by filtration, wash the insoluble matter with cold distilled water, and add the washings to the solution. Concentrate to the density of 1·21, cool, and after 24 hours decant the liquor from the crystals of sulphate of lime which have formed; concentrate further till a film forms on its surface, and set it aside to cool and crystallise. Purify the crystals if necessary by a second crystallisation.—Frank Month.

[48821.]—**Filtering Solution of Citric Acid.**—Try asbestos, sand, or broken glass.—M. M. S.

[48821.]—**Filtering Solution of Citric Acid.**—Put a little asbestos at the bottom of the funnel, and then filter through it, instead of the paper.—Experimenter.

[48824.]—**Astronomical—The Tides.**—When the sun and moon are in opposition we have the moon drawing the water towards her, and the sun pulling the earth away (as it were) from the water on the opposite side of the globe, and we therefore get a very high tide. On the other hand, when sun and moon are in conjunction, we have again the moon drawing the water towards her, but at the same time the sun is also pulling the earth up to the water, to use an unscientific explanation. At conjunction, or new moon, we have, therefore, a high tide; but not so high as at opposition, or full moon. If "Respice Finem" has followed me so far, he will readily perceive that it is at quadrature, or at first and third quarters, when the sun and moon are pulling against each other, that we have the smallest tides, which are equal to the difference between the two forces.—A Young Astronomer.

[48825.]—**Riveting Pottery and Glass.**—The best kind of drills for drilling china, &c., are those which are used by china riveters; they use carbon set in iron wire, but to set them properly requires some practice, as they frequently set drills to make holes 32nd part of an inch. Half-round brass wire, or German silver can be purchased at several shops in London. If "Broken Pots" will let me know his name and address, I will send him full particulars.—Antique China.

[48827.]—**Steam Boiler.**—This is a case in which an inspection of the boiler and engine would soonest point out the defect. Here are a few 'trifles' that would operate disadvantageously; flues want cleaning out; air leaking into flues, through crevices in the brickwork; boiler wants cleaning out inside; bad coal; careless firing; feeding boiler with cold water; engine in bad condition, piston or valve leaky; &c., &c. Add to these that the boiler is very small for the work to be done, and is much less than I should recommend for your size of engine. There is nothing like having a little boiler power to spare—you gain in more ways than one. If your engineman is not competent enough to point out the cause of the boiler not making enough steam, you ought to have it and the machinery examined by an engineer. Any advice I can give, I will, with pleasure.—Labor Omnia Vincit.

[48831.]—**Electro-Magnet.**—You should use bobbins for winding your wire on. The wire should be wound on the opposite poles in such a way that if the bar was straight the helices are in same direction. 28 silk-covered wire is about a suitable gauge.—X.

[48834.]—**Natural Waters.**—In many cases you can only surmise the condition of the bases found. Having estimated the quantity of Ca, Mg, and Cu, together with the CO_2 and SO_3, you calculate from the amount of SO_3 found how much of the Cu and Mg are sulphates. You can have no free SO_3 in a solution containing carbonates; therefore, calculate out your SO_3 to the most probable bases, and class the remainder as carbonates according to your analysis.—M. M. S.

[48834.]—**Natural Waters.**—If "W. G." would consult either Fresenius' "Analysis" or Sutton's "Volumetric Analysis," he would get all that he requires.—Experimenter.

[48835.]—**Fusible Plugs.**—There is no better safeguard than these plugs under certain conditions of use; one of which is, that the plug should be kept perfectly free from scale, as I have known many instances where the water-level has been below the plug, and the latter has been so furred over that the composition either had melted, and the cone held in its place by the corrosion and deposit, or had partly melted and become filled with deposit underneath, preventing further melting. Another condition for their safe use is, that they be high enough above the tube, say, 3½in., for it is not necessary for the tube to be quite dry to produce an explosion, which may occur, and no doubt often does, from the fact of the water assuming the "spheroidal condition," there not having been sufficient volume above the flues to prevent overheating, and when the temperature of the iron becomes slightly reduced, the water touches the hot plates and generates enough steam to explode the boiler. The best form of plug is that consisting of a hollow brass plug, about 3½in. long, screwed at one end to enter the hole in the tube, and having a solid plug about ¼in. smaller than the central hole, and filled round with a composition of tin, lead, and bismuth. The boiler insurance companies pretend to be very strict over this matter; but I know, personally, several instances of long standing, where the inspectors have been aware of the absence of fusible plugs, but never thought it worth mention in their official report.—Fred. Walker.

[48835.]—**Fusible Plugs.**—Considering that a fusible plug inserted in the crown of a boiler-furnace and properly looked after, is certain to reduce the risk of a boiler explosion arising from shortness of water, then there can be no question as to its value. I am fortunate in being able to say that I have, so far, not had one actually in use through the above cause. I have them in all the boilers under my care, and each time a boiler is cleaned out the top of the "cone" is scraped clean, and every six months I take out the "cones" and put in new ones. As these only cost 10s. per doz., the expense per annum is not very heavy. As to which are the best fusible plugs, I would rather not express any opinion, but I am satisfied with those I am using. I believe that most Boiler Insurance Co.'s insist on having plugs in the boilers insured with them.—Labor Omnia Vincit.

[48837.]—**Weight of Waggon Tires.**—You will find the following method of obtaining weight of railway waggon tires simple. To the inside diameter, which you know, add the thickness of the tire and also ½ of the depth of the flange. Multiply the sum of these by 3·1416, which will give you the length of angle iron required for the tire. Multiply this, in inches, by the area of section of tire, which you say you can find, in square inches, which will give you the number of cubic inches in the tire; and since the cubic inch of steel weighs ·283lb., you must multiply the last product by ·283 to get number of lb. weight of steel in one tire.—H. B. G.

[48839.]—**Bacillus Tuberculosis.**—"E. W." will find Dr. Gibbes' method of staining bacillus tuberculosis, which is described *in extenso* in the *Lancet* of August 5, 1882, by far the best and easiest. If this is inaccessible to him, and the matter should be interesting to other subscribers, I will give full details. The bacilli may be seen, if abundant, with a good ¼in., or even less; but much higher powers are necessary to examine details of structure.—G. C. K.

[48842.]—**Warm Bathing.**—Unless indulged in to excess, it is neither relaxing nor enervating; but it is absolutely essential that it should be followed either by going to bed or by a suitable cooling process. This process may be a short, cold shower-bath, or a quick cold douche, which is exceedingly grateful to the bather. The more thoroughly warm the bath, and the more quickly the cold douche is applied, the greater is the benefit derived. With respect to cold bathing (and "Lumbago's" bath is to him virtually a cold one), the great point is to get a good reaction afterwards, and a healthy glow over the whole body. If so, the bath is doing its proper work, for the capacity for inducing a reaction after a bath is the "fulcrum of all water-cure."—R. F. Prettejohn.

[48846.]—**Transparencies.**—Perhaps the solutions were not kept long enough to allow the chemicals to dissolve. The bottles should be shaken occasionally, so that the solutions may become saturated. The trouble and difficulty in weighing bulky chemicals in a small pair of scales, such as we amateurs use, is so great that I adopted the rough method referred to. A drop or two of sulphuric acid will clear the sulph. of iron solution. The oxalate should be dissolved in hot water and allowed to cool before use. The plate should be well washed before being further treated with alum, and again before being placed in the hypo. dish, and plenty of washing after that.—M. I. C. E.

[48847.]—**Noisy Exhaust Steam.**—Your easiest plan to prevent noisy exhaust steam is to use an exhaust chamber (say, an iron barrel) between the engine and stack.—X.

[48847.]—**Noisy Exhaust Steam.**—You cannot remove the noise caused by your exhaust steam, save by condensing part of it and allowing the remainder to blow up the chimney; and I think you will find that sufficient draught may be maintained by much less than the whole of the exhaust steam. —H. B. G.

[48847.] — **Noisy Exhaust Steam.** — Mr. Justice has, I believe, effectually silenced the exhaust by taking it through a chamber containing a number of balls—large glass marbles, for instance. The plan has been tried on some of the torpedo-boats, and has, no doubt, been described in some back number.—Nun. Dor.

[48849.]—**Rack and Pinion.**—To do this accurately you must get the diameter of your pinion at the pitch line—i.e., at half the depth of the teeth, and obtain the circumference of pitch circle by multiplying this diameter by 3·1416. Divide the product by the number of teeth—in this case 20, and this will give you the distance between the centre of the teeth in your rack, by which you can space them off properly.—H. B. G.

[48850.]—**Blower for Brick Chimney.**—You will, I feel sure, find a pipe with a contracted nozzle more serviceable than a circular perforated one for producing the blast in the chimney of any boiler. The practice of making locomotive chimneys cone-shaped was started in America, but is not carried on in this country; nor do I see any practical use in it, unless to allow free escape for the steam which has produced the blast. When they are made cone-shaped the larger end is at the top. If your brick chimney is to be more than about 40 yards high, you had better enlarge the area above that height to permit the rarefied atmosphere to get away easily.—H. B. G.

[48851.]—**Painting Bath.**—If you can lay your hand on the No. of the "E. M." for April 20, 1877, you will see an answer to 28985, by "Slim Jim X.2.B." which I think, will suit you exactly. —T. E. H.

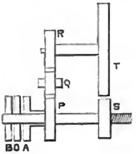
[48851.]—**Painting Bath.**—First scrape the bath well to remove all loose paint, and rub it down with pumice-stone and water; when dry, give it a coat of paint made of genuine white-lead, mixed with equal proportions of linseed-oil and turpentine and a little driers. The colour can be tinted with any colour you desire. Let it stand a day or so; then rub it with fine sandpaper, dust, and coat again: when this has got hard, sandpaper as before; add a tablespoonful of good varnish to the paint, and give it the finishing coat. The paint should be strained through a piece of muslin before using.—Wm. Stanger.

[48855.]—**Brick Moulds.**—Corrosive sublimate. Make a strong solution, and let it soak in. Be careful with it, as it is a powerful poison. I should have thought if there were any risk of damage from worms or maggots, that the wood would be properly pickled before being worked up.—Nun. Dor.

[48857.]—**Painting.**—There is enough in the back volumes of the English Mechanic to start anyone at painting; but "Devoniensis" will find Mr. E. A. Davidson's book, published by Lockwood and Co., useful. I think the title is "House-Painting."—Nun. Dor.

[48857.]—**Painting.**—New woodwork should be well dusted and cleaned; then coat all knots with patent knotting: any very large knots give two coats for priming. Mix your white-lead with all linseed oil, and add a little driers. It is always best to use some red-lead in the priming, as it hardens it. Before applying the next coat sandpaper the work well, and putty all holes, cracks, &c. The next coat may be made the colour you desire the work finished. Use very little turps if for outside work; about one part turps to three of oil is quite sufficient. For inside work you may use a little more turps. When the second coat has got hard, sandpaper and dust the work, and give another coat of same stuff; always use the paint stiff, and rub it bare on with the brush; the less paint you get on the work the finer you can lay it off. Strain your paint through a piece of muslin before using it, and be particular to keep the sides of your can well cleaned with the brush after using it. I always use linseed oil instead of boiled, as it is less apt to blister, on outside work especially. When painting big work, always cross it well with the pound-brush, and lay it off up and down. One great drawback to amateur painters is that they are not always able to get good stuff, brushes, &c., to work with. Those got from the ordinary oil and colour shops and chemists, in nine cases out of ten, are really not fit to use.—W. Stanger.

[48858.]—**Planing Machine.**—I send sketch of quick return. O is an idle wheel, A B pulleys which move table. When strap is on B, motion of screw slow in one direction, but when it is on A screw revolves rapidly in the other direction. The pulley A is attached to tooth-wheel P, so when A is turned P turns with it. These turn freely upon shaft Q and R, toothed wheels. We suppose P and R same size. The size of Q indifferent. P Q revolve in opposite directions, so do Q R, therefore P R revolve in same directions, and with equal velocity. T is a large toothed wheel on same shaft as R. Suppose T has 60 teeth, T revolves, therefore, in same direction as P. Each perform one revolution in same time. T gears into wheel S, which is on screw which moves table. If S has 20 teeth it will turn round three times for each revolution of T, and, of course, in opposite direction. Hence, S turns round in opposite direction to the motion of P, and revolves three times when P has turned once. This corresponds to the return motion of table; but when the strap is shifted from A to B by the fork the motion is reversed. The shaft on which B is keyed is a continuation of the screw S, and hence the screw revolves in same direction as B, and with same velocity. Thus the table will be brought back three times as fast as it is advanced.—Nomen.



[48858.]—**Planing Machine.**—I believe I am right in saying that no quick return can be given to planing machines in which a long screw is the moving medium, though in this form of machine the motion is smoother and truer than with the rack and pinion. In the latter class, however, there is the great advantage that a quick return can be given, and this is done in the following way:—There are three pulleys close together, of which the middle one is loose, the left-hand one, say, is tight on one shaft, and the other is fixed to a hollow shaft which runs loosely on the solid smaller one. When the strap runs on the middle pulley, no motion at all takes place; but to both the hollow and solid shaft, toothed wheels are fixed of the same size as one another, and when strap runs on the left-hand one, which call E, motion is given to the toothed-wheel on same shaft—viz., B. B gears into a larger one C of, say, three times its diameter, which is on a shaft parallel to the others, and carrying also another toothed-wheel D, of same size as B and A, the toothed-wheel on hollow shaft. A and D are made to gear into the same wheel, and it is now plain that if the strap is on E and sets B off, there will be a slow motion, since the table is moved along by a rack gearing into wheel turned alternately by A and D. Again, if the strap runs on pulley on hollow shaft, A is revolved, and since this wheel gears directly into the pinion moving the rack, the motion must necessarily be quicker, and this is used for the return of the table. If C be three times the size of A and B, then the speed when A's pulley is in action is three times as quick as when the strap runs on E. The strap is shifted alternately from one pulley to the other by means of a fork, which is shifted to and fro by means of pins or tappets on the table. If this explanation is not sufficiently clear, I shall be happy to forward a sketch.—H. B. G.

[48859.] — **Peroxide of Hydrogen.** — If "D. M. S." will communicate with me, I can put him in the way of getting what he wants. See advertisement.—Geo. G. Blackwell.

[48861.]—**L.N.W.R. Locos.**—Back-pressure in two small cylinders which supply large one.—Nomen.

[48866.] — **Astronomical Apparatus.** — If "W. S. W." wishes to confine himself merely to objects of the difficulty of Saturn's rings and Jupiter's Moons, he cannot do better than get one of Lancaster's 2in. achromatic telescopes, with one day and one astronomical eyepiece, on garden-stand, complete for 3 guineas. A vast amount of pleasure and instruction may be got out of a telescope of this aperture; but if he wishes to do some real work, I should advise him to purchase one of the above-named firm's 2¼in., 2½in. or 3in. instruments (£5, £7 10s., and £12 10s. respectively), which are much more firmly mounted, and of the finest possible quality. If, however, his ambition soars higher (and he will say so), I will advise him still further.—A Young Astronomer.

[48868.]—**Battery Power.**—The bichromate is by far the strongest battery, but is not quite so constant as the Smee.—Geo. G. Blackwell.

[48869.]—**Mechanics.**—The second part of this query, regarding the pentagon, presents an impossibility. The tangents of the angles referred to can never be as stated, one double of the other (so long as the sliding-bar is horizontal), unless we raise the point C to some distance above its proper place in the pentagon; but in any case the point C would fall down till it rested on the base, the pentagon assuming a shape like the letter M. It is so unusual to find a mistake in one of Todhunter's books, that if the case is correctly quoted it becomes interesting to detect it.—M.I.C.E.

[48873.]—**Water.**—So long as you can keep the tank full, you ought to obtain 558 gallons of water per hour. I presume you do not wish to know how this is obtained. Suffice it to say that I have worked it out exactly as in the query answered by me some two or three weeks back. The velocity in this case is only 2ft. per second, owing to the head of water above centre of hole being but 2¼in. There is a "vena contracta" to be allowed for, as in a round hole.—H. B. G.

[48874.]—**Steam Power.**—If 40lb. on pressure gauge is the safe working pressure of your boiler, then by all means work at that pressure. Now to show the gain by increasing boiler-pressure and cutting off earlier in cylinder, we will suppose the initial pressure on piston to be 30lb. as now carried in boiler. The mean average pressure, cutting off at ½ stroke, would be, if a condensing engine, 36lb. Now to do the same work with boiler-pressure raised to 40lb., you would have to cut of at ¼ stroke —so that without going into any elaborate calculations, you will see that with 30lb. steam cut-off at ½ stroke, you require to fill 18in. of cylinder capacity with steam, while with 40lb. steam cut-off at ¼ stroke you have to fill 10in. cylinder capacity with steam at each stroke. But first of all be certain that the boiler will stand the increased pressure. If your engine is non-condensing, deduct 16lb. from the above average pressure.—Labor Omnia Vincit.

[48874.]—**Steam Power.**—To Fred. Walker and "L. O. V."—Your question can hardly be answered without a diagram, with piston-speed and diameter of cylinder given. Unless you are working at a high speed, say 600 or 700ft. per minute, I don't consider that you would gain by an earlier cut-off; however, you will lose nothing by leaving the expansion where it is, and getting another 10lb. pressure. If you can furnish me with the aforesaid particulars, stating the scale, I shall be pleased to give you any information that I am able to do; but you can see that boiler pressure and cylinder-pressure are widely different, according to circumstances, and without an indicator diagram one cannot obtain a datum to begin the calculation. —Fred. Walker.

[48876.]—**Vice for Bench.**—A parallel vice is unquestionably the better for all purposes, and of the various patterns in the market the American double-jawed vice is the best of all, allowing the jaws to be rotated and used at any angle, or with the smooth or toothed jaw uppermost, as may be required. By passing the work through both jaws at once, it is held firmly with so slight a pressure as not to crush a piece of brass tube whilst being cut or screwed.—R. T. Lewis.

[48877.]—**Egg-shaped Sewer.**—I do not quite see how the length of the sewer and the gradient affect the question. Suppose the upper mouth of the sewer opens into a large reservoir, and that the level of the water in the reservoir is level with the top of the sewer, it will then be running quite full, and there will be no pressure tending to burst it; but if the water in the reservoir is higher than the mouth of the sewer, there will then be an internal pressure, due to the height of the water above the mouth. This pressure is about 62lb. on every square foot of the sewer multiplied by the number of feet of water above the mouth. This pressure will decrease as we increase our distance from the mouth, and at the lower end, if the water is running free, there will be little or no pressure. The strength of brickwork to resist tension depends on the mortar, which, if good and sufficiently set, will resist a tension of 50lb. on the inch, or over 3 tons on the square foot. As the sides are supported by earth, the bursting would take place by the lifting of the arch; so if we multiply the diameter in feet at the springing by the pressure per square foot caused by the head of water, this will give us the strain per foot lineal which has to be resisted by the brickwork. Suppose we found this strain to be 6 tons, 3 tons would be the strain at each end of the arch; and as the brickwork would bear a strain of 3 tons per square foot, we should have to make the arch 1ft. thick, or, for safety, at least double or treble that amount. In practice cement would be used instead of mortar, as mentioned in the query. —M. I. C. E.

[48879.]—**Sphygmograph.**—Does "E. W." mean, will the sphygmograph enable the amateur to recognise cardiac disease? It certainly will not. Is he well acquainted with the normal pulse-tracing and the meaning of the curves? If not, it will be waste of time and labour to try and make a sphygmograph, although the instrument is reliable enough in practised hands. The best form is that of Marey.—G. C. K.

[48881.]—**Engine Indicator.**—I should think that one of the "Distanceometers" for measuring bicycle journeys, could be adapted with ease, with lock, and clipped upon a counter-shaft, the speed of which could be reduced so that when your engine was running at her proper speed, the indicator would show about five miles for an hour's run. You must have gearing to drive your shaft, or your engineman might increase the speed if it were a belt, by packing the driving pulley.—Fred. Walker.

[48881.]—**Engine Indicator.**—Messrs. W. H. Bailey and Co., who advertise in this paper, are the only people I know of who can supply you with the instrument you require. An engine-counter will not do, as that can be altered; you want a recorder in lock-up case.—Labor Omnia Vincit.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "A. G. P." has replied to 48463.

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48192. Civil Service Exam., 123.
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QUERIES.

[48884.]—**To Dr. Edmunds.**—Exactly twelve months ago a dog bit my boy's hand. A month after he was taken very ill, was quite feverish for about two months, during the greater part of which time he was quite light in his head; he had a peculiar vacant stare, the pupils of his eyes were much dilated. When he came to his senses, everything that had transpired appeared just like a dream to him. Since then he has had two similar attacks, but without any fever, which lasted about six days each. In the two latter attacks the pulse has been quite natural, but the vacant stare was the same, and when he is spoken to he does not appear to hear what is said to him. During the time it lasts he is almost incessantly yawning, has no desire to get out of bed, and if he is induced to get up, he will sit in sullen silence for a time, and then he will commence shouting and singing or whistling as loud as he can; he has no pain. I fancy it may be some nervous disease brought on by the dog-bite. I shall be glad to have your opinion, and how you would advise me to proceed to ward off another attack. His age is 16.—H. Thirkell.

[48885.]—**Watch-Case Repairing.**—I have been trying to repair the joint of a silver watch-case, using silver solder and borax as flux, and as soon as the solder began to flow, it would run all over the knuckle I wished to join, and would not stick to the case. I tried several times without success, although I have done exactly as I have done several times before, when I have succeeded. When I had tried as above stated, the bezel joint became very tight, and with repeated opening broke the joint-pin fast in the holes. How should I proceed to remove them? I shall be very thankful to any kind reader who can help me out of my difficulty.—Broken Case.

[48886.]—**Cant of Rails.**—Why are rails canted at an angle leaning towards the inside of the road from end to end of a railway, and why also are the tires of all railway-wheels turned cone-shape on the tread?—Working Fitter.

[48887.]—**Cracked Condenser.**—A steamer arrives in port with the surface-condenser cracked. What are the reasons to cause such?—Working Fitter.

[48888.]—**Locomotive Bridge.**—What use is the brick arch inside the firebox of locomotive engines?—Working Fitter.

[48889.]—**To Mr. Wetherfield.**—Adjoining property that I possess there is an outbuilding with two windows overlooking my yard. This outbuilding has been built about 19 years; but the present owner has only been in possession about nine or ten years, and up to that time the former owner of the outbuildings always gave a tea-ticket annually in acknowledgement; but the present owner refuses to give an acknowledgment at all. Could I close the windows? I must not forget to state that although a tea-ticket was given, no written acknowledgment was given; but witnesses could prove the fact.—J. B.

[48890.]—**Legal.**—A sum of money was left some years ago to be parted among a family. A. marries twice, and marries two sisters. He has no children by his first wife, but 11 by the second. After, A. dies, and also his last wife, leaving nine in family, and in process of time most of these also die before the money which is in Chancery is forthcoming. Now my question is this: Does the marriage of A. invalidate the children of B., the daughter of A., from participating in the share of money which would fall to her? Perhaps Mr. Wetherfield can reply.—Penmaenmawr.

[48891.]—**Preventing Hoofs and Horns from Warping.**—I shall feel obliged if any reader will tell me how hoofs and horns are prepared to prevent them from warping after being turned into buttons, and in what way the hoofs are cut open and flattened out? I turned a small button in the lathe out of a piece of hoof, and in two or three days after it got quite crooked. I think the button-makers must have a way of preparing the horn, and shall be obliged for any information.—W. J. B.

[48892.]—**Oberving Seat and Lamp.**—Will you allow me to thank Mr. E. S. Beavan for his obliging notice in letter 20780 of my inquiry about an observing-chair? I think his idea is good, but do not quite understand the phrase, "In the straight part at the top, small round pegs are let in for the seat to rest on." Which is the "straight part at the top"? I have arranged my lamps, &c., upon a board just big enough to carry the lamp at one end, and box of eyepieces at the other, with space between for map and list. I have inclosed lamp in an old cigar-box, the lid made to slide up and down, so as to regulate degree of light, or shut it out altogether. Air is admitted by a slit at bottom, and hot air goes out by hole at top. I have used this for a year or two, and find it very convenient. The lamp-box is screwed to board by one screw, so as to allow of the lamp being turned to give light on different parts of a page if necessary. I fix this board, with all that it carries, upon the tripod of telescope. A light metal collar round the pillar holds it firmly, and allows of its being easily turned to suit change of position of eyepiece. I have thus, table, book, lamp, eyepieces, all at hand in front of me.—X. P. V.

[48893.]—**Mangle Rollers.**—Would any of your correspondents inform me how mangle-rollers are bored in the lathe, and the description of bit used? They will be the same as used for the handles, I suppose.—D. V. Y.

[48894.]—**Jigger Saw.**—Could any one give me an outline for the best way to rig up one of the above, suitable for sawing limmers, &c., and inform me if the information is to be found in any back numbers? Any hints would be esteemed.—V. D. Y.

[48895.]—**Partnership.**—To Mr. Wetherfield.—I have a business which I have established and carried on for 14 years, and I now intend taking in a partner. He will pay half the value of stock-in-trade, and will put equal share with me in the business. What portion of the profits ought I to derive from the same? If I had, say, two-thirds profits, should they diminish, and to what extent, in course of years?—Inquirer.

[48896.]—**Voss Machine.**—As I am making a Voss machine, according to Mr. Sprague's description in last week's "E. M.," I should be greatly obliged if Mr. Sprague would clear up the following queries for me:—About what distance should the glass discs stand away from the ebonite driving-pulley on the spindle? What distance should the discharging-balls be from the plates? Are the upright collecting combs on one continuous brass rod, or should the top portion be insulated from the lower one? Mr. Sprague describes the fixed plate as having the foils as well as the papers at back of plate; whereas others (including *Engineering*) mention the foils as being on the front, and the papers on the back. Is it of any consequence, and if so, which would be the best? Would it not be better to have the fixed pairs of foils as near as possible to the revolving ones?—Jno. H. Day.

[48897.]—**Montgolfier Medals.**—In the "Scientific News" of Dec. 1, you reported the anniversary of the Bros. Montgolfier, and mention that a medal was struck in commemoration. Now I have three medals, and each one is different on the back; but all have the heads of the two brothers on the face. Could any of our readers give me any further information about them? The inscription on the face of each is—

"Jose. et Etien. Montgolfier."
"Pour avoir rendu l'air navigable."

The inscriptions on the back of each are—

No. 1.
"Que ne peut le genie."
Medaille frapp en vertu duno suscript faite à Lyon par des soins dem. achet ecuier off. de monsieur frere du roi."

No. 2.
"Attonitus orbis terrarum.
Itinere per aera feliciter tentat.

Anno. MDCCLXXXIII.

No. 3.
"Experience du Champs de Mars 27 Aoust 1873 en vertu d'une souscription sous la direct. dun faujasde St. Fond."
—D. H. Goodman.

[48898.]—**Bright's Disease.**—May I ask Dr. Edmunds to give me a simple test for albuminuria or Bright's disease of kidneys? I have a good microscope, &c., suitable for examining urine, &c. The urine is pale on elimination, and when cool deposits a peculiar whitish sediment. The urine then presents a watery pale colour above deposit, as if everything separated and fell to the bottom of bath. I suffer from pain on left side, and especially of my back; middle age; out-door occupation in country; appetite good.—John Stone.

[48899.]—**To Mr. Wetherfield.**—In the year 1877, I put a debtor into the County Court. Before the day of hearing, he offered to pay a certain sum monthly. I accepted his offer, and the agreement was sanctioned by the judge. The debtor paid according to bargain for two or three months, until he had got his house "changed to a fresh name," when he discontinued his payments. I did not like to send him to prison, so he has been able to set me at defiance hitherto; but I have heard that he has got his house in his own name again; so I wish to know if I can still seize his goods in default of payment, or shall I have to begin all over again, take out a fresh summons, &c., with prospect of same tactics being again put in operation?—Enquirer.

[48900.]—**Disordered Liver.**—Will Dr. Edmunds kindly give a few words of advice on the following distressful circumstances?—I am a young man, 24 years of age, compelled to lead a sedentary life in a not over-pure atmosphere. After meals (light or heavy) I am seized with an overpowering drowsiness, sometimes accompanied with acute pain between the shoulder-blades: working under the circumstances being very difficult; in fact, almost impossible. This, and other symptoms, lead me to suppose that my kidneys and liver are in a disordered condition, and likely to get worse. What can I do to get rid of this drowsiness? I have tried dinners of porridge, made after Dr. Edmunds' own heart; but with no effect. I drink on an average a pint of table-beer per day, and smoke one ounce of tobacco per week. Are these two items the cause?—Beta.

[48901.]—**Ebonising.**—Would any of our readers kindly tell me what wood the better class of black brackets, generally containing bevelled glass, are made of, and by what process the wood is blackened, or what, I believe, is termed ebonised? It is a nice black, which appears to be polished by friction.—C. B.

[48902.]—**North London Engines.**—Will some reader kindly give a short account of the new six-coupled side-tanks, such as No. 80? They are of very unusual build in several respects.—W. B. P.

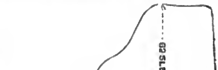
[48903.]—**L. & S.W.R. Engines.**—Wanted the principal dimensions and weight of the new ten-wheeled bogie tanks, such as No. 415, 419, &c. Also can anyone give a few particulars of the curious old four-coupled engines that work between Portsmouth and Southampton. They have inside cylinders and outside frames. Wheels apparently 6ft. No numbers, only names.—W. B. P.

[48904.]—**Magneto-Electric Machine.**—I shall feel greatly obliged if some reader of "E. M." will kindly give me instructions how to make a small magneto-electric machine for giving shocks. I have been trying to make one, but failed to get any current from it. I have looked through all the back numbers that I have, but cannot find what I want. How is the spindle for bobbins made? Is it all iron, or is some part of it brass? Must it be insulated from the iron that connects the cores of bobbins? How are the two ends of wire from bobbins connected to it, and how is the current taken from it to the two handles? In what position must the bobbins be when contact is broken? A short description will greatly oblige—J. T. M.

[48905.]—**Rewiring Grand Piano.**—What gauges should wires be for an old trichord grand piano of 5½ octaves, commencing on F (6ft. long) in bass and ending on C (11in.) in treble? Maker: Broadwood and Sons. The old wires are missing. How many and which notes to each gauge of wire?—F. Stelfox.

[48906.]—**Horsehair Pillows.**—How can these be made or stuffed so as to avoid getting lumpy after a few weeks' use? Mine, when new, were stuffed so full and tight that they were as hard as an old sofa squab. I took out about half the contents, and then they got lumpy. Is there any remedy?—F. M.

[48907.]—**Indicator Diagrams.**—Kindly state the reason of the irregular curve in this diagram. The



engine is an air-compressor, and this diagram is from the air cylinder. Diam. of cyl., 22in.; length of stroke, 6ft.; pressure of air in receiver, 57lb.—J. T. Blackett.

[48908.]—**Electric Thermometer.**—At what height should this be set to act as fire-alarum? If I put a small box over it pierced with holes to protect it, will its usefulness be impaired? A rusty screw got into a cell of my Leclanché and discoloured the solution. I have put in new solution, but cannot get the red rust off porous pot surface. Will it interfere with working?—R. B.

[48909.]—**Indentures.**—An architect's pupil who has paid a good premium has had no indentures drawn up, as the architect is willing to dispense with them. Is the absence of the legal document likely to injure the future prospects and advancement of the pupil?—X. Y. Z.

[48910.]—**Storm-Glass.**—What is the principle of action of the storm-glasses which contain crystalline matter in a sealed glass tube? Does it not act purely by change in temperature? I do not see how changes in amount of moisture or in atmospheric pressure can affect it.—Podura.

[48911.]—**Self-Registering Thermometer.**—Is there no means of preventing the liquid in these splitting into small pieces? I have had more than one by a well-known maker, and they are constantly getting into this condition. I can sometimes make the liquid join, but it is sure to break again. If there is no remedy I cannot see how the thermometers can be used, as it must vitiate every reading.—Brickwall.

[48912.]—**Hardening Lathe Centre.**—Will anyone kindly tell me how this is done? I have turned mine up several times, and, though hardened most carefully, they always get slightly twisted out of truth. I suppose they ought to be tempered to a straw-colour. When soft I find they are very apt to seize if not oiled frequently. An answer will greatly oblige—Puck.

[48913.]—**Landlord and Tenant.**—To Mr. Wetherfield.—My landlord by agreement should do all structural repairs to the house. Some slates were blown off some six weeks ago. I told him of it the same day and he promised to see to it, but has not. The wet has come in and stained ceilings and wall-paper. I have written three times. The landlord does not refuse to put the slates on, but simply does nothing. Who should do the internal repairs, as they are entirely the result of his neglect? Can I refuse to pay the rent due at Christmas until the roof is made watertight?—B. N.

[48914.]—**Tea and Coffee after Meals.**—Referring to Dr. Edmunds' admirable remarks on Drinks I wish he would on a future occasion tell us why "a cup of tea or coffee directly after dinner is especially bad." I am in the habit of indulging pretty regularly in an after-dinner (6.30 p.m.) cup of coffee without as far as I can observe any ill effects. I should mention that I never drink anything over the meal.—G. L. T.

[48915.]—**Jack-in-the-Box Gearing.**—Would someone kindly give full description of the above, with a rough sketch of same, and oblige?—M.M.I.Sc.S.

[48916.]—**Buttons.**—Can any reader oblige by describing a machine for making iron legging buttons?—G. B.

[48917.]—**G.N.R. and L. and N.W.R. Locos.**—Will "Prometheus," or some other correspondent, kindly give me the numbers and dimensions of the G.N. engines that still have their domes remaining on them (there are only two or three, I think), and, also, the numbers and dimensions of the L. and N.W. engines?—Diomed, Baltic, Isis, Herald, Isabella, Odin, Bucephalus, and Archimedes, and oblige—A. Marriott.

[48918.]—**Eyesight.**—Will Dr. Edmunds tell me whether dry red-lead injures the eyes when it gets into them, and would it destroy the sight in time, as at my work I frequently get my eyes full of it when scraping joints under boilers which I have to look up to? I have noticed a dimness coming over my eyes when reading lately during evenings, which I had not before. Is this the reason for it?—A Young Fitter.

[48919.]—**Fire Annihilators.**—Will some correspondent instruct me how to construct a simple apparatus to discharge carbonic acid gas vapour on the principle of Phillips's annihilator? I require it to be ready for instantaneous use, where a hand-pump or L'Extincteur would not be available.—Sebbach.

[48920.]—**Dog-Cart Brakes.**—I notice a recent reply about dog-cart brakes from one who says, let the drum on the axle. As the axle does not revolve, how is the drum to be moved against the back part of a dog-cart not much above the level of the axle? In some carts it is lower, and, of course, would not pull down the back of a cart, but break the car if the axle revolved as a railway axle. Cannot some practical reader give reliable information on this matter?—W. Lodia.

[48921.]—**Street-Lamp Reflector.**—By what means could a good ray of light be thrown a distance of one hundred yards from a gas-lamp, extending in two opposite directions, at a moderate cost, the object being to light up a dark road?—Subscriber.

[48922.]—**Coloured Photographs.**—Can any of your readers inform me what is the exact process to adopt in colouring photographs by means of paint laid on from the back? What wax or oil should be used to render them transparent? How, and at what heat, it should be applied, and what are the best paints to use? Any practical hints will be most useful.—Bitte.

[48923.]—**Congestion of Liver.**—In June last, I had an acute attack of stomach irritation, with total stoppage of digestive action, &c., for several days. My liver, always sluggish, became congested. I recovered from the attack, excepting that my liver remained congested, and there is now constant tenderness within the lower ribs, and immediately beneath them. Having been under medical care for six months, and paid every attention to diet and exercise without result, if Dr. Edmunds or any of your readers can give me any hints based upon experience of similar cases, I shall be very grateful; as at my age (35) the prospect of becoming a confirmed invalid and dyspeptic is an alarming one.—A. W. D.

[48924.]—**Legal.**—To Mr. Wetherfield.—Will you please give me your opinion of the following?—A. dies and leaves certain lands and property to his two daughters, B. and C., during their lives, and after death, to their children who live to attain the age of 21 years, or to their issue, if any; but failing such children or issue, then to the other of the daughters or their issue. C. has one son in marriage; then her husband dies, and she marries her late husband's brother, and has other children by him. C.'s son with the first husband attains over 21 years, and then dies without issue, but leaves a will, giving the property at the death of his mother to his sisters by the second husband of his mother. Then his mother, C., dies. The legal son never had possession. Is the second marriage legal? Are the children by the second marriage sisters to the first son? Can the son will the property to the children by the second marriage as his sisters? The daughter B. is still living, and also B.'s children. To whom should the property belong?—J. B.

[48925.]—**Heating Apparatus for Billiard-Room and Conservatory.**—Will some of the contributors to the "E. M." be good enough to advise as to the best kind of heating apparatus (hot water), with approximate cost, for a billiard-room with conservatory attached? The billiard-room would be about 24ft. × 18ft. × 11ft., and the conservatory 18ft. × 10ft. × 10ft. There must be valves to regulate the supply of hot-water or to cut it off if required. The boiler will stand in an outhouse attached to the building.—Boiler.

[48926.]—**Analysis of Binoxide of Manganese.**—To Mr. A. H. Allen.—Will Mr. Allen kindly give as simple a way as possible of estimating, approximately, the amount of iron contained in a sample of commercial binoxide of manganese? and oblige—Artizan.

[48927.]—**To "Sigma."**—I thank you very much for information concerning magnets, electric generators. May I venture to further ask if it is best to use a large or small diameter surface on the shaft (of the discs carrying bobbins) for the collecting springs to press against, and receive the current from? To illustrate my meaning, supposing the metal pulley of my lathe was fixed on the revolving axle of discs to lead away current to collecting spring, would the largest or smallest speed be best for spring to bear against, and should the bobbins be connected quantity fashion or in series for incandescent lamp?—Electra.

[48928.]—**Astronomical.**—Would any correspondent kindly furnish me with the following particulars, if they have been yet ascertained?—(1) The polar compression of Mars and Venus. (2) The angles at which the equators of Mercury and Neptune are inclined to the planes of their orbits. (3) The time in which the axial revolution of Uranus and Neptune is performed. (4) The periods of the following binary stars:—η Cassiopeiæ; β Cameli; ι Leonis; ε Boötis; ξ Boötis; η Orionis; ζ Herculis; α Piscium.—Amator Stellarum.

[48929.]—**Conductivity.**—Should I materially diminish the resistance in the line of telegraph circuit if I employ copper wire 18 instead of galvanised iron 14, and will it stand weather as well?—Reginald Hanner.

[48930.]—**Rendering Wood Fireproof.**—Can any of your readers give me particulars of any substance which, when dissolved in water, will render wood fireproof? I have a factory where a good deal of oil is used, and the floors in time get almost saturated; so that if a fire took place, the consequences would be most serious. My idea is to use such a solution instead of plain water whenever the floor is sprinkled for sweeping (and occasionally, at other times, it might have a considerable quantity poured upon it). The woodwork would thus become impregnated with the substance held in solution, and in time the woodwork would become almost non-combustible.—Manufacturer.

[48931.]—**Chadwick's Oxygen Apparatus.**—I bought a second-hand one of these lately, and I attempted a short time ago to give an exhibition with it, but it was a failure. It worked well enough at first, and filled the gas-holder nicely when the retort was cold and newly charged, but when the supply got done and I attempted to fill the retort again, the gas all escaped out of the joint of the retort. I tried in all the ways I could think, but gave it up in despair. I thought that the 2 parts of the retort were not a good fit, so I got a brass-finisher to grind them properly gas-tight, which we both tried by blowing into was perfectly air-tight. I also got stronger springs to hold the top part down. I tried it again last week, but I was afraid to trust it this time, so I had my bag filled in readiness if anything should go wrong. It just went the same way: worked well enough at first when the retort was cold, but when the supply was getting done and the retort had to be recharged it all escaped at the joint. Although this apparatus was a failure with me, perhaps with others it may be a success. Any information on the working and using of such an apparatus, will be valued by an—Exhibitor.

[48932.]—**Renewing Lathe Collar.**—I wish to renew a lathe collar for mandrel. Will anyone who has tried the soft metal self-lubricating collars tell me whether they answer, and any direction as to making and fitting it? The journal is level, not coned, and 1in. thick, and the collar would have to be in two parts; otherwise the mandrel cannot be renewed. I suppose it is much less trouble to make the soft metal one than a new brass one would be if, when done, it would answer.—F. G. T.

[48933.]—**Photographic Quantities.**—How many grains to the ounce forms a saturated solution of (1) sulphate of iron, (2) protosulphate of iron, (3) neutral oxalate of potash? Are the two former nearly the same thing, or when (say) the sulphate appears in a formula, might the proto be substituted in default of deficiency of the sulphate, or vice versa?—J. S.

[48934.]—**Medical—Weak Eyes.**—To Dr. Edmunds.—Will you kindly advise in the following case?—My mother (40 years of age) has for the last two months suffered from what we call a watery eye—that is, the corner of the left eye being continually filled with water, and has to be constantly wiped, causing great inconvenience. I may add there is no inflammation whatever.—A. C. T.

[48935.]—**Fan for Smith's Hearth.**—Would "Jack of All Trades" or someone kindly help me? I cannot get sufficient blast as some of the wind comes out at the eye. Do you think it is throttled, or is the fault in the blade? The blades are straight; outside diameter of fan 22in.; 9in. wide; the eye 8in.; blades 6in. square, driven by steam-power and runs about 2,000 revolutions per minute. Any information would be thankfully received by—Blacksmith.

[48936.]—**The Temple Organ.**—Will one of the readers of the "E.M." kindly forward scheme of this organ as rearranged by Forster and Andrews in 1878?—C. H. D.

[48937.]—**Star Magnitudes.**—Will one of "ours" kindly give necessary information how to estimate star magnitudes?—Anxious.

[48938.]—**Harmonic Analysis.**—Will someone tell me where I can find a full account of harmonic analysis (mathematical)?—H. N.

[48939.]—**Stewarton Beehive.**—Will someone kindly give me sketch of Stewarton beehive, and method of making same?—J.

[48940.]—**Specula Working.**—To Mr. Wassell.—Will Mr. Wassell kindly say whether it is practicable to give figures traced by the motion of a pencil fixed in the bar of his machine? It would show graphically what is the effect of certain varieties of stroke?—Ordanic Vital.

[48941.]—**White Background for Photos.**—I have seen some portraits all white but the figure. Is the background white, or are they vignettes? I have tried to vignette some, but they have a light shade round them.—Le Meritoire.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 13, and unacknowledged elsewhere:—

E. White.—Chance Bros. and Co.—C. Richardson.—J. Noble.—Lt.-Col. Fendall.—J. Place.—A. de Böe.—G. F. B. Ault.—R. O'H.—Compositor.—Alfo'oe.—F. Gallagher.—G. P.—Country.—E. G. T.—Mountaineer.—W. Bodle.—An Anxious Working Man.—E. P. Liverpool.—Captain.—Thomas Farrington.—A. A., B. S. P.—R. C. L.—W. L.—A. B. C.—H. B.—W. Wright.—J. H. Gartrell.—Tyke.—D'Elgo.—A. Cowley Malley.—J. S. H.—J. C. L.—Walter Hardie.—J. C. King.—Fred. Walker.

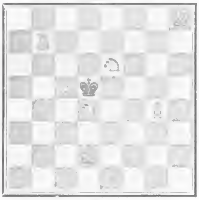
Trooper. (Has he not already sent them? See p. 311, No. 793. We gave a list of recent back numbers containing incubators on p. 281. Woollen rugs pressed tightly. We should think a ¼in. wick too small; ½in. might do.)—Petitio Principii. (Any herbalist or druggist will supply you with the suitable remedy; but you had better seek medical advice as to the faintness.)—Scott. (Would introduce replies of an advertising nature.)—W. H. Houldsworth. (Rather beyond us. Such matters are esoteric, and questions should be put direct to professors. Possibly the Editor of the *Lancet* may know of some paper on the subject, read at one of the medical societies.)—D. McMurtrie. (Stretch a sheet of linen on a board by means of tacks. Coat with strong size. Paste the paper well, and leave it to soak in; then apply another coat and lay it on the linen, working it down from the centre. If you want the map to fold up, cut it in pieces, and lay these, say, a sixteenth of an inch apart. 2. Is not the construction explained in back volumes? 3. Has he not finished them? We expect he is too busy just at present.)—L. Groves. (They have been used for many years under the name of bort, carbonado, &c., for boring purposes. They are inserted in the steel crown of a boring tool. We do not remember the name of any particular company.)—F. Stelfox. (If you had referred to back volumes you would have discovered that name and shape were of little use. What is wanted is the strength and condition of the frames. So recently as p. 180 some information will be found. However, we insert the query.)—W. Moody Bell. (A letter addressed to the City and Guilds College, Cowper-street, E.C., will reach them.)—Caloric. (You do not say for what purpose the "telegraph bars" were used—in what way did they utilise the heat of the fire? If merely an arrangement for conducting heat to surfaces, which can radiate it into a room, there are many in existence, for which, consult catalogues of stove-makers. 2. You had much better leave it alone, except under competent medical advice.)—J. R. Jackson. (Yes, Leroy's non-conducting composition (see front page) will do just what you want.)—Musicus. (See p. 97. You can make them any size you think convenient. Yes.)—Ignoramus. (That is eleven days, if you count, and another day has been added since March, 1800, for just the same reason that last century needed eleven days deducted to bring the time back to old style. You will find it fully explained in most cyclopædias.)—A. (Read the first paragraph in Dr. Edmunds' letter last week.—)—An Old Subscriber. (It is a matter on which he would not advise without personal examination.)—George Canham. (We do not see how you draw the gas and air into the cylinder. If you cannot refer to back volumes, you should endeavour to get a look at an engine itself.)—T. H. Hall. (Yes, see many instructions in back volumes.)—A. B. C. (Any optician could suit you with spectacles if you let him know at what distance from each eye you can best read this column, and the distance at which it becomes undistinguishable.)—M. A. (Many things have been recommended, but we believe the most effective are borax mixed with a little meal or bran; flour, plaster of paris, and powdered sugar mixed respectively in proportion 1, 2, 1. Leave these in little heaps about their haunts. All crevices should be filled up where possible with cement or plaster.)—Aqua Pura. (Several filters recently. See p. 530, last volume, and the index.)—Cleanliness. (The effective remedy is to have it re-galvanised, but try scrubbing with sand and then coat with limewash. When dry brush off.)—A. H. F. (The best plaster of Paris mixed with alum-water; or shellac dissolved in alcohol. The latter requires heat.)—W. H. Aston. (Very few care to take the responsibility of advising men to emigrate. You do not state age; but if you can do what you say, and mean to work, there are no doubt many openings. You can get an assisted passage to South Australia. Write to the Agents-General of the different Colonies, and see pp. 121, 142.)—John Jones. (Your best plan is to attend some mining school, or, at least, procure a list of the examination questions.)—Daniel Rowe, Jun. (We do not know any book that treats all the subjects you mention; but if you procure catalogues from Crosby Lockwood and Co., Stationers' Hall-court, E.C., and E. and F. N. Spon, Charing-cross, you will find several works that will suit you.]—Fitter. (If you have not scales you will have to work each dimension out; but you will find metric measures in most pocket-books and almanacs. To take the case given, a metre is 39·37in.—say, 3ft. 3in. and ⅓rd, and 6 centimetres is exactly six hundredths of that.)—A. T. S. (See a reply on p. [illegible]; but in back volumes you will find a great deal of information on hardening and tempering.)—A Machinist. (Without personal examination, all that can be said is "Wear elastic stockings.")—Amateur. (It is simply sulphate of copper—bluestone—and water. For nickel-plating, see No. [illegible].)—W. E. S. (If received, it was certainly noticed in some way. We cannot pretend to recollect all the letters received. Cassells publish a guide to the Civil Service, and if you look through the indices you will find references to replies to special questions. You do not say what branch.)—Anxious. (No useful advice can be given without a thorough examination by a medical man.)—M. C. P. (If the spectacles are suited to your sight, wear them whenever you have occasion to use your eyes. 2. Try the effect of a little weak ammonia water and a clean rag.)—Dandie Dinmont. (If small quantity only is wanted, try Stephens' stains.)—A Collier's Boy. (If really by Dollond, most likely. Write for price to one of the opticians advertising in our columns. 2. What colour is wanted. You clean off the old lacquer with a little warm spirit, warming the article itself.)—Newark. (On p. 81, last volume.)—Nemo. (You will find a description in "Electric Illumination," published at the office of *Engineering*.)—[illegible]. (We do not know of any others.)—W. Davis. (Dr. Edmunds will not, we are quite sure, undertake to give analyses of quack medicines. One of these days, perhaps, he will write us a paper on the subject, just to let readers know how, as a rule, they swallow unnecessarily gallons of rubbish for which they are charged about nine hundred per cent. profit. 2. Turn the lazy rascal out of doors. 3. Virgin cork is the best material. You can hardly fail to succeed with that.)—Vox. (Explained many volumes back. A moment's consideration ought to show any one that no explanation is needed.)—Curious. (It is neither the paper nor its contents—rubbish, as they undoubtedly often are—that render cigarette-smoking harmful, but the greater facilities afforded for the passage of nicotine into the mouth, and the constant communication of the tobacco with the lips and tongue. A medical contemporary recently went fully into the subject, and we fully agree with its conclusions that cigarettes are more injurious than either pipes or cigars. Other query next week.)—D. J. I. (We have all the blocks, and will reproduce them with "Screw-mania" next week.)—Bow, [illegible]. (In type.)

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCVII.—By D. Mackay.

Black.

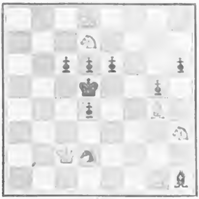


White.

White to play and mate in two moves.

PROBLEM DCCCVIII.—By J. Rayner.

Black.



White.

White to play and mate in three moves.

This problem gained the first prize for the best three-mover in the *Lebanon Herald* Tourney.

Solution to 803.

White.	Black.
1. B to R 7	1. B takes B (a)
2. Kt to B 2 (ch)	2. Kt takes Kt mate
	(a) 1. R to Q sq (b)
2. Q to Kt 3 (ch)	2. B takes Q mate
	(b) 1. P to Kt 6 (c)
2. Q to B 2 (ch)	2. P takes Q mate
	(c) 1. Q to Kt 7
2. Q takes P (ch)	2. Q takes Q mate

Solution to 804.

White.	Black.
1. R to Q 8	1. P to Q 7 (a)
2. B to R 3	2. P to K 7
3. B to Q 7	3. P takes Kt
4. B to B 5 mate	
	(a) 1. K takes Kt (b)
2. B to Kt 4	2. K to B 7
3. B to K B 8 mate	
	(b) 1. K to Q 7
2. B to R 3, &c.	

Game played in English Mechanic Correspondence Tourney between "Plevna" and Mr. J. H. Blake.

(Scotch Gambit.)

"Plevna" (White).	J. H. Blake (Black).
1. P-K 4	1. P-K 4
2. Kt-K B 3	2. Kt-Q B 3
3. P-Q 4	3. P takes P
4. B-Q B 4	4. B-B 4
5. Kt-Kt 5	5. Kt-K 4
6. Kt takes B P	6. Kt takes Kt
7. B takes Kt (ch)	7. K takes B
8. Q-R 5 (ch)	8. P-Kt 3
9. Q Q 5 (ch)	9. K-Kt 2
10. Q takes B	10. R-K sq
11. Castles	11. R takes P
12. P-Q Kt 4	12. R-K 4
13. Q-B 4	13. P-Q 4
14. Q-Kt 3	14. B-B 4
15. B-Kt 2	15. R-K 7
16. Kt-R 3	16. B-Kt 5 (a)
17. P-Q Kt 5	17. Kt-B 4
18. B takes P (ch)	18. K-Kt sq
19. Q-Q B 3	19. Q-Kt 4
20. Q-K R 3	20. Q R-K sq
21. B-Q B 3	21. Kt-B 5
22. Kt takes Kt	22. P takes Kt
23. K R-K sq	23. R takes Q B P
24. R-K 3	24. Q-B 5
25. Q R-K B sq	25. R-K 2
26. P-K Kt 3	26. Q-K R 2
27. Q-K R 4	27. R takes R
28. R takes R	28. R-Q 4
29. R-R sq	29. R-K 7
30. Q-Q 4 (b)	30. Q-B 6
31. Q takes R P (c)	31. R-Q 7
32. Q-Q 4	32. R-Q 8 (ch)
33. R takes R	33. Q takes R (ch)
34. K-Kt 2	34. R-B 8 (ch)
35. K moves (Resigns.)	35. Q takes Q

NOTES.

(a) Moves 12 to 16 are not in the best style, and give White more attack with his P than he ought to have.

(b) If White checks at Q 8 and then at Q 4, Black interposes Q, and after the exchange would probably win.

(c) If 30. $\frac{\text{Q-K R 4}}{\text{R takes R P}}$ 31. $\frac{\text{K R-Q B sq}}{\text{R takes R}}$ 32. $\frac{\text{R takes R}}{\text{Q takes Q}}$ 33. $\frac{\text{P takes Q}}{\text{P-B 6}}$, and should win.

NOTICES TO CORRESPONDENTS.

Correct Solution to 802 by W. T. Bayne.

Dicky Sam.—The second move in 796 should be Kt-Q 3. Then if 2. $\frac{}{\text{P takes Kt}}$, 3. Kt-K 4 mate; if 2. $\frac{}{\text{Q takes Kt or Kt to K 8}}$, 3. Kt-Q 7 mate; if 2. $\frac{}{\text{Kt takes Kt}}$, 3. P takes Kt mate. We are sorry you have had so much trouble through the mistake.

The Married Women's Property Act.—Mr. F. Wetherfield has written a "handy book" containing full explanations of the new Act affecting the property of married women, with special chapters on the new relative position of husband and wife as regards property, creditors, and liabilities. The Acts of 1870, 1874, and 1882 are given in their entirety, and after a couple of introductory chapters Mr. Wetherfield goes through the new Act, clause by clause, adding explanatory notes and citing cases bearing upon the construction of the Statute. The book is issued at the price of 1s., by W. Cate, Cursitor-street, E.C.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock street, Covent garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

GRAND SPECIAL OFFER FOR CHRISTMAS.

TO OUR READERS.

The immense success which has followed our efforts to offer to our readers Special Parcels of Cutlery and Plate suitable for their requirements at this season of the year, and the great satisfaction they have always given to our Patrons, has induced us again to make up a number of these parcels of superior Sheffield goods, any of which can be dispatched the same day as we receive the order. No more acceptable or desirable present can be obtained than one of our useful Parcels of Cutlery or Plate, and as the demand is bound to be very great, we advise all our readers to secure one or more Parcels without delay.

Do not miss this opportunity, as it may not occur again.

OUR HALF-GUINEA CUTLERY PARCEL.

Half-dozen strong riveted handle Table Knives, half-dozen ditto ditto Dessert Knives, half-dozen Table Forks, half-dozen Dessert Forks, 1 pair Carvers, and 1 Steel, all to match.

The whole 27 pieces for 10s. 6d., carriage paid.

OUR GUINEA HOUSEHOLD PARCEL.

Half-dozen superior quality Table Knives, half-dozen ditto ditto Dessert Knives, 1 pair superior Carvers and 1 Table Steel to match, half-dozen genuine Nickel Silver Table Forks, half-dozen ditto Dessert Forks; half-dozen ditto Dessert Spoons, 2 pairs ditto Table Spoons, half-dozen ditto Tea Spoons.

The whole 43 pieces for 21s., carriage paid.

OUR SPECIAL FIFTY SHILLING PARCEL.

Half-dozen best white balanced handle Table Knives, half-dozen Dessert Knives to match, 1 pair superior Carvers, and 1 Table Steel to match; half-dozen Electro Silver Plated Table Forks, half-dozen ditto Dessert Forks, half-dozen ditto Dessert Spoons, 2 pairs Table Spoons, half-dozen Tea Spoons, all to match.

The whole 43 pieces for 50s., carriage paid.

OUR UNIVERSAL 12s. 6d. PLATE PARCEL.

Half-dozen genuine Nickel Silver Table Forks, half-dozen Dessert ditto, half-dozen Nickel Silver Dessert Spoons, half-dozen Nickel Silver Tea Spoons, 1 pair Salt Spoons, all to match.

The whole 26 pieces for 12s. 6d., carriage paid.

The above parcel can also be had in very superior Electro Silver Plate, price 35s., carriage paid.

OUR GRAND GUINEA PARCEL OF ELECTRO-PLATE.

1 electro-plated Cruet Stand, with 4 Cut Glass Bottles, 1 Glass Butter Cooler, with electro-plated Plate and Cover. 1 electro-plated Toast Rack, 1 electro-plated engraved Butter Knife, 1 electro-plated Pickle Fork, 1 electro-plated Sardine Fork, and 1 electro-plated Jam Spoon.

The lot for 21s., securely packed and carriage paid.

OUR GUINEA CHRISTMAS PRESENT PARCEL.

1 electro-plated Tea and Coffee Service, comprising, Coffee Pot, Tea Pot, gilt lined Sugar Basin, and gilt lined Cream Jug, handsome pattern, beautifully embossed.

Price 21s. the set, carriage paid.

The above can also be had in the new can shape of very superior quality, plated on best metal, very handsome design, and beautifully engraved, price 30s. the set, carriage paid.

OUR TWO GUINEA CHRISTMAS PRESENT PARCEL.

1 Case beautifully lined with purple velvet and silk, containing 1 pair superior plated Fish Carvers, 1 Case lined as above, containing 2 pairs plated Nut Cracks, 1 Case lined as above, containing half-dozen electro-plated Napkin Rings, 1 Case lined as above, containing 1 dozen plated Tea Spoons, 1 Sugar Spoon, and 1 pair Sugar Tongs, 1 electro-plated engraved Butter Knife, 1 electro-plated Pickle Fork, 1 Sardine Fork, 1 plated Jam Spoon.

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Initials or Monogram engraved on any of the above goods at 4s. 6d. per dozen articles.

All the above parcels are now ready, and can be despatched immediately on receipt of order.

P.O. orders payable to

DRALLIM and OLIVER,

MANUFACTURERS,

18, IRONMONGER LANE, CHEAPSIDE, LONDON, E.C.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 22, 1882.

HOME CHIPS.—V.

Summer-house Construction.

WE can now commence actual building operations if we have materials suitable; and, by preference, as the easiest to manage and having the best appearance for rustic work, fir poles may be used—size about 6in. dia. at bottom and 4in. at the top, and we may as well use them unsawn, so as to get good, firm posts to work upon. These fir posts are, however, very liable to rot at the bottom, unless well tarred where they are to be in contact with the soil. Oak can, of course, be substituted, but is very hard, though very durable. It may be, consequently, of somewhat less diameter. Whatever is used, care must be taken to saw the posts off at top truly square; but, as probably all will not be let into the ground to exactly the same depth, this final sawing will take place subsequently. It is, however, easier to saw when the stuff is lying horizontally than when it is upright, and the saw itself has to be moved in a horizontal plane. Take, therefore, all possible care to keep them of one height, which is not so difficult if the ground is level, so that tolerably accurate measurement can be taken. A post is, of course, to be set up at each angle of the proposed hexagon or octagon. Be very careful, too, to set each post accurately true by plumb-line, or you will have much additional trouble subsequently. Now, there is some art in setting up posts to stand securely. The great secret is to ram the earth well round the bottom of it, and to use the stiffest of the earth at that part; ram every spadeful thrown in, and by no means throw in a lot before ramming any of it. If the bottom and top are secure, the post is sure to stand well. Bits of brick and stones to fill up do best above the bottom layers, as they are not likely to make a solid mass. In some soils it is best to point and drive the posts, especially if of oak, which will stand this summary proceeding; and this will save a lot of hard work in digging. But you will hardly drive posts of four to six inches diameter, and, therefore, if of fir of that size, dig you must. The next step will be to unite the posts by the top framework; and for this use fir, sawn down lengthwise (unless you go in for sawn plank wood). The flat side of these pieces is to be upwards, and the ends are to meet accurately in the centre of the top of each post. The half-round surface which is to lie on the posts must be therefore levelled with the axe at that part, and then sawn off at the required angle so as to meet. See Fig. 22, where the arrows denote the angle in question. If, however, you use sawn plank or quartering, or if the top of the posts does not allow sufficient bearing for these beams, cut them like Fig. 23, holding them together upon their respective posts. This will give a better bearing surface than the other. You will now have a framework like Fig. 21, and if the posts have been well rammed it ought to be pretty stiff without any ties or braces. If this is not the case, put diagonal braces, as shown by the dotted lines, fitting them nicely inside or between the posts, and taking care not to allow them to project to interfere with the boarding. For these may be used either fir, sawn once through, or sawn into quarters. The latter will generally be stiff enough. In order to fit without difficulty diagonals or rafters which have to be sloped off at a given angle, it is best to have a bit of flat ½in. board about 3in. wide as a pattern. Try this again and again, and get the slope or bevel correct, and use it as a pattern by which to cut all the rest. For this work a carpenter would use a hand-axe; but if uncertain of your skill, a saw will have to be used instead. Of course, a half-lap joint like 23 must be sawn; but no carpenter would saw for a lap or splice like 25 for an outdoor job such as we are contemplating. In this, however, as in most cases, the amateur is sure to find that his want of skill necessitates increase of labour. Use for a job like this good new cut nails of 3in. and 4in., according to necessity, and bore holes to give them a fair start. Old nails and odds and ends will not prove satisfactory; and if using oak, stick to old-fashioned shell augers and gimlets. The twisted gimlets will break. They are only fit for light work in deal. Large screw augers, again, with gimlet screw-points are, in my experience, poor tools. The thread of the screw gets filled up almost directly with the particles of wood, which convert the whole into a smooth, hard, conical point, having, of course, no penetrative power whatever. A good shell auger gets a hold and keeps it. I like the shank with a ring instead of a pointed tang, as in this case the handle cannot get split, which so often happens when the tang goes into it. One tough handle of ash, slightly conical, will also answer for two or three of the augers made with rings. I suppose, indeed, they are so intended to be used, as a set will take but little room if the handle can be removed. As to nails, they are sold by the pound, at one price; only, of course, a pound of big nails may mean half a dozen, and a pound of small ones several dozen. An assorted lot, say 10lb. of all sizes, is best. The nail-box should have, say, two divisions, making three separate compartments, one for spikes of 4in. and 3in., one for 2in., and one for the smaller sizes, and it should have a stout leather strap nailed on each side (i.e., one end of it on each side) to form a handle. Also have a good tool-basket for out-door work, or the loss of tools will be the rule, and not the exception.

FIG. 23.

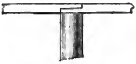


FIG. 21.

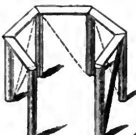


FIG. 25.

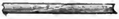


FIG. 22.

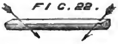


FIG. 26.

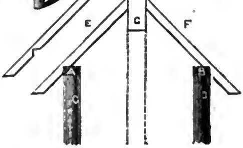


FIG. 27.

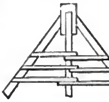
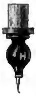


FIG. 29.



I must now go back again to the building; but digressions are sure to occur in a paper of this kind, because so many scattered ideas crop up one after the other, demanding notice as they severally occur. The next process will be setting up the roof. Outside, if it is thatched, it will be circular, although inside the rafters will be set on in an octagon, meeting in a centre-post at the peak. Now, there is more than one way to manage this roof; but I think the easiest and best is to set up a centre-post in the middle of the floor, build the rafters up to it, and then saw it off, unless you prefer to leave it wholly standing, to form a central support for the table. If the table is to be a fixture, the post will not be in the way; but there is no difficulty in getting rid of it when once the roof is built up. For a house 8ft. across, the rafters must be 6ft. long at least, to get a sufficient pitch for thatch, so as to carry off the rain quickly. If the pitch is low, making the roof too flat, it is sure to leak in a heavy rain. Slates or tiles allow of a flatter roof, but neither is so suitable for our present purpose as thatch, or preferably reeds, if they are to be had; they are very durable, and look far better than straw, but they need to be put on by someone used to the work—a straw thatcher generally fails to put reeds on properly, although he will attempt it, because unwilling to confess his incapacity.

In addition to the length required in the rafters from peak to wall-plate, they have to extend a foot beyond the latter to form eaves to carry the drip well away from the boarding, so that if 6ft. suffices above, another foot should be added below the wall-plate—i.e., the horizontal timbers which rest on the walls of a house to carry the lower end of the rafters, or, as here, the pieces laid on the top of the several posts for the same purpose. For these rafters quartered fir will do, or small round stuff or poles sawn once lengthwise. No great strength is required, because of the steep pitch, and because they are so near together except at their lowest ends. Although using a round post to form a central abutment to all the rafters, in common, to which they can be nailed, I should, in practice, just flatten slightly each face against which the bevelled ends of the aforesaid rafters rest, giving six or eight sides to the end of the post at this place. The rafters will bed down more neatly, and get a better hold when nailed on. Begin by fixing two opposite ones, and then the two that are nearly at right angles to these (in an octagon house they will be actually at right angles), and thin the ends of the rafters a little to flatten them, if necessary, in order to get room for the six or eight, which are thus made to meet at the summit of a cone. Fig. 26 shows a part of the house thus built, C D being the main upright posts; A B two of the wall-plates or horizontal timbers; E F a pair of rafters meeting, at their upper ends, the centre post G. I have dotted this below to show where it will be cut off, and on to the end there can be an ornamental pendant subsequently attached, such as H. A similar one, reversed and longer, to allow of the thickness of the thatch, can be placed on the top to hold a weathercock, if desired. These must be turned. If the top one is to be added, I should not bring the rafters nearer to the end of the middle post than 9in., which the thatch will about cover and conceal. A thatcher will, instead of this external ornament, form one of the thatch itself, if told to do so; but some finish of the kind is advisable, or a zinc conical cap fitted on and painted, which will make a good protection against the weather. This is all a matter of taste, however. Now that we have got thus far, it will be seen that by using, at first, a fixed post, the work of attaching the rafters is much simplified, and can be done single-handed, whereas it is very difficult to work with a short separate bit of post, although it is quite possible to do so. There will be no great difficulty in sawing it off afterwards, as it is held at both ends steadily until the saw is fairly through it. Of course you need not ram it or let it in deeply, as you have to do with the other posts, unless you mean to leave it permanently. The framework of a good substantial summer-house will thus be finished, with the exception of the battens, which are to be nailed from rafter to rafter to carry the thatch, and which may be put on about a foot apart, not wider. It does not matter much what these are; only they will be visible from the inside by those who like to crane their necks for the purpose of inspecting them. The lighter ends of poles, or split stuff like hurdle-rails, will do well enough for the greater number. You should put the stoutest below, because they will be shorter and shorter as they get nearer the summit. Remember the ends need not be fitted together in any way, as these cross battens may be nailed one above another like Fig. 27. The first layer of straw or reed is laid on these and sewn or tied on with tarred twine, and on the foundation thus laid subsequent layers are attached with what are called, I believe, "spits," which resemble hairpins suitable for Mrs. Blunderbore. They are made of rods of split hazel, about 2ft. long, the section being triangular, and are sold in bundles as straight sticks pointed at both ends. The thatcher, with a peculiar dexterous wrench, twists and bends them in the middle, the twist preventing breakage; and I may add that an amateur is pretty sure to fail in this work, which needs practice and strength of wrist for its accomplishment.

O. J. L.

THE GAS AND ELECTRIC EXHIBITION AT THE CRYSTAL PALACE.

ALTHOUGH the "international electric and gas exhibition" was opened at the Crystal Palace last week, it is not yet complete, the electric exhibitors being notable chiefly for their absence. The official title places "electric" before "gas"; but it is clear that, so far as variety of exhibits is concerned, the gasmen will take the lead, though there will eventually be some novelties in electric lighting which will attract much attention. The north nave with its courts and the annexe is appropriated to the electricians, while the gas appliances are shown in the south nave, its courts, and the west corridor. At the time of our visit the south nave was illuminated by Sugg and Co., Bray and Co., and the Siemens Patent Gas Light Co., with hanging lamps of about 600 candle-power each, of the different patterns adopted by the firms, while one of Sugg's 1,000 candle-burners on the argand principle was hung in the centre line. The Siemens lamps are shown in some variety and power, but the principle is that described on p. 532, Vol. XXXII., and by Dr. C. W. Siemens (see p. 373, Vol. XXXIII.), the flame being drawn down over a ring of porcelain into a pipe connecting with a chimney. The lamp is thus not only made to convey away the greater part of the products of combustion, but by drawing the flame downwards the gas and air are highly heated before reaching the point of combustion. A comparison of the three exhibits is not easily made by viewing them in the nave, but the effect of the Siemens' regenerative burner will, when the arrangements are complete, be well seen in the Concert-Room. The larger sizes burn from 85 to 90 cubic feet per hour, giving about 600 candles, while the smaller consume 55 cubic feet and give 330-candle light. Under the best condition the regenerative gas-burner gives a light of 7 candles per cubic foot—a very high result indeed. Strode and Co. have a fine exhibit in each division, and deserve special mention for being ready on the opening night. Near the centre transept in the north nave they have a stand showing the Swan incandescent lamp in a variety of ornamental forms, while overhead are several McKenzie arc-lights. Looking southward from the middle of the north nave, the contrast between the electric arc and gas is well marked; the latter being decidedly yellow and warm, although burning in the most improved, and unquestionably the best, burners to be found. At the various stands in the south nave may be found burners of all kinds—some professing to give a considerable economy; others claiming notice from the fact that they are so arranged as to help in ventilating the apartment in which they are used. Of the improved systems of incandescent gas-lighting there are two, but neither were on view at the time of our visit. M. Victor Poff will, however, light the French court with a mixture of gas and compressed air, said to be "overheated up to 1,200 degrees," which renders a gauze of platinum incandescent. This system is presumably similar to that of M. Clamond, which we illustrated and described on p. 514, last volume, and which will be shown in the Chinese Court. The best exhibit in the gas section is that of the Albo-Carbon Light Company, who have taken possession of the Pompeian House, and fitted it up with a billiard-table, a dining-table, and sundry other domestic appliances, wall and pendant lamps and gaseliers. The hanging lamps, each containing from six to eight burners, give a very white light (for gas), and the general effect leaves nothing to be desired. We described the principle of this invention in Vol. XXVIII., p. 86; but since then the arrangements have been considerably modified, and the solid hydrocarbon (naphthaline) is now added to ordinary coal-gas just before it reaches the point of ignition. The result is, that the gas is enriched with a large proportion of a light-giving material, and the flame is rendered white and brilliant. Visitors to the exhibition will certainly make a note of the system adopted in the Pompeian House; and when they have done that, they should go to the other end of the building, and see the effect produced by the Duplex Electric Light, Power, and Storage Company in the Roman Court, where they have fitted up a drawing-room and a kitchen with incandescent lamps, and promise a display of cooking by means of electricity. The incandescent lamps exhibited by this company have two loops (hence the name of duplex, we suppose); but, considering that the number of wires is thereby doubled, the advantage is doubtful, especially as the light given is no more for two carbon fibres than can be obtained with one. The company also exhibit a hand dynamo, to be driven from a large fly-wheel, with a few small incandescent lamps attached just above the dynamo. Just what is sought to be proved by this exhibit, it is impossible to say; but it will be useful as demonstrating the fact that the energy which can be exerted through a man's arm is capable, by suitable means, of being converted into light. A number of electrical appliances are shown in the court, and by means of vacuum tubes and other apparatus in motion, the company have produced an attractive exhibit. Returning to the gas-lighting section, near the Pompeian House, will be found a 9ft. buoy, with the appliances for using Pintsch's gas. This buoy has a lantern and dioptric lens, and, when fully charged to a pressure of about 90lb. per square inch, holds enough gas to last for three months continuously. A number of these buoys are employed off some of the principal harbours in this country, and are found to give great satisfaction, not only to the harbour board, but also to mariners. Close by is a portion of a first-class railway-carriage, showing the application of Pintsch's system to the lighting of trains. The gas is compressed in a cylinder placed beneath the framing, and sufficient is carried to last for thirty-six hours, the cost being stated to be less than half that of the usual oil-lamp. Alongside of this exhibit the Portable Gas Apparatus Company show the application of their gas (made from gasoline), to the lighting of railway-carriage lamps, and also the working effect of Clark's high-pressure governor. In this apparatus the gasoline is not merely used to saturate air with a hydrocarbon, but is subjected to destructive distillation and, mixed with warm air, forms a "permanent gas of high illuminating power." Gas-engines are shown by Crossley Brothers (Limited), and by the Turner Gas Engine Company, while "accessories" in great variety are exhibited at the various stalls. By "accessories" we include those relating to the branches of heating, cooking, and lighting. We have not space merely to enumerate the various devices exhibited in the shape of cooking and heating appliances; but we shall take an opportunity of describing any really useful novelties at some future time, when the exhibition is more complete. In the West Corridor, Deane and Co. have a collection of Mr. Fletcher's devices, comprising heating stoves and gas and petroleum furnaces, cooking appliances, and all sorts of useful apparatus for the laboratory, the kitchen, and the house. His asbestos gas-stoves undoubtedly take the first place, for they have all the appearance of a "cheerful" coal fire, and give out an intense heat. Amongst other gas-stoves exhibited may be mentioned those with a fireclay back and a cast-iron grating in front, on which platinum wires are arranged. The fireclay and the cast-iron become hot, and radiate the heat, while the thin platinum wires becoming incandescent impart "liveliness" to the fire; but they are not to be compared with Fletcher's for a fire which has all the "cheerfulness" so much desired without the smoke, dust, and dirt of coals. The Hygienic Heating and Lighting Company exhibit specimens of Clark's Syphon gas-stoves, giving "both light and heat while condensing injurious vapours by a special patented internal arrangement." In appearance these stoves resemble three pipes connected at top and bottom, the centre one containing the lamp or burner as the case may be. It is not quite clear why they are made with both lamps and burners—unless under some conditions the light is considered a disadvantage,—as it is quite clear they give the same amount of heat in any circumstances. There are not a few appliances in this gas exhibition which must be condemned, on sanitary grounds, unless they are placed beneath a flue, or in some situation where the products of combustion are taken out of the air breathed by human lungs. Some persons appear to think that if a gas-flame is blue, and no smoke is visible, that it may be safely used in any position; but even assuming the gas to be perfectly pure, carbonic acid must be produced, and if some arrangement for "condensing" or absorbing is not adopted, it ought to be taken away by means of a flue. Amongst other notable exhibits connected with gas, we may specially mention a beautifully made patent Beale gas exhauster, constructed by Bryan, Donkin and Co., the formation of which is shown by a model. The one engine drives two exhausters coupled direct, the screwdown valves being bolted to the exhausters, and all combined on one bed-plate. H. Greene and Co. exhibit at their stand a patent hydrostatic gas governor, which "cannot get out of order by wear," and a hydro-incubator, which works at a cost of one penny per week with 90 eggs. This has a small boiler by the side of the case, and a tolerably large reservoir for the water over the eggs. Judging by appearances, it is as simple a device as can be imagined for an incubator, and we shall probably have something more to say about it.

Although the arrangements for the electric lighting are in a backward state, there are several stands already occupied, and the majority will be completed by Christmas. Strode and Co. show McKenzie's arrangement for lighting gas jets at a distance by means of a spark between platinum points—a bichromate battery with lifting plates and an induction coil being the necessary appliances; H. and E. J. Dale have a large assortment of electrical appliances, and many other stalls are remanets from the previous exhibition—for instance, the working model of the Sykes' electric lock and block system. The Electric Light Carbon Co. show carbon rods coated with copper, wired through the centre or cored with metallic composition for better conductivity, and hollow for receiving colouring or other matter. The Electric Lighting Supply and Fitting Co. show Hedge's switches and "reliable" cut-out, adjustable to melt with any desired current. Amongst these is a switch used with the Crompton 10,000 candle arc lamp at the last exhibition, looking but little the worse for the wear. The Electrical Trading Company exhibit several of the inventions of Mr. C. V. Boys, in the shape of measuring instruments (one of which we described on p. 323, Vol. XXXIV.), and samples of the Berthoud-Borel cables which we recently noticed. Amongst methods for laying cables underground, Meyer's patent permanent way will attract attention. In this system the cables are laid between tiles which shut down upon one another with suitable tongues and grooves, the interspace being filled up with asphalte or pitch. The cables can thus be packed tier upon tier, and while thoroughly protected from wet are not very difficult to get at. Doulton and Co. also show specially devised "preservation pipes" of earthenware with ground joints raised upon chairs. The joints are held in place by wedges driven in between the flanges on the pipes and the cheeks on the chairs, the sealing being made with cement. The Alhambra Court, a favourite spot, will be illuminated by Werderman semi-incandescent lamps and Lea arc lights, which are said to be of a new type. Ferranti, Thompson, and Ince will light the Handel orchestra and the Italian Court, the former with a 300 ampère arc light and the latter with 300 20-candle incandescent lamps—the machines being placed on the ground-floor. Gerard and Co. will have some of the lamps in the nave, and a few other exhibitors will show the electric light, while there will be a fairly complete display of electric apparatus and materials generally; but it seems clear that the gas section will be the most interesting portion of the exhibition. Probably with the new year the arrangements will be fairly complete, but at present there are no signs of some of the electricians. Visitors, however, will find plenty to occupy their attention in the gas section, which is alone worth a journey to the Palace.

THE ACHROMATIC OBJECT-GLASS.—XIII.

By W. Bradbury.

(Continued from page 290.)

SINCE the condition of achromatism does not preclude a slight variation in the constitution of the residual spectrum, we must next inquire whether any other influence can be brought to bear upon this focal imperfection, by which the colour shall be wholly or partly destroyed. We have seen that the primary cause of this incomplete union is the irrationality of the spectrum, or the inequality with which the colours are dispersed by different media. To remove it by a radical change in the constitution of the glass, is not at present possible; for we require a crown of less—or a flint of greater—action on the interior rays, without correspondingly altering the extreme lines. The composition of a medium of this character has not yet been discovered.

But if the requisite change in the inherent action of a substance is not attainable, cannot the shape of its surfaces be so disposed, that its ultimate effect shall, to a certain extent, agree with what is required? A certain length of spectrum has to be produced, and we are not confined to one way of doing it. Its extent depends on the obliquity with which the rays leave the second emergent surface; and our object must be to inquire whether any modification in the internal relation of the coloured spaces is caused by the pre-emergent refraction.

In a series of articles published in this journal some time ago, I gave an account of Brewster's "Researches on the Irrationality of the Spectrum." He has shown that a slight variation in the allotment of the colorific intervals, is found in differently produced spectra of equal length. In a primary sense, equal spectra, from the same kind of glass, must always proceed from rays leaving the second surface under the same angles. But the rays are dispersed before they reach the emergent surface; and this interior dispersion must have some effect upon the exterior spectrum. To emerge at the same angle from a large or small angled prism, the first incident ray must enter the first surface under widely-differing obliquities, and consequently the internal dispersion will vary accordingly. Now what is the essential difference, besides their unequal extent, between a spectrum produced by a low angle of incidence, and one formed by a ray of great obliquity?

We estimate the dispersion of a ray by the angular extent to which it is separated. The refractive index of a colour is a constant quantity; therefore the angles, of whose sines it is the ratio, cannot increase by equal differences. When angles are very small, we take their differences as corresponding to the differences of their sines; but when they are large this proportion is not applicable. Consequently we may infer that, with different deviations of the mean ray, some of the colours will be more expanded than others.

Referring to the table, which shows the effect of irrationality when C and G are united, it will be observed that the E ray, or green index, is the middle of the residual colours, so that we may refer the requisite alteration of the colorific spaces to this ray alone. If a crown lens acts less energetically on this ray, the places of the others will also be reduced; and if one line can be made coincident, the others will be very nearly so. This green colour seems to be the most obtrusive. Mr. Wenham, in treating of the achromatism of the microscope, says, with reference to the test by mercury globule:—

"On placing the globule, either in or out of focus, the luminous point expands into a ring. If the object-glass is *undercorrected* for colour, the bright ring appears *within* the focus, the outer margin is *red*, and the inner circle *green*. If the lens is *overcorrected*, the bright ring appears *without* the focus, with the colours in the same order as before. When this is corrected, as far as practicable, a pale green colour only is perceptible beyond the focus. This arises from the secondary spectrum, or relative distance in the width of the prismatic colour-spaces of the crown and flint; and seems to be a variable condition, according to the composition of the glass employed."

By considering this green ray as a variable line, showing the contraction of the lower half and the expansion of the upper half of the spectrum, or *vice versâ*, Brewster found that the effect of various refractions could be expressed in the following manner:—

1. When a ray passes from a rare to a dense medium the lower half is expanded; but if it passes in the contrary direction the lower half is contracted, by increasing the angle of incidence. The greater dispersion occurring in the second case, the whole effect of a prism is to contract the red and green part, under an increasing obliquity of the incident ray.

2. Consequently, when refraction takes place from a dense to a rare medium, in a spectrum formed by a high refractive power, red and green will be less contracted than in an equal spectrum produced by a great refractive angle of a substance with a low refractive power.

Brewster found that these theoretical deductions were confirmed by experiment; for by inclining a small prism, in order to achromatise a large one of the same glass; there remained an outstanding green colour, similar in character, but opposite in position, to that produced from two different glasses. And on trial with flint and crown-glass prisms, it was found possible to correct, and even over-correct, the secondary colour, by an opposing colorific change due to the variable obliquity of the incident ray. With a crown-glass prism, angle 41° 11′, and a flint of angle 50° 28′, the outstanding green fringe had the same position as in an ordinary achromatic combination—viz., towards the vertex of the flint, thus showing that it had the *least* action on green light. With the same crown prism and a flint of much greater angle, 66°, the position of the fringe was reversed. Here the increased flint dispersion needs a greater inclination of the crown prism, which contracts the green so much that the secondary spectrum is overcorrected, and the preponderance is obtained by tertiary colour. This at once leads to the conclusion that with certain prismatic angles the two opposing effects will exactly balance. On trial being made with flint angle 62° in combination with the same crown prism, achromatism was perfect.

Several important conclusions may be drawn from Brewster's investigations. First, it appears that the *form* of a lens, as well as its focal length, has considerable influence on its dispersion; and, secondly, that by increasing the convexity of the inner convex, or diminishing the concavity of the inner concave, the secondary colour may be reduced. But the chief inference is:—the rays should leave the lower refractive medium at a *less* angle than that with which they enter the denser medium. Or, applied to lenses, the inner convex curve should be of *shorter* radius than the adjacent concave. So that it appears the condition of marginal contact, however convenient it may be in practice, is not the best arrangement for securing perfect achromatism.

Theory indicates that the interior curves of a combination have the greatest influence upon the final correction for colour. The aim must be to cause the ray to leave the lens in the same state, as near as possible, in which it entered; and this does not seem attainable, if a large amount of refraction is left to the back surface. Probably a slight corrective influence may be usefully exercised by it; but the chief part of the work must be accomplished within the lens. To quote the words of Mr. Wenham, which are as applicable in this case as they are to the microscope:—"Achromatism in the microscope object-glass, like that of other perfectly-corrected optical combinations, must be the reunion of the rays of the spectrum, *close* to the final emergent surface of the system." And so must it be with the telescope; correction for colour cannot be far removed from the centre of the combination.

These considerations relate to the general structure of the object-glass; but the influence which may be obtained from the procedure adopted to remove spherical error should not be neglected. The sphericity of the lens induces a species of chromatism very similar to general spherical aberration. To quote again from the same eminent authority:—"Correction for spherical aberration is intimately related to that of colour; a single lens, when finally achromatised, being also nearly free from spherical error." A spherical surface causes a similar aberration for each of the different colours; it can be figured absolutely correct for one colour only, though the correction of the rest will be partly obtained at the same time. Hence, there will be some variability in the amount of spherical chromatism, according to the ray for which the surface happens to be most agreeably fashioned.

Although it is imposible to distinguish, by mechanical means, which of two surfaces is the most suitable for truly refracting a ray of a given index, yet it is evident that for spherical chromatism, one or both surfaces of a lens may be under or over-correct without appreciably affecting its general freedom from aberration. This, of course, can not be visibly shown, for it is scarcely appreciable in comparison with the general prismatic dispersion, but it exists, nevertheless; and when the chief chromatism is corrected by a suitable proportion of foci, small matters become important in securing a final balance of error. In a parabolic mirror, there is one definite value for the aberration, for the ray is unchanged in transmission; but in refraction, there is a definite aberration value for each of the different indices. The curves which will destroy these errors must evidently be of the same family, but varying in magnitude. Thus, for parallel rays falling on a convex surface, the combination curves are ellipses, having the vertex and back focus alike, but varying in their convexity. If a curve be so fashioned as to cut through some are all of these, there will be a minute difference in the focal error, consistent with equally distinct focal points.

Although it is not possible to gauge the correctness of a curve, for any specified colorific refraction, yet its effect should be readily discernible in a nearly correct combination. Bearing in mind the surplus dispersion which is inseparable from crown refraction; it would seem to indicate that both the curves, and especially the second one, should be worked to destroy the colour as much as possible, even at the risk of incurring a slight addition to the minimum aberration attainable. As to the flint lens, I believe a very great power in final chromatic correction may be developed by a suitable curve to its inner surface. General considerations show that its concavity should be reduced as much as possible, due regard being had to other conditions; so that it is probable that in removing it from sphericity, a graduated depression from centre to circumference must underlie any particular curvature that may be assigned to it. Alterations of this character, although they do not admit of more than a general indication, must form the basis of any process for destroying the residual spectrum by counteraction among the various curves.

Erratum in Section XII.—Two diagrams were inserted in Prof. Young's paper which have no connection with it. They should have been reserved for a succeeding section.

(*To be continued.*)

SAFETY-VALVES.

ON the 30th October, 1878, an accident occurred at the Union Workhouse, Macclesfield, by which three persons lost their lives, and the master of the house was also very near falling a victim. The occurrence which led to this fatality was a very ordinary and a very simple one. Indeed, had it taken place in most boiler houses, it would in all probability have excited no alarm, or even surprise, and would never have been heard of by the outside public. The fatality was due to nothing more or less than the blowing off of a safety-valve, something which occurs almost every day with a great number of boilers. As in this particular instance, however, loss of life resulted, an inquest had to be held, and public attention was thus drawn to it.

The valve was of the kind known as Holt Lloyd's Patent, respecting which, without going here into any detailed description of the valve, it will be sufficient for our present purpose to say that it is capable of blowing off a large quantity of steam in a very short time, the makers claiming for it that it has "the largest possible outlet for the discharge of steam, with the least opposing weight." On the occasion in question it proved to be the reverse of a "safety" valve, though that was probably no fault of the valve; the quantity of steam suddenly set free was so great, and the space within the boiler house so limited and so difficult of access, that before two men who were in the stokehole, and another who was on the top of the boiler could make their escape, they were overpowered by the great volume of escaping steam, and either suffocated or scalded to death.

The evidence adduced at the inquest showed that the only access to the stokehole was by means of a ladder leading down into it from the yard and another ladder from the stoke-hole to the top of the boiler, was the only mode of access to the upper part. When the escape of steam from the safety-valve took place, the coping stones were blown off the wall in front of the boilers, and the door opening into the boiler house from the yard was blown violently to. One of the boilers in the house was at rest, and one of the men, in his anxiety to escape, had made his way into the furnace tube of the empty boiler, where he was found suffocated. Space will not permit of our referring to several interesting features about this accident, which was made the occasion of several homilies by chief engineers and others, on the enormity of making safety-valves without waste-pipes. It is on this latter point that we wish first to make a few observations, as although had the valve above mentioned been furnished with a waste-pipe for carrying away the steam, the men's lives would probably not have been lost, we think that the Macclesfield incident points rather to the great folly of building inclosed boiler-houses, access to and from which is so very difficult, rather than to the necessity for escape-pipes. Many engineers indeed have a very strong objection to waste-pipes under almost any circumstances, but especially as they are frequently found arranged It is not an uncommon thing to see safety-valve waste-pipes carried straight up through the boiler house roof, or often a considerable distance horizontally, and then made to rise, and in many instances this is done without any drain-pipe being inserted in the lowest point of the pipes for draining away the water of condensation. With such an arrangement, water is almost sure to accumulate in the pipes, and some years ago a most disastrous explosion occurred through the water in such a pipe becoming frozen solid and thus rendering the safety-valve completely inoperative. Only a week or two ago the writer saw two men deluged with a shower of hot water by the testing of a safety-valve fitted with a waste-pipe, under the outlet of which they were standing outside the boiler-house. The object of waste-pipes attached to safety-valves is of course to obviate the nuisance of the escaping steam whenever the valves blow off. But safety-valves as a rule should *not* blow off, and when they do they ought, in our opinion, to become a nuisance, so that the attendant may leave them blowing as little as possible. If the valves are in order, blowing off means that the steam pressure is getting too high, and this ought to be made demonstratively apperent to everybody about the boilers. Waste is taking place whenever steam escapes from a safety-valve, and when valves become leaky, as they frequently do, such waste may go on undetected and unnoticed for a long time, when the steam does not blow into the boiler-house, but is conducted into the chimney or some place outside where it cannot be so readily seen. It is possible that under some circumstances, as, for instance, when the room over the boiler is used for drying purposes, &c., the escape of steam may be very objectionable, and waste-pipes for carrying away the steam may thus be essential. If the pipe, however, has to *rise* at all after leaving the valve, a drain-pipe should in all cases be applied, to prevent the accumulation of water in the pipe and on the top of the valve, which otherwise will invariably be found to take place.

FIG. 1.

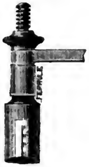
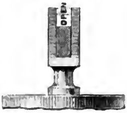


Fig. 2.



To avoid, as long as possible, the trouble of grinding leaky safety-valves, it is not an uncommon thing for lazy attendants, when valves are of the lever construction, to apply extra weights, screw-keys, fire-bars, bricks, &c., to the ends of the levers. This is a most objectionable practice, and one which cannot be too strongly condemned, as when the attachment of miscellaneous weights is permitted, it frequently opens the way to dangerous overloading. If, therefore, a higher pressure at any time is required, and the boiler is sufficiently strong to withstand it, if the weight at the end of the lever is too light, the best plan is always either to have the lever lengthened, or to procure a new weight of sufficient size, instead of attaching extra weights.

It is astonishing to find to what an extent safety-valves are sometimes tampered with by ignorant and reckless men in charge of steam boilers. Not only is additional weight put on the valve when more steam happens to be wanted, or owing perhaps to the valve being leaky and requiring grinding, but numerous instances can be adduced where the valve has been wilfully wedged down and rendered inoperative. In one instance that we remember, a piece had been cut off a file, and so neatly fitted in the guard over the top of the lever, that the fact of the valve being wedged quite fast could not have been detected had not the end of the lever been lifted and tested by hand. The lever or steelyard construction of safety-valve it will be seen is peculiarly liable to be tampered with and overloaded, a weight of a few pounds at the end of the lever being often equivalent to 10 or 12 times as much in its effect on the valve. Hence it is always desirable, in addition to a lever safety-valve, to have a good auxiliary valve of dead-weight construction, those of the external pendulous type being probably most to be preferred, and it is gratifying to note that most new boilers are now furnished with such a valve. Lever safety-valves loaded by a spring balance at the end are particularlarly liable to be overloaded, as this can generally be done by simply screwing down the nut, and when the latter is screwed down to its fullest extent, the valve is often locked quite fast and rendered completely inoperative. A disastrous explosion of a portable tramway boiler which occurred at Maidstone, Kent, a year or two ago, and the explosion of the boiler at the Wicklow Harbour Works, on the 7th September last, were due to the safety-valve having been screwed down fast in this way. This contingency may be guarded against by simply slipping a ferrule over the screw of the spring balances, as shown in Fig. 1.

The "guard" through which the safety-valve lever passes is frequently made too short, allowing very little lift, and the writer found a safety-valve a few weeks ago completely inoperative, owing to the small space (only about the eighth of an inch) between the top of the lever and the guard, having become filled with dirt. It is a good plan to have the top of the guard open, as shown at Fig. 2. When arranged in this way it will be seen that it is impossible to wedge down the valve in the manner above referred to. Much might be written, did our space permit, on the importance of placing safety-valves in open and accessible positions, and not immediately under roofing beams, walls, &c., as is frequently done. We have seen many instances in which the safety-valve lever has been within an inch or two of an overhanging beam, or passing through a wall where the insertion of a small piece of wood or anything would render it quite fast.

Happily, the old-fashioned type of safety-valve, where the valve spindle passed through a packed stuffing-box, has now almost entirely passed away; but a few are occasionally met with on old boilers. With this barbarous arrangement it was not an uncommon thing to find the spindle completely fast in the stuffing-box, and the boiler practically without any safety-valve, and the records of the different Boiler Inspection

Companies show many a disastrous explosion to be due to this cause.

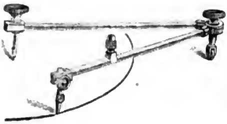
There is another point about lever safety-valves, inattention to which has led to many cases of scalding. Sometimes the spindle is too short, and one or two loose pieces of packing are inserted between the top of the spindle and the underside of the lever. A friend of the writer, some time ago, had a narrow escape from scalding, through testing a safety-valve in this condition. The loose packing-pieces fell from the spindle, and the valvo was blown out of its seat. In the Board of Trade reports, issued under the now Boiler Explosions Act, 1882, wo find an account of a boiler explosion at Norwich (No. 6), where such a packing-piece between the lover and valve had evidently been used, and by which the driver had evidently been enabled to increase the pressure on his boiler to any extent. Being loaded by a spring-balance, the valve had, in all probability, been locked fast, and thus led to the explosion.

Safety-valves should in all cases be attached direct to the boiler itself, and, if possible, should never be combined with any other fitting, such, for instance, as the steam junction-valve. One of the most disastrous explosions on record (St. Helen's, 1872) was due to the safety-valve being fixed upon the steam-pipe in connection with four other boilers. The boiler which exploded had been laid off for repairs, and to prevent the hot water which leaked into it from the other boilers dropping upon them, one of the workmen had driven a wooden plug into the opening of the steam-pipe. When the repairs were completed, the plug was forgotten, and the boiler was put to work with the communication between the safety-valve thus completely shut off; and as, unfortunately, one pressure-guage served for the whole range of boilers, nothing remained to give any indication of danger. As the attendant got up steam, the only effect on the wooden plug was to force it more tightly into the hole, and eventually the boiler burst from sheer over-pressure. By this accident four persons were killed and thirteen injured, and the whole works laid in ruins.

Generally, and on very many grounds, we consider the lever safety-valve in common use open to grave objection; and, in our opinion, the best safety-valve equipment for large boilers consists of an external pendulous dead-weight valve and an auxiliary valve, arranged so as to blow off for low water as well as high steam. With duplicate safety-valves, such as described, and without any waste-pipes in which water could accumulate, these important fittings would be kept in better order, and accidents from them would become extremely rare.

BROOKE'S HORIZONTAL JOINTED DRAWING COMPASS.

THE ordinary beam compass is always more or less difficult of adjustment, and is frequently the cause of much trouble to the user on account of its want of firmness and solidity. In any instrument where the distance between the working points is of an extended character, these difficulties are rarely overcome, especially when lightness of construction and absence of clumsiness have been insisted upon. Mr. W. H. Harling, of 40, Hatton Garden, has introduced Brooke's horizontal jointed drawing compass, which bids fair, in our opinion, for many purposes, quite to take the place of the old form of beam compass. It is constructed with two arms of tubular section, at once giving the greatest strength with corresponding lightness; these arms are jointed in the centre after the fashion of the compass joint, but a thumb-screw enables the user to firmly fasten the arms at any desired angle. A glance at our engraving will at once explain how this is managed, and it will be noted that the slightest bending of the knee or alteration of the angle will cause a correspondingly delicate reduction or enlargement of the diameter intended to be struck by the instrument. By a simple contrivance any needle-point can be adjusted for use as a centre, and at the other end of the instrument an expanding holder for the pen or pencil point is provided. A pen is made and specially suited to the compass, and an over-pointed pencil point is used with it, though beyond this there is the advantage of being able to use an ordinary lead pencil point by reducing the wood upon it, as is usually done for use in bow pencils. An engine-turned knob or working handle is contrived near the marking point, and this, in conjunction with the ivory wheel in the centre of the compass, gives the draughtsman entire control over the instrument. The one before us is in white metal, and will strike circles from 3in. to 14in. diameter with the greatest nicety. Other patterns are made, having telescopic arms for the production of much larger circles, and for cheapness, brass is substituted in some cases for white metal.



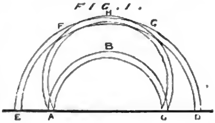
ON RAINBOWS PRODUCED BY LIGHT REFLECTED BEFORE ENTERING THE RAINDROPS.

By William Ackroyd.*

RAINBOWS which are produced by rays of light reflected from a sheet of water before entering the drops are only seen on rare occasions. They are non-concentric with the ordinary primary and secondary bows, and are, as a rule, of a fragmentary nature. On August 6, 1698, Halley,† the astronomer, saw a complete non-concentric bow, and for clearness I may here give, in a few words, such particulars of his observation as I shall require. He was standing by the Dee in the evening when he saw the usual primary and secondary bows, A B C and E F H G D, and between them a tertiary bow A F H G C, (Fig. 1.) The order of colours in the tertiary was the same as in the primary bow, and, consequently, where the secondary and tertiary bows appeared to overlap there was portion of a white arch. The phenomenon has been seen before, and has often been seen since, and nearly all observers have noted the presence of a reflecting sheet of water, which they have regarded as the cause of the non-concentric bow. Halley remarks:—"Recollecting that the sun shone along the river Dee, I concluded this arch, A F H G C was produced by the beams of the sun reflected from the water." He further regarded the tertiary bow as that part of the circle of the primary which would have been under the water bent upwards by reflection. I shall show that it was an independent bow. When Dr. Sturges observed the phenomenon he similarly regarded the tertiary bow as due to reflection of the sun's rays from the surface of the sea. He remarks:—"The image reflected from the water, having its rays issuing from a point lower than the real sun, and in a line coming from beneath the horizon, would consequently form a bow higher than the primary."‡ The phenomenon has been often seen since, and the same cause has been assigned for it; but the bare assertion that a tertiary bow is produced by light reflected from the water has evidently not been accompanied by a clear conception of how it is produced. I shall try and show clearly how such a bow is produced; the conditions requisite for seeing it complete or fragmentary, and the reason why a low-lying sun is necessary.

Let the bows A B C and A F H G C (Fig. 2), which are formed of hollow cylinders of rays from the sun, intersect in A and C. Rays parallel to S^1 B form the primary bow A B C, and other rays parallel to S^1 B form the bow A F H G C after striking the water at an angle of incidence, say, of 80°. The observer at o sees both bows, and with the same order of colours. Therefore, a portion of the ray $S^{11}r$, after reflection at r and striking a raindrop at H, is returned to o, making the angle r H o equal to the angle S^1Be, about 42°. The two bows are formed by rays proceeding as if from different sources in the directions S^1B and r H respectively; the bows are, therefore, inclined to each other at an angle which will vary with the angle of incidence $n\,r\,S^{11}$, and the tertiary bow is also inclined to the reflecting plane at the same angle as rays from the sun are incident on the plane, because rHM being a right angle, the angle HMr is complementary to HrM, and, therefore, equal to $n\,r$ H or $n\,r\,S^{11}$. The bow A F H G C inclined at any other angle could not optically exist to the observer at o, for the angle r H o must remain constant, and if the angle r M H were decreased or increased there would be an inverse alteration of the angle r Ho, which would render the bow in its new positions invisible at o.

FIG. 1.



The ray r H proceeds to the raindrop at H as if it came from S_{11} below K L. And the rays, $S^{111}e$, $S^{1v}f$, reflected to other parts of the bow as to F and G, proceed as if from S_{111} and S_{iv}. These rays are part of a hollow cylinder, coming as if from below K L in the direction S_{11}H, and, meeting a ring of drops, is then turned in on itself, backwards and analysed, to o. This hollow cylinder producing the tertiary bow has its surface cut by the mirror-like plane of water A$e\,r\,f$C, and it is along the curves thus formed, A$e\,r$ and C$f\,r$, that light from the sun is reflected to the drops forming the bow A F H G C. Through o draw ef parallel to A C. It is obvious that the sun's light reflected from the dotted curve $e\,r\,f$ produces the top portion of the bow, F H G; and light reflected along the lines e A and fC produces the portions A F and C G respectively. Hence the part and extent of tertiary bow seen depends upon the observer's position with respect to the reflecting surface. If the observer at o be on the sea-shore with water A$ef$C in front of him, it will not be possible for him to see more than the legs A F and C G of the tertiary bow. On July 9, 1792, Dr. Sturges being at Alverstoke, on the sea-coast of Hampshire, and looking out to sea, saw the fragment C G of a tertiary bow, and also a faint similar fragment of a quaternary bow. On the other hand, if the area A$ef$C be land or some other comparatively non-reflecting surface, and the water, or a river, whose bend coincides with the curve $e\,r\,f$, be all behind the observer at o, then F H G of the tertiary ought only to be seen. When a comparatively narrow river is the reflecting surface in front and to one side of the observer one leg only will be

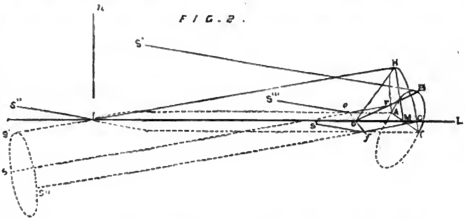


FIG. 2.

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* Read before the Physical Society, Nov. 25th, 1882.

† *Phil. Transactions*, abridged by Lowthorp, Vol. II., p. 188.

‡ *Phil. Transactions*, 1793, Part I., p. 2.

seen, as was the case in M. Estienne's* observation at Chartres on the evening of Aug. 10, 1665. It is also apparent that to see a complete bow the position of *o* must be such that he is surrounded by a reflecting surface, which contains the whole of the curve A *e r f* C.

Both the primary and tertiary bows form portions of cones whose vertices are at *o*, and bases partly in the rain shower. The axis of the cone producing the primary is below the reflecting plane, while the axis of the other is above it; therefore, A F H G C is the greater segment exposed to view, and its summit H has been known to extend far above the summit of the secondary bow.

I have referred to the fact that when a tertiary bow is seen the sun is at a low altitude; thus, Estienne's observation was made at 6.30 p.m. in August; Halley's also between 6 and 7 p.m. in the same month, and Sturges's between 7 and 8 p.m. in July. The reason of this I take to be as follows: Rainbows consist wholly of light polarised in the plane of reflection within the drop, according to Sir David Brewster. Consequently, if the sun were at such an altitude that its rays were incident on the water at the polarising angle, then the legs A F and C G of the tertiary bow would not be visible to the observer at *o*, for the drops in these legs would act as analysers to the already polarised light entering them. Therefore, when the sun is at a low altitude the loss of light from this cause is minimised, and the amount reflected from the surface of the water is so far increased as to make the tertiary brilliant enough to be seen, and sometimes even a quaternary bow too. It is unnecessary to enter into an explanation of the quaternary bow, as it bears the same relation to the secondary that I have shown the tertiary bears to the primary.

THE PROGRESS OF LIFE ON THE EARTH.

LAST week Miss Arabella B. Buckley delivered two lectures before the Edinburgh Philosophical Institution on "The Progress of Life on the Earth." In the outset of her first lecture, Miss Buckley spoke of the rapid advance of knowledge during the present century on the subject with which she had to deal, and mentioned that there were two methods by which this branch of research was being prosecuted—palæontology and embryology. She proceeded to point out that the earliest known life was invertebrate, and that it was only on coming to the upper Silurian rocks that we began to find vertebrates in the shape of fish. These fish were shown to be covered with heavy plates, and to have a gristly skeleton; and, as throwing some light on the transition from the invertebrate to the vertebrate form, reference was made to the existing lancelet and ascidian. Tracing next the history of the cartilaginous fishes on to the sturgeons and sharks, Miss Buckley alluded to the double breathing mud fish of our day as helping to explain anomalous ancient forms. The mailed fishes, she said, were very heavily weighted in the battle of life. They lived in bays and estuaries; were too heavy to venture far out; and, when higher animals began to appear, they had not the power to move quickly to make the water their own. They were intermediate dwellers just on the margin of the land; and the battle of life became too heavy for them when the amphibians and the reptiles began to appear. These took possession of the water as well as the land; and then the mailed fish began to give way, and died out, with the exception of eight or nine types. Very small in comparison with their gigantic ancestors, these had taken to fresh water had crept into the nooks of life, where they were less attacked, with the single exception of the sturgeon. The history of the sharks had been somewhat different. They had not armour; they had a strong gristly skeleton, which, as ages went by, they strengthened; and thus, fighting the battle of life, they had held their own up to the present day, breaking out into all kinds of strange types, such as skates and rays. Before the mailed fish gave way, they sent out an offshoot to take possession of their peculiar kingdom, in the shape of the osseous fishes. These acquired a stronger skeleton, more powerful as a means of pushing their way through the water; while, getting rid of the heavy armour, they began to wear the scaly armour which was so perfect a protection to the bony fish of the present day, and yet was so light as to be no encumbrance. Passing on to speak of the change from water-breathing to air-breathing animals, such as began to appear in the Devonian rocks, Miss Buckley showed how light was thrown upon this transition by that which may be observed in the development of the tadpole into the frog. In further illustration, reference was made to remarkable peculiarities of other living forms; and in answer to the question, at what point the early amphibians broke off from the fish-like forms, it was submitted that the inquirer must go back to a point where fish were beginning to be fish, and there he might find the amphibians beginning to separate. These latter also, the lecturer remarked, fought their way up, and became enormous animals; but they came in contact with the larger reptiles, and had to give up their large forms; they dwindled, almost disappeared, and only in small forms in later times began to make their way into the nooks and corners of the earth.

In her second lecture, referring to the conditions under which early reptiles lived, the lecturer pointed out that when fish first began to appear we knew of little but marine life; but there could be no doubt that at the amphibian period there were large land areas, some dry and some swampy. The origin of the amphibia might seem clear to persons accustomed to look on them as something nearly akin to reptiles, yet the truth was that there was a larger gap, in many senses, between amphibia and true reptiles than there was between fish and the frogs and newts. It was shown that it was in the secondary rocks where the great age of reptiles was to be found. Nothing was more remarkable in the history of the world than this great life of reptiles. By the time the chalk rocks were reached they were found to be filling every point in land, water, and air, which were now filled with mammalia. In the sea these creatures must have reigned supreme. Various kinds of these animals were described, including flying reptiles. These were powerful flyers and fed largely in the air, yet it was curious that it was not by them that we were to pass on to the birds. The former had the power of conquering the air, yet they were to be swamped by another type which was not to spring from them, but to spring from a type essentially land mammals, and which had no power of conquering the air. When the mammals took possession of the land, birds drove reptiles from their home in the air. After remarking that with the disappearance of reptiles, at the end of the secondary period, came an outburst of mammalian life, the lecturer proceeded to show that in the battle of life mammals have had a great advantage over other animals—an advantage which, she believed, she was the first to bring into prominence. The young of creatures born from eggs, it was pointed out, must necessarily have a hard time of it. In mammalia, on the other hand, the mother protected the young, which gave them a very great chance in life; and as soon as mammalia were traced in the earth they were found to take the place of conquerors. Allusion was made to the gradual development of social feeling and affection through types of animals as they rose upwards. It was pointed out that there was little parental feeling shown by fish, who quickly leave their eggs. Few of them watched over their young, and when they did so it was the father who took care, and not the mother. When we came to the amphibia it was the same, and the same, also, with reptiles, with the exception of the crocodile and a few others. We only come to strong parental feeling in animals with warm blood, four chambers of the heart, and quickly flowing blood through the system, which heightened the nervous faculties and made the mother observant. Social affection was found in birds, and still stronger in mammals, though in the lower mammals affection was weak. In carnivorous animals the affection was purely parental; and it was in the weaker herbivorous animals who had to combine to protect themselves, that social affection was to be found. In conclusion, the lecturer maintained that man was as surely linked with the rest of the mammalia as the dog, the lion, or the cat; and she argued that if they went back to the time, which must once have been, when man sprang out from the other mammalia, they would see that, as was the case with other animals, when the struggle became keenest, it would be the degraded links, which hid in the nooks of life, that would continue to live, while the intermediate links would disappear.

OIL ON TROUBLED WATERS.

THE influence of oil in calming the surface of the sea has been occupying a good deal of attention lately. In a paper to the Paris Academy, Admiral Bourgeois expressed his views regarding it, which are as follow:—

The principle is hardly contestable; but the practical results which may follow are the object of serious doubts, which the facts recently announced do not wholly dissipate. The witnesses of those facts generally omit to specify precisely the nature of the agitation which the oil is said to have calmed. There is, however, a distinction to be drawn between the two phenomena, whose superposition constitutes the wave or surge.

The first and the most important, because it agitates the water to a great depth, is the orbital motion of the liquid molecules, whence results the succession of waves that catches the eye; a motion produced by the prolonged action of the wind, and which is often propagated to very great distances from the regions where the wind has blown, and continues long after that has ceased.

The second phenomenon is the horizontal motion of translation of particles of the liquid surface, when they reach the crest of the wave, are disaggregated from it by action of the wind, and by mixture with the air, acquire the whitish colour of foam. They then fall over in front of the wave in volute forms, the dimensions of which depend on the force of the wind and the size of the waves. The same phenomenon is observed in absence of wind, when the swell from a distance breaks on a beach; only it has another cause, the retardation of the lower part of the wave through friction on the bottom.

When, the wind having ceased, the first phenomenon is produced alone, it is the *swell* which raises large ships as well as small boats, and causes them to roll; but which is not dangerous, except for fixed obstacles, such as breakwaters or jetties, against which the swell breaks.

None of the facts recently cited appear to prove any sensible action of oil spread on the surface of the sea on these undulations, and, perhaps, it would have been prudent to wait till experience had shown the reality of such action before seeking to explain it by calculation.

The second phenomenon constitutes the *breaker*. It is observed in the open sea when a breeze begins to blow, and becomes more marked in proportion as the breeze freshens. Small vessels are in danger from it in the open sea or near shore, when the breaking wave threatens to fill them. Large vessels may receive dangerous shocks from these breakers, especially if they are not protected by their lee way (*dérive*); which, by ploughing the sea, weakens the breakers, while the swell subsists.

It is incontestable that the presence of oil, or of any other viscous substance, on the surface of the sea, may hinder the liquid particles being disaggregated under the influence of the wind, and so forming the *breaker*. A fact often observed by sailors in the tropics furnishes an irresistible proof of this. At night, the phosphorescence of the waters reveals the presence, in them, of large masses of organic substances of animalcules, which give these waters a greater cohesion, and so oppose the disaggregation of particles from their surface. Then the wake of the ship, luminous during the night, hardly produces any whitish foam during the day. The waves thus lose their crests, and the ship, whatever its speed, glides over the sea, leaving hardly any traces of its passage in daylight.

The presence of an oily matter, then, on the surface of the sea, has a certain effect in hindering, not the formation of waves, but that of breakers.

In what measure may this property be utilised in the interest of navigators? That is a point experience has not yet determined. In any case, it is indispensable, in order to its being fruitful, that experimenters should observe, and specify clearly, the nature of the agitation calmed, the wave, or the breaker. The former will perhaps defy all their efforts. The latter seems less difficult to master, and nature, in the vast laboratory of tropical seas, furnishes convincing proof of it.

DYNAMO-ELECTRIC MACHINERY.

ON Monday night Prof. Silvanus P. Thompson delivered the third and last of the course of Cantor lectures on this subject before the Society of Arts, the special topic of this lecture being "The Dynamo as a Motor." Prof. Thompson said that in 1821 Faraday invented a dynamo machine which converted power and produced action. It was improved on some years later by Barlow. Page invented an electric motor in 1834, and continued to improve on it till 1852, when it was stated to be able to drive a circular-saw and a lathe. It was improved later on by a Scotch electrician, who was able to make the motor drive a machine, while another was able still later to make the instrument drive a machine at the rate of 10 miles an hour. The lecturer then described the power of the motor current on the magnet when it was acting on iron filings, and showed that when the force of the current was forward and backward the lines were in directly opposite directions. If they wished to get as much work as possible out of their dynamo and generator, they must be of equal power of current. When they accomplished that object they got the greatest quantity of work, and if motors were to be of use in the workshop they must run at a uniform rate. He might say that a great field of labour still lay before the dynamo motor. They were aware of the electric railway car that was produced in Berlin, the tram in Paris, and, in fact, there was a line of railway being now worked in Ireland by the motor power. It had also been applied to the driving of boats, and there was now one on the Thames which carried 12 persons. The boats worked by motor power would increase in size in time, in the same way as steamboats had, and if those who saw the first steamboats plying on the waters were to rise and see the immense vessels driven by that power they would be surprised. He then referred to the electric lighting of the present day, and expressed a belief that by the application of the electric power of the dynamo they would be able to light up every town most successfully.

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* *Phil. Transactions*, abridged by Lowthorp, Vol. II., p. 183.

SCIENTIFIC NEWS.

THE British Transit of Venus expeditions have been successful at all stations except Brisbane—a telegram having been received announcing the success of the Madagascar party. The interval between the contacts at ingress, as observed at Madagascar and Bermuda, is about 13 minutes. The ingress observations at the West Indies, combined with those at the Cape, will supply the means of making one good determination of the sun's distance; while the egress observations of the West Indies, combined with those made in New Zealand, will furnish another.

At the last meeting of the Royal Dublin Society Mr. Grubb stated that he had received a letter from Dr. Huggins announcing the fact that he (Dr. H.) had succeeded in photographing the corona of the uneclipsed sun. Dr. Huggins was himself to describe the *modus operandi* at the next meeting (yesterday), and his communication regarding this unique feat in solar photography will be read with great interest.

By means of an approximate orbit of Barnard's comet (*c* 1882), calculated by Mr. Hind, and forwarded to Mr. Gill at the Cape, the object was found the same evening, and was subsequently observed on the meridian for several days in succession. The comet arrived at perihelion on Nov. 13; and Mr. Gill's first position on Nov. 11 was: R.A. 12h. 53m., 21·740s.; S. Dec. 65° 57' 28·3".

At a meeting of some members of the general committee of the British Association, held last week, it was determined to memorialise the council with reference to the proposed visit to Canada. The question has been under consideration for some time; and it is probable that the meeting will be held as usual in this country for the transaction of formal business, and will then be adjourned to Montreal. A suggestion is, that the meeting should be held in England, and a deputation be sent to Canada—the deputation, presumably, including all who wish to go.

Prof. Kennedy held a reception at the Engineering Laboratory, University College, last Friday, in order that visitors might inspect the machinery and appliances which render this "workshop" the most complete of its kind. The laboratory was the first established in connection with a college in this country, and since 1878 it has been gradually enlarged and improved.

Electro-motors are to be used for working the tramway in San Francisco, the current being supplied by accumulators. The "Friscans" have also established an Edison Light Company with a capital of five million dollars.

Besides the utilisation of small incandescent lamps as ornaments for fairies, &c., several of the theatres are abolishing the lime-light apparatus and using arc lights fitted up much in the same way as they are on board men-of-war.

The rumours as to the discovery of a method of obtaining aluminium have not taken a very definite form, beyond the statement that a ton can now be produced in a week at a cost of £100, instead of in nine months at a cost of ten times that sum. The method consists, it is understood, in first calcining ground alumina and pitch, and treating the product in vertical retorts through which steam and air are forced. Should the rumours prove to be true, cheap aluminium will be found to be very useful in many branches of industry.

The Danish Arctic vessel *Dymphna* is now reported to be safe near the mouth of the Petchora, all well. The proposed sledge rescue expedition has been abandoned, however, because no reliance can be placed on the rumours, and it is felt to be a hazardous undertaking.

The French Minister of Public Works has issued an order requiring that all trains should be fitted with continuous brakes—if possible, automatic in action.

M. Dumas recommends water saturated with alum for use in extinguishing fires, and the French Minister of the Interior has recommended that firemen should be supplied with facilities for using alum.

The Academy of Sciences of the Institute of Bologna offers a gold medal, value £40, for the best memoir on systems or apparatus for the prevention or extinction of fire. The memoirs must be written in Latin, French, or Italian, and be sent in before the end of May, 1884.

The ease with which persons fall under hallucinations of special sense is illustrated as follows by M. Yung (in a recent communication to the Helvetic Society of Sciences):—The operator places eight cards on a table, in positions corresponding to forehead, eyes, ears, nose, mouth, and chin; he pretends to "magnetise" them, and also some person in the company, and then goes out, while the magnetised person is required to touch any one card. The operator having returned, notes the action of a confederate, who scratches a part of his head corresponding to the card touched. Then he commences an innocent comedy, passing his hand carefully over the cards, and on reaching the touched card, seeming to experience a strong shock. The observers are surprised, of course. One of them is then asked to go out and repeat the experiment. It is assumed that a certain card has been touched. Passing his hand over the cards, he indicates, in nine cases out of ten (M. Yung says), a particular card as giving him a shock, and if the company be instructed to support his idea of that being the "correct card," he is confirmed in his illusion, which may be successfully repeated. Of 85 persons tried, M. Yung found only 9 who refused to indicate a card, not having experienced any sensation; 53 said they had exactly the sensation announced, and 23 described some different sensation.

A formidable shark was lately captured at St. Paul, in the island of Réunion. The fishermen had observed it for some time following their boats. It was caught with a baited line, and pulled ashore by fifty men; a slip-knot having been passed round the tail. It proved to be a female shark of the species called *Carcarias prionodon* (having saw-like teeth). It measured exactly five metres (about 16ft. 8in.) in length, and 3·60m. (12ft.) circumference at the middle. It was stranded at a point where a man would be beyond his depth. Two other small sharks were captured soon after. A considerable crowd came to see the monster, which was exhibited by the fishermen at 10 centimes a head. M. Lantz, director of the museum, was advised of the capture, and has preserved the skin and the skeleton.

A disease of pigs, known in France as *rouget* or *mal rouge* (red evil), has of late wrought terrible ravages in the Rhone Valley, 20,000 pigs having succumbed in a year. M. Pasteur has detected the microbe to which the disease is due. It is somewhat like that of chicken cholera, but much smaller and different in physiological properties. Its form is that of the figure 8. It has no action on fowls, but rapidly kills rabbits and sheep. Injected in almost inappreciable quantity into pigs, it suffices to cause mortal disease. M. Pasteur has succeeded in producing an attenuated form of this virus, wherewith healthy pigs may be vaccinated and rendered refractory to the contagion.

It is now known that the substance of glaciers is made up of crystalline grains (each grain a single crystal), which increases in size as the glacier descends. Swiss physicists differ as to the nature of this increase. Prof. Forel attributes it to freezing of water of fusion that comes from the surface through capillary fissures. The mass cooled below zero in winter cannot rise to the temperature of zero in summer except by the latent heat liberated by water at zero, when it freezes in the heart of the glacier. On the other hand, Prof. Hagenbach-Bischoff thinks M. Forel's theory inapplicable to the compact mass of the glacier proper (though it may explain the change of pulverulent snow into that of the *névé*, and the change of the *névé* into ice). He considers the cause of the increase to lie in the *over-crystallising (Uebercrystallisiren)* of one grain at the expense of its neighbour. The known fact that the melting temperature of ice is lowered by excessive pressure and raised by extension, accounts for the plasticity of a crystalline mass; water produced by fusion at points where the pressure is greater is transported and frozen at points of less pressure. It is further supposed that the crystals of ice present differences of compressibility in their different axes; hence crystals differently directed will have unequal power of raising or lowering the temperature of fusion under pressure, and some will tend to grow at the expense of others less favourably directed.

From a recent examination, by Dr. Franzius, of the teeth of 650 soldiers in Russia, it appeared that 258, or nearly 40 per cent., had dental caries. He finds that of all the teeth, the third molar is most often affected: such cases making up one half of all the cases. The teeth are affected in a certain successive order; first, the lower third molar is attacked, then the upper, then the lower fourth molar, and so on. The incisors and the canine teeth of the lower jaw stand last in the line. The durability of the upper teeth stands to that of the lower as three to two. The teeth in persons of fair complexion and hair, are less durable than in those of dark complexion and hair (40 to 37 per cent.). Stature has a manifest influence on the durability of the teeth, which increases with decrease of height, and *vice versâ*. (Dr. Franzius seeks an explanation of this curious fact in a less perfect outer circulation in tall men than in short men.) The right teeth show a greater vitality than the left. The conditions of the soldier's life do not show any harmful influence on the state of the teeth.

Recent experiments by Prof. Kohlrausch lead him to the result that silver chloride, bromide, and iodide conduct electricity, at temperatures above their melting points, much better than the best-conducting sulphuric acid (that is, the best-conducting liquid conductor at ordinary temperature). The chloride conducts best; the bromide comes next; then the iodide. The resistance of silver chloride and bromide increases very much and quickly in solidification of the substances; and on cooling to 20°, it rises to more than a million times the initial value. Iodide of silver, on the other hand, does not alter in resistance in solidifying; but first shows a rapid increase of resistance at 145°, the temperature at which it passes from the amorphous into the crystalline state.

The reaction-force of out-flowing liquids may be determined (Herr Meldo has lately shown) by means of the torsion force of a wire. The method may yield good results, he finds, when applied to the flow of electricity from points, as in the electric flywheel. No attempts have before been made to measure these forces in an exact sense. There are various points to be determined: the influence of nature of the points (in form and material), that of the source of electricity, the mode of conduction, the surroundings, the difference of positive and negative electricity, &c. Herr Meldo is pursuing this investigation.

The opposition of the English Government to the construction of the Channel tunnel is, to the editor of *La Nature*, "un sujet d'etonnement et de tristesse." "We see once more, by this example, that it is often more easy to conquer nature than human prejudice." Our excellent contemporary furnishes a fac-simile of a curious old engraving of June, 1803, in which are represented not only numerous boats with cannon being rowed over towards the English coast, and the protecting fleet, but troops and war material passing through a tunnel below, and balloons floating over above. The English appear to have resorted to a system of huge kites, with a sharpshooter at the end of each tail! The artist must to have drawn considerably on his imagination, but he doubtless also manifests the inspiration of ideas then prevalent. M. Tissandier wonders that this picture of subterranean invasion is not as laughable to English minds as it is to French.

From recently-published statistics, it appears that the French Administration des Postes, in 1881, transported 568,978,000 letters, 354 million newspapers, 347 million books, &c., and 32,234,000 post-cards. In four years the postal traffic has increased about 56 per cent. On an average, each Frenchman receives nearly 14 letters a year, and nearly 10 newspapers. The letters, with a mean weight of about 10 grammes, represent more than six million kilogrammes, a weight which would take nearly 3,000 horses to draw in carts. The newspapers weigh on an average about 25 grammes each, or, altogether, 8,850,000kgr. that is to say, they would load a train of more than 800 waggons. If the letters sent last year were unfolded, and placed flat, side by side, with their envelopes, they would cover about 500 hectares (say 1,235 acres). The papers would cover a surface of at least 17,000 hectares (say 42,000 acres).

The silver medal, the highest prize given for non-conducting compositions at the Bradford Exhibition, has been awarded to F. Leroy and Co., for their well-known non-conducting composition.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

GALILEO—THE ONLY LEGITIMATE FORM OF ENDOWMENT—DIALLING: ERRATUM—"BALL'S" (?) DIVISION IN SATURN'S RING—THE TIDES—OUTFIT FOR AN INCIPIENT ASTRONOMER—A RATHER INDISCRIMINATE INVITATION FROM THE SOLAR PHYSICS COMMITTEE—COMETS AND SUNSPOTS—SUNSPOTTERY AND ITS "NATURE"—THE ELLIPTICITIES, ANGLES OF INCLINATION, AND PERIODS OF ROTATION OF MERCURY, VENUS, MARS, URANUS, AND NEPTUNE—STAR MAGNITUDES.

[20849.]—I have just finished reading that painfully interesting book, "Galileo Galilei and the Roman Curia," by Von Gebler, in the excellent English translation by Mrs. Sturge; and I have risen from its perusal assuredly a sadder, if not a wiser, man. The study of the miserable history of the mighty Pisan, as derived from authentic documents, has brought with it an amount of disenchantment to me that is mournful indeed. That Galileo was, in any legitimate sense, a Martyr of Science, it is as impossible to maintain, in the face of the attitude he assumed when arraigned before the (so-called) "Holy Office," as it is to contend for the historical truth of the legend of King Arthur's birth at Tintagel. Verily, both the immortal Natural philosopher and the "infallible" Church come but meanly, indeed, out of the ordeal of Von Gebler's critical inquiry. Anything more slavish than the submission of Galileo to the dicta of the Inquisition it would be impossible to conceive. Its abject servility is pitiable beyond expression. Moreover, Von Gebler shows that the time-honoured legend of the utterance by Galileo, as he rose from his knees, "E pur si muove"! is the merest fiction, and utterly without foundation. Of course, in forming an estimate of the character of Galileo, we must not lose sight of the fact that had his submission not been complete, but one possible fate awaited him. "All that a man hath," it has been said, "will he give for his life"; and the maintenance of any doctrine, however irrefragably true, in the 17th century, in opposition to that held as orthodox by the bloodthirsty fanatics who formed the Inquisition, meant absolutely certain and painful death. Still, it is very saddening to find a popular hero, such as Galileo has undoubtedly been, while intellectually so great, yet morally so singularly small. It is instructive at the present time to note that the author of the book which has formed the text of these remarks traces all Galileo's misfortunes to his removal from the University of Padua, in the great Venetian Republic, to the Tuscan State;—a removal having its origin in Galileo's wish to be "endowed." "After twenty years' professorship," says Von Gebler, "Galileo longed for a post in which he could prosecute his own researches, and devote himself to the completion of his works, free from academic duties. A letter from Padua, even in the spring of 1609, shows his longing for this salaried leisure. But he is aware that the Republic can never offer him such a post, for it would not be suitable to receive a salary from a free State, however generous and magnanimous, without serving the public for it; because if you derive benefit from the public, you have the public to please, and not a mere private person." In the event, as is well known, Cosmo II., the Grand Duke of Tuscany, gave Galileo the honorary post of first philosopher and mathematician of the University of Pisa, and, as says his biographer, "It was the first step which precipitated Galileo's fate." Surely the moral to be drawn from this is too obvious to need insisting on here. Another lesson to be learned from this sad history is that of the exact kind and amount of deference which need and should be paid to theologians who dare to oppose their dogmas to the ascertained facts of science. It may well be noted that up to the year 1835 Galileo's dialogues on the motion of the Earth round the Sun remained in the "Index Expurgatorius" of the Roma Curia!

Turn we now to a very different sort of Endowment, the fruits of which are evidenced by Professor Pickering's "Statement of work done at the Harvard College Observatory during the years 1877—1882," in which, in the compass of a twenty-three page pamphlet, the eminent American astronomer gives an account of an amount of solid, substantial scientific labour of which he may well indeed be proud. Crippled as the Harvard Observatory was for want of funds, an effort was made in the autumn of 1878 to secure for it an annual subscription of 5,000dols. for five years. I need not assure my brother-readers that the kind and character of work prosecuted at this noble institution was thoroughly well known; and hence it is scarcely surprising to learn that "about seventy ladies and gentlemen of Boston and vicinity responded to this call; and by their generous aid have placed the Observatory in its present improved condition." Let us see how Professor Pickering summarises the effect of this wise private munificence. "Without it," he says, "only one instrument, the meridian circle, was kept actively at work, the large telescope being comparatively idle. The reductions even of this one instrument could not be kept up, but every year fell more and more behindhand. With the subscriptions, the large telescope, the meridian circle, and the meridian photometer are in constant use. A large number of the old observations have been published, another volume of meridian photometer observations is now passing through the press. The unfinished volumes of Annals were completed so that, as is shown below, our work is now known through twelve quarto volumes, while in 1876 but four had been given to the public. Eight more volumes of Annals will be needed to complete the publication of observations already made. The increased rate of work ensues, simply because the corps of assistants has been more than doubled." It is needless for me to follow this extract up with a detailed account of the admirable work which has been done at Harvard in photometry; in the arrangement for disseminating the news of the discovery of Comets; of the meridian observation of stellar and planetary co-ordinates, &c., &c. All this is familiar enough to every working astronomer who will read these lines. The moral I would draw from the Report before me is this: that no difficulty need ever arise in obtaining the needful funds for genuine scientific work. Does anyone imagine that if it were possible to conceive that Professor Pickering could go whining to Congress to build him a big observatory and "endow" him with a handsome salary in order that he might predict (say), earthquakes from the observations of Jupiter's Satellites, that he would ever have had his petition granted? Nay, if we could assume that he would appeal to the ladies and gentlemen of Boston for funds to carry on such a "research," does any sane man conceive that he would have got 5,000 cents—to say nothing of 5,000 dollars. I am thoroughly persuaded that no legitimate scientific investigation will ever be stopped in any civilised country for want of funds. If the people (outside of the Brompton Ring proper) who profess to believe in the necessity for an Observatory for Solar Physics, were honest and sincere, they would put their hands into *their own* pockets, and not advocate an assault upon those of other people.

I note a typographical error in my reply to "Solar Time" (column 1, p. 316) which I must ask him to correct with his pen. It occurs in lines 4 and 5 from the bottom of the column, where "from a to l and from a' to l'" should be from e to l and from e' to l'. As this same error occurs again in lines 40 and 41 of the next column, I assume that it must have had its origin in my own bad writing; otherwise I should have attributed it to that long-suffering individual, the compositor. By the bye, your engraver, too, has turned my small italic l's, d, and e into capitals, for some reason best known to himself. I do hope that your correspondent has not begun to construct his dial from my directions, and been misled by my carelessness (or caligraphy).

Perhaps I may be allowed to inform Mr. Hildersley (letter 20804, p. 317), in connection with his mention of "Ball's division" in Saturn's Ring, that quite recently Mr. W. T. Lynn and Mr. C. L. Prince, both Fellows of the Royal Astronomical Society, have independently shown conclusively that Ball had nothing whatever to do with the discovery of the chief division in Saturn Rings. Cassini was, without doubt, its real discoverer, and it should certainly be called by his name. Vide the *Astronomical Register* for the current month.

I must ask "Respice Finem" (query 48824, p. 327) kindly to read my reply to Mr. Hartshorn (letter 20750, p. 272). Having done so, and impressed the fact upon his mind that the tides have their origin in the differential attraction of the body causing them, a very little reflection will cause his difficulty to disappear. Assuming the earth to be spherical, and to be surrounded by a shell of water; and, say, the moon to be acting alone; then (as I tried to explain to Mr. Hartshorn) she will attract the water under her more than she will the earth's centre, and pull the water away from that. Again, she will attract the earth's centre more powerfully than she will the water on the other side of it, and so pull the earth away from that, the effect being to convert our hypothetical thin sphere of water covering the globe into an ellipsoid, whose major axis passes through the moon and the earth's centre, and whose minor axis passes through points on the earth's surface 90° from that where our satellite is vertical, the water, of course, being taken away from the extremities of such minor axis to make up the two heaps beneath the moon and on the opposite side of the earth's centre. Now let us introduce the sun at this opposite extremity—in other words, let us suppose that it is full moon. Does not "Respice Finem" see that the sun will, in turn, heap up the water beneath him, and at the opposite end of the terrestial diameter (just as though the moon were not present), and so exaggerate the tides? as, in fact, he is found to do.

"W. S. W." (query 48866, p. 328) should get a 3in. refracting telescope (or a 5in. reflector) at a cost of about £15, a good timekeeper of some sort, Balls "Astronomy" in Longman's "Text-books of Science"; Webb's "Celestial Objects for Common Telescopes"; and Proctor's "Star Atlas." This will suffice to start him in the kind of astronomical study wich he pretty evidently desires to take up.

I would commend your report of the last meeting of the Royal Astronomical Society, on p. 344, to the perusal of anyone who may have regarded my utterances with reference to the action of the "Endowment of Research" party as too strong; and especially to those of my brother-readers who have occasionally hinted that there was no such party. From your report it will be seen that Mr. Lockyer announced that the South Kensington "Solar Physics Committee" had sent in an application to the South Kensington Science and Art Department, pointing out the extreme importance of making observations of the Solar Eclipse of next May, from two islands in the South Pacific, and standing, as it were, *in loco Reginæ*, proceeded to invite the Fellows of the Society to volunteer to go out at the National expense! What was the meaning of this little farce? Does anyone for a moment suppose that Mr. Lockyer was anxious that a number of gentlemen, strangers to him, should join him in what he described as a "pleasant expedition?" Evidently he has no such affection for unknown friends, but desires the backing of the Royal Astronomical Society to his application to the Treasury, in place of that of the little body who have christened themselves the "Committee of Solar Physics." On the whole, I am glad to see things done a little more openly than they have been for some years past. Those who saw Messrs. Christie, Dunkin, and Lockyer in consultation on the front bench, will now be able to appraise the value of a denial that there is any connection between them.

In order to give any definite answer to the first question put by "San Tzse," in letter 20827 (p. 337), it would be necessary to possess an amount of knowledge as to the mass, velocity, and resistance offered to the passage of the comet through the solar photosphere, which, I regret to say, neither I nor any other human being possess. Meeting, though, as the great comet probably did, with a high degree of resistance in its passage through the Sun's surroundings, it may well have become as highly heated as (if not more so than) the photosphere on which it was superposed, and so, of course, have become invisible. It is only when light is transmitted through a gas cooler than the medium emitting it, that absorption takes place. Any connection between comets and sunspots has yet to be proved. A great spot appeared shortly after the passage of the great comet of 1843 through perihelion; and it is asserted that the heliographic longitude of this spot corresponded with the longitude of the comet's perihelion. I must add, however, that I have not myself checked these facts. On the other hand, though, it is quite certain that there are comets which go both over and under the Sun, and have their perihelion in latitudes in which spots never occur.

I have to thank Mr. Westwood Oliver (letter 20829, p. 337) for the courteous and kindly tone of his communication. I do not fancy, however, that I ever went the length of denying that solar activity might affect terrestrial conditions. What I have said, and must continue to say, is that no sufficient proof exists of any such connection. Surely Mr. Oliver remembers Dr. Jelinck's paper in the *Zeitschrift für Meteorologie* for March 15, 1873, in which that eminent meteorologist discussed observations of rainfall made from 1833 to 1867, during which five periods of sunsopt maxima and three of minima occurred. They were made at Guernsey, Greenwich, Orkney, Taru, Toulouse, Bagès, Béost, Calcutta, Algiers, Oran, Philadelphia, Fort Columbus, New Bedford, Barbadoes, Conaçon, Paris, Geneva, Great St. Bernard, Rome, and

Palermo, with this most pregnant and instructive result: that while 51 records of annual rainfall seemed to favour the Sunspot hypothesis, *50 absolutely contradicted it.* What mathematician needs me to point the moral of these pregnant figures? Put popularly, I may say that if there were two periods of maxima and minima in each case, this corresponds with the probability of two pennies being weighted; if in a hundred and one tosses, two heads appeared 51 times, and head and tail 50 times. No person would dream of making such an assertion. It is about what ought to be expected. Besides, I can never too often reiterate that any effect produced by the Sun must affect the whole world, and not different parts of it differently. It may suffice to point, in illustration of this, to the strangely diverse weather which has prevailed this year on opposite sides of the Atlantic. I thoroughly agree with Mr. Oliver in his estimate of the objects of the journal to which he refers, and only grieve that more of the general public do not see it as clearly as we do.

Taking seriatim the questions put by "Amator Stellarum" (in query 48928, p. 347), I may tell him that to modern observers Venus presents a sensibly circular outline (as she assuredly did during her Transit on the 6th instant); but that as long ago as 1807 Vidal measured her polar diameter as 60·4″, and her equatorial diameter as 61·5″. With reference to Mars, Webb says (*Celestial Objects*, p. 150): "Herschel ascribed a great ellipticity ($\frac{1}{16}$) to this planetary globe; Dawes could detect none; Schroter made it less than $\frac{1}{81}$; Hartwig gives it $\frac{1}{230}$." I am tempted to think that even Hartwig's estimate errs rather in excess than in defect. Nothing is known as to the inclination of the equators of Mercury and Neptune to the planes of their respective orbits. Schroter *fancied* it to be 20° in the case of Mercury, from a band which he imagined he observed on the planet during the early summer of 1801. Buffham, in 1870 and 1872, observed what he took for white spots on Uranus, and from their apparent motion deduced a rotation period of something like twelve hours. No one has yet attempted to ascertain the length of the Neptunian day. With reference to the binary star periods, that of η Cassiopeiæ is very uncertain indeed. Doberck makes it 222·435 years; Gruber 195·235 years, and Dunér 176·37 years: a pretty wide range. "β Cameli" (Camelopardi?) is new to me as a binary system; while the physical connection of the components of ι Leonis is, as yet, scarcely proven. If ε Bootis is a binary star, it must have a very long period. Nothing beyond this can at present be predicated of it. In the case of ξ Boötis, we again have the most discrepant estimates of its period. Sir John Herschel made it 117·14 years; Madler 160·695 years; and Dr. Doberck 127·35 years (this being the latest calculation). η Orionis, ζ Herculis, and α Piscium may be included in the same category as ι Leonis.

Does "Anxious" (query 48937, p. 347), wish to estimate star magnitudes with the naked eye, or with the telescope? If the former supposition be the correct one, he had better get Heis's atlas, and so learn the precise magnitudes of certain standard stars, whence those of intermediate ones may be estimated. In the case of telescopic stars, the simplest method for the amateur is that of limiting apertures. I have described this, at least once, if not more frequently, in your back volumes, to which "Anxious" may perhaps be able to refer.

A Fellow of the Royal Astronomical Society.

PROF. ARCHIBALD, THE "STANDARD," AND SUNSPOTTERY.

[20850.]—I SHOULD not feel disposed to answer a letter in your journal last week, signed "A Fellow of the Royal Astronomical Society," in which he indulges in some rather strong language with reference to a letter of mine which appeared in the *Standard*, were I not moved by a feeling of sincere compassion to rescue him (and possibly some of the readers of his letter) from the horns of a dilemma, on which he has gratuitously impaled himself.

The only two conclusions he seems to be able to draw from a perusal of my letter are, that I am, in plain language, either a fool or a knave.

Considering that, according to his own impression, he has only just made my "literary acquaintance" (he is wrong here, as I have had the honour of being mentioned by name in, at least, two previous letters of his), he appears to have made up his mind about me somewhat rapidly, to say the least of it.

I have no doubt, however, of being able to show that in his personal animosity to a certain committee (for reasons best known to himself) he has simply exposed his own utter ignorance of what is known in India and elsewhere as to the connection between sunspots and meteorology.

First as to Mr. Stone. Your correspondent will find his exhibition both statistical and graphical of the inverse concord of the sunspots and the temperature curve at the Cape of Good Hope, in the Proc. Roy. Soc. for 1871.

Next as to Mr. Blanford. Your correspondent's amazement at my audacity is only equalled, if not exceeded, by my surprise at his ignorance of Mr. Blanford's recent work in this direction. In the "*Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*," the leading meteorological Journal in the world, and one which I would recommend your correspondent to study; and in the Report on the Meteorology for India in 1878, (after the date referred to by F.R.A.S.), occurs a most elaborate paper by Mr. Blanford, "On the Variation of the Barometric Pressure over India and Siberia in connection with the Sunspot Cycle," which may be said to mark a new era in the history of the question. To clench the matter, I quote the following words from the Report, p. 62, "The excessive pressure which characterised Asia and Australia and the intervening Indo-Malayan region, from the spring of 1876 to the autumn of 1878 was . . . in part the *maximum phase of a cyclical oscillation coinciding with the sunspot period.*" Mr. Blanford has likewise written at some length in his reports and elsewhere on the relations between sunspots and solar radiation, vapour tension, &c. After this, I think I may fairly say "Volvuntur risu tabulæ" with reference to my audacity (or fatuity). That your correspondent never heard of my existence before, is only a further proof (if one were needed) that he has never read Mr. Blanford's "Indian Reports," since in those of 1876 and 1879 Mr. Blanford has referred in terms of approval to two separate investigations of mine in connection with sunspots and meteorology.

For a really admirable and comprehensive résumé of the entire subject, I would recommend "F.R.A.S.," if he has not seen it, to purchase Prof. Hermann Fritz's prize essay (275 pp.) entitled "Ueber die Beziehungen der Sonnenfleckenperiode zu den Meteorologischen und Magnetischen Erscheinungen" (Haarlem, de Erven Loosjes, 1878), for which the Haarlem Society of Science awarded him a prize of 150 gulden. A perusal of it would tend to enlighten and perhaps convince him of the futility of trying to extinguish a hypothesis which is supported by collateral evidence in every meteorological element that has been discussed, and is thought worthy of investigation by several of the leading foreign meteorologists and physicists. For the benefit of your readers I will quote the final result of Prof. Fritz's inquiry in his own words, which I dare say "F. R. A. S." will kindly translate (I have purposely refrained from doing so for fear of being accused of attempting to pervert their original sense) in his next letter.

"Als gesammt resultat finden wir, dass bestimmte Beziehungen bestehen zwischen der Veränderlichkeit der Sonnenflecken, der Variation der magnetischen Declination und dem Polarlicht; dass Beziehungen zwischen dem Wechsel der Sonnenflecken Haufigkeit und den meteorologischen Erscheinungen der Erde sehr wahrscheinlich sind."

What "F.R.A.S." may precisely mean by the term "sunspottery" I do not know; but that all the gentlemen in the list I gave in the *Standard*, and a good many more besides, believe that sunspots affect the meteorology of our earth, I am prepared to prove to the satisfaction, if not of such a sceptic as "F.R.A.S.," at any rate of those of your readers who are possessed of an ordinary amount of intelligence and honesty.

With nine of these gentlemen I am acquainted either personally or by correspondence, and if I am "credulous to fatuity," it is plain that I am the victim of a widespread conspiracy to uphold an intellectual fraud whose ramifications penetrate every quarter of the globe.

Your correspondent, like Mr. Proctor, and the writer of the article in the *Standard* (in which production "F.R.A.S." betrays an almost *parental* interest), lays much stress on the opinion of the Astronomical Society, as if their dictum (or that of a polemical clique which for the time represented them) were alone enough to condemn the theory of the connection of sunspots with meteorology; whereas it is plain that the question properly (after the fact that there is a recurring cycle of sunspot frequency has once been established by the astronomers) belongs to, and can only be adequately solved by meteorologists. It is, therefore, important to notice that in India, where their effects bear a much larger ratio to the total changes observable than in this country, every official meteorologist, from Mr. Blanford downwards, including Mr. Pogson, the Government Astronomer at Madras, recognises their influence not only in temperature (which Mr. Proctor admits in his letter to the *Standard*), but in pressure, rainfall, cyclones, humidity, and wind. (See amongst other things "The Meteorology of the Bombay Presidency," by Charles Chambers, F.R.S.)

Moreover, in one case at least—viz., the winter rainfall of Northern India—its inverse concord with the sunspot curve, discovered independently by Prof. Hill and myself in 1877, has been confirmed and extended by Prof. Hill to the greater part of Northern India (a region which could geographically swallow up more than half a dozen *Great Britains*), in a paper published in the "Indian Meteorological Memoirs" in 1879 (another valuable series of papers which I can cordially recommend to "F.R.A.S.," if he wishes to inform himself of the latest developments of "sunspot literature," outside what the American geographies used to call "a rocky island off the coast of France."

Finally, when "F.R.A.S." and his friends, or aliases (?), have studied the question in its meteorological, as well as its astronomical aspects, I shall be willing to discuss the matter more minutely with them. Meanwhile, I would merely warn them (to paraphrase our Laureate) to beware lest they mistake the cackle of their society for the murmur of the *world*.

E. Douglas Archibald.
(Late of H.M. Bengal Educational Service.)

VARIABLE STARS.

[20851.]—I FORWARD the following notes:—

ι Draconis.—As I expected, this star is brightening. At present it seems to be 4·5 or 4·4.

α Cassiopeiæ.—This star is also brightening, and appears to be losing colour. It is now about 2·8.

ν^1 and ν^2 Cassiopeiæ.—I have been observing these stars at intervals during the past year. They often seem absolutely equal, but on some occasions ν^1 appears to be distinctly inferior to ν^2.

ζ Ursæ Minoris.—This star is 319 in Messrs. Espin, Read, and Gage's catalogue. The limits of variability are there given as 4·2 to 4·7. In March last I entered it as 4·2, but during the past six weeks I have observed, during such brief glimpses as I have got of the sky, it to be 4·8. It seems, however, to be brightening again.

β Cygni.—The following are some estimates of this rather perplexing "suspected variable":—

1882.	March	11, 3·3.	Aug.	8, 3·2.
,,	March	15, 3·4.	Aug.	29, 3·4.
,,	April	25, 3·3.	Sept.	17, 3·2.
,,	May	15, 3·2.	Oct.	4, 3·2.

The weather here has been so bad as almost to prevent observation.

S. Maitland Baird Gemmill.
Glasgow, Dec. 18.

TRANSITS AND ECLIPSES — A CORRECTION.

[20852.]—MAY I be allowed, with all due deference, to correct a rather serious mistake (or misprint) that occurred in your report of the otherwise able and interesting lecture on "Transits and Eclipses," by Mr. P. Braham (p. 333)? Mr. Braham is reported as having said, "It is known perfectly well that our nearest neighbour does not produce any effect by the light it emits under a period of 36 years, and light travels at the rate of 180,000 miles per second." The lecturer no doubt referred to α Centauri, but the distance of that star is, in round numbers, 20 billions of miles, which would give a light passage of 3½, and not 36, years.

A Young Astronomer.

MEDICAL REPLIES.

[20853.]—DOG BITE (48884).—Your son's dog-bite has probably no connection with his present attacks, which are a mild form of epileptic fits, and need careful medical treatment.

BRIGHT'S DISEASE (48898).—In Bright's disease the urine contains albumen; generally, also, casts indicating the stage of disease in the tubes of the kidney. To test the urine for albumen get a clean test-tube. Pour in an inch of urine; test by means of blue litmus paper to see that the urine is acid. It should just redden the blue test-paper. If not acid, one drop of nitric or other acid should be added to the urine. Then bring slowly to the boil over a spirit-lamp. If the urine contains albumen a haziness appears or a flocculent precipitate falls, according to the amount of albumen present. If the tube be set aside the coagulated albumen will subside, and, at the end of twenty-four hours, an estimate of its amount may be made and compared with succeeding amounts day by day or at weekly intervals, if the case be a chronic one. The urine should be that passed directly on rising in the morning, so as to secure an average specimen. The examination of the casts from the tubuli can only be made by means of the microscope.

DISORDERED LIVER (48900.)—Leave off the beer and tobacco, and take proper easy-going exercise in the open air. If not relieved, get carefully examined by your doctor.

TEA AND COFFEE AFTER MEALS (48914.)—"G. L. T." has misread my dictum. My words are, "The habit of drinking *strong* tea or *black* coffee directly after dinner is especially bad, and certainly interferes with digestion." I am clear on this point as a general rule in healthy stomachs. Of course, *habit* is a powerful modifying influence, and those who have long used themselves to such use of tea or coffee may not feel that they are developing a dyspepsia or a liver affection. But, nevertheless, they will find out the fact if they live long enough. Sleepiness ought not to be a very troublesome matter to persons who eat only such a moderate dinner as previous exertions have entitled them to. If after-dinner sleepiness be a consequence of severe and long-continued ante-prandial fatigue, let the sleepiness be indulged, and get the system refreshed and renovated thereby, and the digestion of the well-earned dinner meanwhile perfected. In that case a strong tea or black coffee simply interferes with a necessary and well-earned indulgence. If after-dinner sleepiness be a consequence of mere over-eating, the use of strong tea or black coffee to antagonise that sleepiness merely acts by diverting the blood to the brain when the stomach needs the blood in order to complete the digestion of the food which has been put into it. The remedy here is not to artificially hurry up the stomach, but either to stop the habit of gorging like a boa-constrictor, or to accept the torpor which comes upon the boa-constrictor after a gorge. But in all such matters, habit becomes a mother-in-law if not a mother-nature, and man is a very difficult animal to kill. One should consider the Pythagorean maxim, "Fix upon that course of life which is best; habit will render it most delightful."

Eyesight (48918).—Red-lead powder falling into the eyes is certainly injurious—not only by its poisonous effect, but also as a mere powder mechanically irritating the eyes.

Congestion of Liver (48923).—"A. W. D." probably has not arrived at a correct diagnosis of his disease. The liver, being out of sight, is often made the scapegoat when it is in no way in fault. Get carefully examined.

Watery Eye (48934).—If the running-over is from the inner corner of the eye, your mother probably has an obstruction of the lachrymal duct, which drains off surplus secretion into the nose. Get eye examined by a competent doctor.

James Edmunds, M.D., &c.
Grafton-street, Bond-street.

LEGAL REPLIES.

[20854.]—Ancient Lights. — Prescription (48889.)—It is necessary that I should have more exact particulars of this case before I can answer with certainty. But clearly the tea-tickets, whatever they have been, cannot affect the case, as the only way to take it out of the Prescription Act is by a consent by deed, or in writing. If under that statute an ancient light has been enjoyed for 20 years without interruption, it becomes an absolute easement. The Act further provides that no "interruption" shall be reckoned as such which does not extend to a year. The result is that, if windows have been open for more than 19 years, the right is practically acquired, as there can then be no valid "interruption." So without exact dates I cannot answer this question; but it looks as if the right had been acquired by prescription.

Will—Marriage.—Deceased Wife's Sister (48890).—This question is rather confused; but as far as I can make out, the querist wants to know whether the children and grandchildren of A. can claim property as lawful issue of his marriage with his deceased wife's sister, and certainly they cannot. B. was not the lawful child of A., and therefore her children cannot be his lawful grandchildren, and so cannot claim property in that capacity. But I may have missed his point, and if so, he had better put it again, and more plainly.

Partnership.—Share of Profits (48891).—This is not a legal question, but rather one for the consideration of the querist, upon all the facts and circumstances. Such matters as a share of profits must always be arranged between the partners, and there can be no legal or other rule upon the subject.

County-Court—Old Judgment — Execution (48809).—Execution can be issued upon a county-court judgment at any time within six years, by producing it to the registrar's clerk, and at any time after six years if leave be obtained, and which will be granted upon a formal application by the plaintiff, of which no notice need be given to the defendant. In this case, therefore, the creditor should go and issue his execution at once, and he will probably get his money. He may find my shilling "Hints on County-court Practice" useful in these cases.

Architect—Indentures (48909).—It would be very unwise of the pupil to do without his indentures; for then he would have no clear and ready means of proving and enforcing the contract entered into, and of compelling his master to teach and employ him in the event of disputes, which may always happen.

Landlord and Tenant- Repairs (48913).—The breach of a contract to repair on the part of a landlord is no answer to the claim for rent, and if the tenant does not pay, the landlord can distrain, although he may be liable for damages as to repairs. As the landlord has not attended to the roof, after due notice that he will do so, the tenant should repair it himself, and then sue his landlord for the sum so paid, upon the agreement. He may also claim in that action damages resulting from the landlord's neglect to repair the roof, and so recover the expense he has been put to in doing the internal repairs rendered necessary, if he can show that they resulted from the landlord's breach of the agreement.

Will—Invalid Marriage (48924).—When the son of C. arrived at the age of twenty-one years he took a vested remainder in the property, and, although he never had possession of this property, he had a legal title to it, and he could leave his right to it by will if he chose. Without seeing a copy of this will, or its operative clause, I cannot say if it is valid. The children of the second marriage were, of course, illegitimate; but if the son of C. described his so-called sisters by their reputed names, the gift would be good, and probably, also, if he only spoke of them as "sisters," as he had no others, and so they would take the property. But in these cases of difficult construction I should really see the will itself.

Fred. Wetherfield, Solicitor.
2, Gresham Buildings, Guildhall.

DIE ENGRAVING—SAW SHARPENING.

[20855.]—I will endeavour to finish the subject in this letter, as space is valuable, and it will not do to trespass on the good-nature of the Editor.

If Fred. Carre is determined to make his own blanks, he must buy his embossing press at once, as then he can make the blanks to fit the press, and not *vice versâ*. The dies for small work (crests and monograms) are about $\frac{3}{8}$in. thick or less, with a shank on underside; they are turned from the solid, and may be of any shape—round, square, or oblong. Not one amateur in 500 has the appliances for making his own press; it would be cheaper to buy, even if you had a good pattern to copy.

For list of makers see "Post-Office Directory." If I were about to buy one, I should ask the maker what size he would recommend for proposed work, and then select one *one size larger*. A press only just powerful enough wastes time and irritates the temper. Get a pattern die with the press. To do a small spray with a few leaves and flowers, make a punch for every flower and every leaf, and finish each one carefully, so that when driven in it is done with; cut the stalks and stems with fine half-round graver; the shallower all the work is the better it will look; rub the face of the die when finished on oilstone; you do not want a better polish than this will give.

To make the counterpart, take two or three small pieces of the very best Bristol board, stick them together with smallest quantity of very thick paste, give a few moderate blows with press, and when you have a nice impression cut away all superfluous card with a sharp pen-knife to a bevelled edge; cut close to your work without regarding size of die. If the impression is not quite perfect, warm the counterpart with a *small* piece of lighted paper, strike while warm. Professional embossers often melt, not burn, a small piece of guttapercha in the gas, dab it over the face of counterpart, and immediately give a squeeze, not a blow, with press. This gives an impression absolutely perfect. Of course, cut away all superfluous guttapercha.

The best way to fasten the die in press is to place a piece of thick and good paper, *slightly* pasted on both sides with thick paste, between bed of press and back of die; trim the counterpart before you stick it up in its place, with a very little paste. Once pasted you can only tear it off in pieces. For large dies they use 3 or 4 pieces of good millboard, instead of Bristol board—that is, for dies as large as a page of note-paper.

Fred. Carre has not yet seen a good American saw, if he thinks it a "toy, not a tool." I saw a carpenter cut off about a yard from the top of two piles to make them the right length. He did them both while I was waiting on Ryde pier for the steam-packet. **Gamma.**

THE VOSS INDUCTION MACHINE.

[20856.]—Will you allow me to suggest to Mr. Molison that working drawings of this machine, together with the plainest possible directions for its construction, would be much appreciated by those who, like myself, have not sufficient electrical knowledge to construct one from the more scientific directions given by "Sigma"? I, for one, cannot afford to buy a large one, but should like to make one if I could be certain to do it without failure; and I would not attempt it from any particulars I have yet read.

It is just the same with the instructions I have seen as to the construction of dynamo-machines. I should like to make a small one that would light a few Swan lamps, and do not see why some of our able contributors should not give instructions and drawings that would enable any one to do it. Such plain instructions as have appeared some time back with respect to the "Induction Coil" is what hundreds want; and if Mr. Patrick or any one else who makes the various parts that an amateur could not readily construct, would take this in hand, it would create an interest and promote instruction in electrical science to a very large extent.

Dyer's "Coil, and How to Make It." is a little pamphlet that any child could work from. Why should not other machines be made equally easy to comprehend? **Apprentice.**

[20857.]—In reference to letter 20841, p. 339, I trust Mr. Molison will not defer his intended communications on account of my having treated the subject. I really do not know much about it, and am not likely to go very much into it at present at all events, having gone into it just now because I wished to be in possession of the latest and best information in this as in other departments, while the new edition of my book is in the Press. Mr. Molison can, no doubt, give readers more information than I can on the subject, and I shall be very glad to be among the learners.

In reply to J. Day (48896), the length of the tubular spindle of the movable disc is about 3in. between plate and the driving pulley. That of the discharging-balls is about 6in. It would be better for them to project another 3 or 4in. beyond the two jars and over the base-board, as it is inconvenient to pass discharge in any apparatus as it is arranged except by connecting it to an external and separate discharger. The papers ought to be at the back of the fixed disc. This brings the inductive capacity of the glass plate into action. If in front, only that of the air is utilised. The upright combs are connected together by a brass casting, into which the rods are screwed. As I explained, they serve to short-circuit the discs after they have done their work. They would otherwise carry over a residuary charge opposed to the work they have to do. **Sigma.**

THE SLIDE-RULE.

[20858.]—In reply to letter 20843, "The logarithms of logarithms" is to me an expression that I have not hitherto met with. I desire to see its form and use elucidated. As the statement stands, it appears to be as follows:—What is the logarithm of the logarithm of n? Suppose $n=2$, then its log. is 0·30103000; thus the question asked is, What is the log. of ·3010300? which is 9·4786098. The letter 20843 goes on to state—"for instance, to calculate the functions of the term $\sqrt[n]{(P/q)}\,m$"—which I interpret as m multiplied into the n^{th} root of P/q. There is a slight uncertainty in my mind, whether the expression is properly printed or not; for it may mean $\sqrt[n]{(P/q)^m}$, that is the n^{th} root of P/q raised to the power of m. To take the first interpretation $\sqrt[n]{(P/q)}\,m$. Let us give values to the symbols. Let $n=2$; $m=3$; $P=16$; and $q=9$; then $\sqrt[2]{(16/9)} \times 3$ is the question to be worked by slide-rule practice: this can be reduced to $(3\sqrt{16})/\sqrt{9} = \sqrt{(9 \times 16)}/\sqrt{9}$, which is a simple question in two operations on the four lines A, B, C and D of the common slide-rule with a single slide, and equals 4; or in this case it is further reduced to $\sqrt{16} = 4$. Hence I fail to see how the example elucidates the proposition of obtaining "the logarithms of logarithms." Suppose we take the 2nd interpretation, and using the same values to the symbols, then the question becomes $\sqrt[2]{(16/9)^3}$. This is not so simple as the previous working. Still, it can be solved in the four lines, as before described, and equals 2·37. Under this form the application of the example is as inapplicable to the question as the previous notation.

It is well known that mechanical calculations have engrossed the minds of many learned men for hundreds of years, and that any form or expression may be resolved by special mechanism devoted to that particular form. Therefore it is not surprising to hear that "the logarithms of logarithms" have been deduced from an especially constructed slide-rule. I should, however, be pleased to see under what circumstances the above expression is made available in mathematical calculations, and how the instrument for solving such questions "is of great scientific value and well worth re-introducing," when we have such perfect modern instruments most accurately divided.

I have been led to take an interest in letter 20843, from having paid considerable attention to slide-rule practice, conceiving the slide-rule to be an invaluable friend to the calculator who has not an assistant always at his elbow to check his calculations. This feeling led me to patent a form of double slide-rule, not hitherto used, which I find of great assistance, chiefly in checking the pen-and-ink work of civil engineers, architects, and builders. The rule is made in two forms—a decimal rule, and a duo-decimal rule. The decimal rule is so contrived that any amount of multiplications and divisions can be carried out consecutively without losing the last calculation, as is the case in a single slide-rule; and it is also graduated to give any power or root that may be required, so that the question of finding the hypothenuse on either side of a right-angled triangle is solved at one setting. The duo-decimal rule is a speciality, and is so constructed that it cubes any quantity up to 100 cubic ft. at a single setting of the two slides, giving the answer in cubic feet and inches, which is supposed never to have been done before. At the same time, the whole working remains on the rule, open to inspection, to be revised by sight without removing a slide to work separate parts of the question. The great advantage of the decimal rule is that it entirely (except in most abstruse cases) does away with that source of disgust to all who begin slide-rule practice—viz., the great amount of "gauge points," "mean areas," or "special divisions" that encumber all works upon the single slide-rule, which must in practice be either committed to memory, or the "book" must be constantly at one's side to be referred to. The slides are so arranged that the working on the rule corresponds with the usual working on paper by rules learned at school. Thus, for cubing, the sequence is

Length,
Breadth,
Thickness,
Content,

the breadth and thickness being the two slides, the length and content the Standard portions. Thus no slide-rule arithmetic is required to be studied.

The limits of the paper will not allow me to fully explain the rules. I feel confident that they will be found most serviceable for the usual every-day practice of the office, bench, or yard. They are made by Mr. F. M. Stanley, of 3 and 4, Great Turnstile, Holborn.

Referring to the original question the logarithm of a logarithm, my decimal rule solves the difficulty by inspection only. Thus: Invert the lower slide and place the line of numbers fairly in its seat—that is, the 0 in the slide over the 1 in lower line of figures, then the line of numbers is a line of logarithms to the line of figures below. Thus, what is the log. of the log. of 2? Over 2 in the lower line is ·301 on the line of numbers, and over ·301 is ·478 on the line of numbers—the log. of ·301. Mr. Alb. Kapteyn will understand the logs. found are the "mantissæ" only, and that the indices must be supplied in accordance with the question.

Fredk. A. Sheppard, C.E.
46, Angell-road, Brixton, S.W.

[20859.]—Some years ago a friend of mine wanted a Roget's slide-rule, but found that they were not to be had of any instrument maker.

It occurred to me that they might be made on the principle of Prof. Everett's proportion table, in cardboard, and after one or two trials I succeeded in making one with a radius of 25in., which answered very well.

The job is somewhat tedious, but if Mr. A. Kapteyn (letter 20843) is not afraid of that, I can put him in the way of doing it, either by letter or through the pages of the English Mechanic, if the Editor can spare the space required for the instructions and a diagram or two. **A. D. L.**

MIRRORS OF REFLECTING TELESCOPES.

[20860.]—The interest which this subject seems to excite induces me to supplement my previous letter with a few further remarks. But at the same time I regret that so few practical correspondents take part in the discussion.

Referring back to letter 20730, I find our esteemed contributor, "A. N. H.," saying that when he had ground and polished an 8in. spherical mirror he "set to work to try and fit a small hyperbolic convex to it; but, after repeated trials, was obliged to give it up."

I do not wonder at his failure, nor that it should lead him to conclude that a hyperbola might be anything between a parabola and a "boomerang." The cause is very evident, if he will refer to my previous letter. The companion curve to the hyperbola is the *parabola*, not the *sphere*, so that by hyperbolising the small convex he was really increasing the already too powerful undercorrection of the large mirror, and thereby making matters worse. If the large speculum had been parabolised before he commenced to alter the small one, I have no doubt his experimental work would have led to a more satisfactory result.

The next part of "A. N. H.'s" interesting letter is very valuable, for it records the fact that two spherical curves do not always give satisfaction. He says, "My Cassegrain at present consists of two spherical curves, but as soon as I have time I intend to *slightly parabolise* the large mirror." From this it appears that the aberration of the larger mirror is too powerful, and requires reduction. Theoretically, the effect of sphericity in the Cassegrain mirrors is to produce a balance of error similar to a convex and concave lens; but this can only occur when their foci, apertures, and distances are in a certain proportion. In the object-glass, the destruction of spherical aberration requires a certain arrangement of curvatures, and this condition is just as essential to the reflector. It is this problem that I intend to touch upon, so far as I am able, in the present letter.

Let Y and F represent the semi-aperture and focal length of the large speculum, and y and f those of the small mirror; u and v the conjugate focal distances of the small mirror, that is, u is the distance of the mirror in front of the focal point of the large speculum, and v the distance of the mirror from the final focus behind the large speculum. For the sake of brevity, let the reciprocals of u and v be connected by the expressions $1/u = (1 + a)/2f$ and $1/v = (1 - a)/2f$. Then we have—

Equation of conjugate foci—

$$\frac{1}{v} = \frac{1}{u} - \frac{1}{f}.$$

Equation of variation due to spherical error—

$$d\left(\frac{1}{v}\right) = d\left(\frac{1}{u}\right) - d\left(\frac{1}{f}\right)$$

Now, it is evident that if the first term is to be reduced to zero, or no error exist at the point denoted by v, the second quantity must equal the third. The variation of the second focal reciprocal is easily found to be $a^2 . (y^2 / 8f^3)$, (a being the quantity connecting u and v). And since the distance u is measured from the focus of the large mirror, the variation of its reciprocal must obviously be the same as that of the reciprocal of F, the focal length of the large speculum.

This for parallel rays is, of course $\frac{Y^2}{8F^3}$. Hence rejecting the numerical dedominators and taking the root of each quantity, the equation of spherical error is—

$$\frac{Y}{F\sqrt{F}} = a \, . \, \frac{y}{f\sqrt{f}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Now, with respect to the semi-apertures Y and y, it is evident that they must, *at least*, be in the same proportion as F and u, for if not the small one will be unable to receive the whole of the converging luminous cone from the large one. Therefore, instead of Y substitute F, and in place of y put the value of u—viz., $2f / (1 + a)$. Then the equation takes the form—

$$\frac{1}{\sqrt{F}} = \frac{2a}{(1 + a)\sqrt{f}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

From this we can easily get the value of a, viz.—

$$a = \frac{1}{2\sqrt{\frac{F}{f}} - 1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

When a is known, the conjugate focal distances can readily be determined. For brevity, let the focal ratio be denoted by x: then the values of u and v are—

$$u = f\left(\frac{2\sqrt{x} - 1}{\sqrt{x}}\right); \; v = f\left(\frac{2\sqrt{x} - 1}{\sqrt{x} - 1}\right).$$

These values will show where the small mirror must be placed, and where the final focal point will fall. We must next find what values can be given to x; for it has a limit which must not be exceeded.

It is evident that the final focus must always fall *without* the large mirror; that is $(u + v)$ must always be greater than F. Adding together the above values of u and v, we have—

$$(u + v) = f\left(4 + \frac{1}{x - \sqrt{x}}\right) \ldots. \quad (4)$$

This is the *maximum* value of $(u + v)$, and as the second part is fractional, we may say that it cannot exceed $f \times 4·5$.* Therefore, when the ratio of foci is 4·5, the final focus falls on the surface of the large mirror; and if it be greater, the same point is in front of the mirror. Hence, we conclude that in no case must the focus of the small Cassegrain mirror be less than one-fourth that of the large one. Taking the value of $x = 4$, we find $a = \frac{1}{3}$, from which $u = \frac{3}{2} \times f$, or $\frac{3}{8} \times$ F and $v = 3 \times f$, or $\frac{3}{4} \times$ F. So that the sum of u and v is $\frac{9}{8}$ F, which shows that the final focus is at a distance behind the large mirror equal to one-eighth of its focal length.

It is necessary to observe that the above relations apply to spherical mirrors only; if they have conic curvatures, much greater latitude is allowable in the proportions of the various parts.

I now come to the Gregorian form. There is no doubt that those who desire a direct-view reflector would prefer the Cassegrain plan, on account of the balance of error being obtainable with spherical curves. In the Gregorian both the mirrors should—and one of them must—be other than spherical.

Keeping to the small spherical mirror, it seems that the curve of the large one should be a rectangular hyperbola. The equation to this curve is $\underline{y = \sqrt{2\,rx + x^2}}$; that of the circle $y = \sqrt{2\,rx - x^2}$; so that the two aberrations for parallel rays are alike, only of opposite signs. This shows that this particular curve "rolls back" as much from the parabola as the parabola does from the sphere; thus indicating a large amount of alteration in the curve of the large mirror. Probably few would care to go beyond the parabola, unless it was the result of a "fluke."

I am rather at a loss to understand why a man who could produce a perfect parabola with certainty should fail to produce a correct Gregorian ellipse, unless there is some extraordinary difficulty in dealing with small surfaces. Evidently the small mirror should be very nearly parabolic; and the same process of working should answer for both species of curves, only it must be stopped before the parabola is quite reached.

In the working of convex surfaces I believe it is not a very difficult matter to produce an approximate ellipse or hyperbola; but we shall hear more about this matter when "Prismatique" deals with it in object-glass working. Let anyone draw a curve representing the section of one surface of a spherical lens, and insersect it by a line representing an axial ray. Draw a tangent at the vertex and another at the margin; and on each, at a short distance from where they intersect, erect a normal, and produce them to cut the axial ray. Now if each tangent and normal be supposed to sweep round in the same direction, on the vertex and margin as centres, then their axial intersections will approach and meet. This shows that in order to *draw out* the marginal rays and *close in* the central ones, the spherical zone or ring-mound, intermediate between vertex and edge, must be depressed in a gradually decreasing degree each way towards centre and circumference. I do not say the *midway* zone requires most "planing" off, because the point of maximum depression cannot be exactly located; but indicate only the general nature of the alteration required to convert a convex sphere into either ellipse or hyperbola. I should think a graduated "ring-polisher" would be useful in alterations of this kind. This would require to be less in diameter than the surface, and have a central aperture, dependent for its size on the extent and position of the local alteration.

On transferring our attention to a concave surface, it will be seen that we have to deal with errors of a precisely opposite nature. The spherical working has worn down the intermediate zone too low; and, as we cannot raise it, the centre and edge must each be depressed, until the intervening hollow is eliminated. It is the *proportion* between the depression of centre and circumference which gives the character to the curve. Evidently, for an ellipse, the centre requires most depressing; while for the parabola and hyperbola, the edge must undergo the most action. Of course, the same focussed curve will not always come out from the same spherical foundation. When outer and inner rays are made to approach, it is evident that both need not, and most probably will not, be equally affected. More influence may be exerted on the inner than the outer rays, or *vice versâ*; and though the result is the same, the corrected focal distance will not be the same in each case. But whatever curve be desired, both centre and edge must be acted upon; and the required figure must be, as nearly as possible, obtained as soon as the remnant of the spherical hollow is obliterated. Any further working must tend to produce error; for if the process is not such as will give the desired figure when a portion only of the surface is being abraded, it is not likely to give a better result when the action is spread over the whole.

Dec. 4th. **Orderio Vital.**

P.S.—I observe Mr. Calver uses the plan I advocated as being theoretically the best for securing correction in these forms of reflectors. The maximum focal ratio 4·5 applies to two spherical curves only; if a greater ratio is used, the small convex will need hyperbolising, or if left spherical, the large one must be elliptic. I must thank Mr. Calver for telling us that theory and practice agree as to the best way of arranging two combined mirrors.

The result obtained by "A. S. L." agrees with my former one, only he has taken x as one of the conjugate focal distances: I took it as the distance separating the mirrors. **O. V.**

SIZE OF FLATS IN REFLECTING TELESCOPES.

[20861.]—I have lately, with the assistance of Mr. Calver, reduced the size of the flat for my 12½in. mirror from 2¼ inches to 1⅝in., and as my experience may be interesting to some of your readers, I append it as follows.

I suppose we must all admit that if any plan could be devised to dispense altogether with the flat, and so utilise the central rays of the mirror, it would be most desirable to do so: that this is indeed the defect of the reflecting telescope—that the most valuable part of the mirror, which has most to do with the formation of perfect discs, is lost. Probably no plan for this can be devised, without as in the Herschelian construction (at any rate for small instruments) the remedy being worse than the disease.

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* Perhaps some of our correspondents will show us the quickest way of obtaining an exact solution to the equation $x = 4 + \frac{1}{x - \sqrt{x}}$. It is easy enough to see that it must be about 4·5; but in the solution seems rather more complicated than one might at first imagine. Thee xact value is of little moment to the subject in hand, but the solution may interest some of our mathematical friends.—O. V.

If this is so, it seems desirable that the flat should not be larger than is absolutely necessary, so as to interfere with the central rays and obstruct the light as little as possible.

I found that the diameter of my cone of rays from the mirror 12¼in., 9ft. 3in. focus, was just under 1⅝in. at 12in. from the focus, and as this is about the distance of my flat from the focus I concluded that a flat of 1⅞in. diameter would still have a margin of $\frac{1}{16}$in. all round outside the cone, which I deemed to be sufficient.

Conferring with Mr. Calver on the subject, he proffered his best assistance, as he always does, to help me in the matter, and sent me a fine 1⅞in. flat and mount, made to fit my instrument, and be exactly, when fixed, opposite my eye-tube.

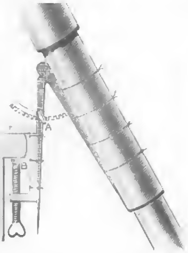
I had an opportunity of testing it on Saturday, the 9th inst., and the result was entirely satisfactory. Saturn was a perfect picture; I seemed to be looking into the planet. Ball's division was of course very distinct and clear all round, while the colours on the planet and the paper-ring were most beautiful. Encke's division was also at intervals (the atmosphere was hazy with very heavy dew and frost) perfectly distinct, full mirror 240 aplanatic. I then tried on doubles, and was struck with the increased light, good definition, and smallness of the discs. This was particularly the case with Castor; the discs were beautifully small and round, with the faintest appearance of rings. ζ Orionis was most sharply divided, the close comes standing out from its bright primary, like a diamond. The same applied to σ and 32 Orionis and Rigel. These I viewed with 10in. stop powers 224 and 300 Hoy. I then turned on the great nebula with full mirror 240 aplanatic large field, which was grand indeed. The 5th and 6th stars in the Trapezium were very distinct, the 6th, which your readers know is immensely more difficult than the 5th, being perfectly clear the whole time. Although my 2½ flat is an especially good one, there is no doubt at all as to the superiority of the result with the 1⅞in. in every point—light, colour, definition and smallness of discs. The night was a good one—unfortunately I omitted to test the radiation, but as Saturn would not bear my [illegible] achromatic which is a particularly fine one, I have no reason to think that it was especially so.

The thanks of observers who have his instruments are due to Mr. Calver for the exquisite perfection of his mirrors and appliances, which alone renders such an evening's enjoyment as the above possible. A friend who was observing with me, although well versed in smaller telescopes, on viewing Saturn said, "Well I never saw anything like this before; you have a fine instrument indeed."

Fordingbridge. **T. Westlake.**

STAND FOR SMALL TELESCOPE.

[20862.]—There must be many of "ours" who possess telescopes which are too small to be of much use in practical astronomy, yet large enough to afford some interesting peeps into the economy of some of our nearer neighbours in the stellar universe; and, as I often hear the owners of such instruments complain of the difficulty of holding them steadily, I have devised a cheap and simple stand which I find both portable and rigid. I enclose you a rough sketch of it, and if, Sir, you consider the matter of sufficient importance, you might find a spare corner for it and this letter in your much valued paper. The stand consists of a table-cramp, fastened by means of strong copper wire or solder, to one leg of a pair of joiner's screw compasses, the telescope being similarly fastened to the other leg, the whole is attached by the cramp to the top bar of a window sash, or to the edge of a table or pair of steps. The screw of the compasses A, gives the vertical motion, the horizontal motion being easily imparted by the hands, as the head of the cramp B, is loose. In the hands of some of your ingenious readers, the idea is doubtless capable of great improvement—in fact, cheaper and better stands may be already known to many, but, as there are others who seem to be at a loss for a simple stand for their small telescopes, I venture to hope I am not wasting your valuable time and space.

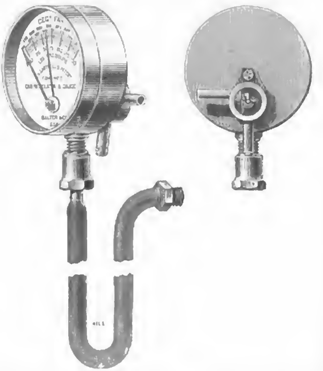


December 2nd. **Makeshift.**

AUTOMATIC REGULATORS FOR GAS.

[20863.]—I notice a letter (20812) in your last issue, by Mr. Fletcher, on gas regulators, in which he states that "a good gas-regulator, which will work at any specified temperature, is yet a thing of the future." I am pleased to state that such an instrument I designed and patented about four years since, and the fact that nearly a thousand of them are at work in Europe, with great satisfaction to the users, is proof that it is a practicable and serviceable instrument. The patent is now also being taken up in the United States.

It has been used chiefly for indicating and regulating the heat in dentists' vulcanizers, but it is also in use by chemical manufacturers, and can be applied for automatically regulating heat in any apparatus or boiler heated by gas. It will be seen from the illustrations that it is a combination of a Bourdon steam-gauge and gas-regulator in one instrument. To the back of the gauge is secured a gas-chamber having two pipes, over which are slipped the rubber tubes for conveying gas through the chamber and on to the gas-burner for heating the apparatus or boiler. One end of the spindle of gauge projects into this gas-chamber and carries a valve. The gas chamber is also provided with a pointer, and the parts are so arranged relatively to each other that when the pointer is set to any figure on the dial of the gauge, and the fluid pressure reaches a degree corresponding with this figure—that is to say, when the position of the gauge-hand coincides with the pointer—the valve in gas chamber will close, or nearly close, and cut off the free supply of gas to the heater. It will be seen that by this arrangement of the gauge and regulator the quantity of gas supplied to the burner is automatically regulated by the pressure, and according to the desired pressure of the fluid in the apparatus being heated, and the heat will be maintained at the set point for any length of time *without any attention.* The only part in the instrument that has any strain or does any real work is the Bourdon tube, and these tubes, when well-made, will work accurately for years. Some of these regulators have been used daily now for over three years, and are still doing good work. **P. H. Gartrell.**



Penzance.

ELECTRIC CLOCKS.

[20864.]—With regard to the notice of electrical contacts being placed on the hammer of an ordinary striking clock (p. 335, No. 925), Messrs. E. Dent and Co. finished a clock to my order with that adaptation last March. As the clock is not of the ordinary type, a short account may be of interest to some of your readers. It is a large English spring striking clock (hours only on 5½in. bell), Graham's escapement, going fusee, 12in. pendulum. The winding squares, being placed below the face and mount, are hidden by the bottom of the door. They are connected to the fusees by a train of four wheels each.

The clock is synchronised by Dent's method every hour by an electric dial. A V-shaped piece, raised up by an electro-magnet, catches a pin at the back of the minute-hand; it is also arranged that the bell is struck at the same time. This operation takes place, not as is usually the case at the hour, but at the 59th minute—the object being that warning should be given that the hour is going to be struck, a point much appreciated by persons suffering from insomnia. Apropos of electric dials, I have six 6in. and one 10in. dial in circuit worked by a regulator which makes contact every 60th second. Dent's contact apparatus on seconds wheel of regulator has been figured and described before in these pages.

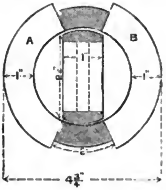
The electric dial consists simply in an hour and minute wheel geared together as usual. On the minute arbor is a ratchet-wheel with 60 teeth. There are two clicks, one to prevent the wheel turning in the wrong direction, the other being fixed to the armature. When the armature is attracted the click falls into the next tooth, and when released, the weight of the armature drives the ratchet-wheel round one nick. So long as the battery is strong enough to lift the armature the clock must work. The plan of making the magnetic attraction drive the clock will never succeed, but by making the fall of the armature drive the clock an equable force is secured. The proof of the correctness of this principle is the way in which they work. I set up four new Leclanché cells (7 by 4 size) in circuit with the seven dials and the regulator on Dec. 29th, 1881. Since that date the batteries have not been touched or examined, not a single current has been slipped; the dials are working as perfectly to-day as when the batteries were new. This is somewhat of a triumph, as the Royal Society completely failed to get their dials to work synchronously for any length of time. Those set up in the International Exhibition, and in the exhibition of scientific instruments at South Kensington also failed. Sir Edmund Beckett, too, in his book says that it cannot be done. The regulator which drives the dials has a 4-wheel train, 12-leaved pinions, Graham's escapement, zinc and steel compensation pendulum, size of bob 9 by 3 $\frac{w\,h}{w\,l} = \frac{1}{44}$ arc 1° 30′, 10in. dial. Rate—July 22nd, 1882, G.M.T. Maximum accumulated error on Oct. 28th—viz., 5 seconds fast, since that time it has been losing a little, and is now one second slow. I omitted to mention that the electromotive force required to synchronise the spring striking-clock is one Leclanché cell.

December 18th. **Edward M. Nelson.**

ELECTRIC MOTOR.

[20865.]—I have constructed a motor after the style of a Griscom motor, of which I send a cross-section.

The coils A B are 4in. long, and covered with No. 22 cotton-covered wire. The armature is of the same length, and has 60 yards of No. 22 wound on. The total resistance of coils A B is 7 ohms, and that of the armature 2 ohms. There is no leakage.

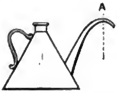


I have tried to drive the above by the current from a Siemens generator, which is used ordinarily for magnetising the coils of four dynamos. The motor refuses to move, although the current passes without a break. At a preliminary trial, when only one of the coils A was wound, the motor would run at a very high speed. By driving the motor with a pulley and belt, a current is generated, as proved by galvanometer.

Can any one tell me where the defect is, and how it can be remedied? **D'Elgo.**

A PROVED WRINKLE IN FILLING LAMPS, OIL STOVES, &c.

[20866.]—In an ordinary oil-pouring can, instead of the spout terminating at dotted line A, let it be continued a little further, and rounded downwards. With the ordinary spout, if one happens to have filled any vessel quicker than anticipated, one naturally raises can bodily, and consequently pours some more oil over the outside of vessel. With this spout one has merely to drop the spout further into the vessel, and depress the back of can, and the spout at once acts as a siphon, and draws back as much oil from the vessel as you choose.



J. S. H.

SPECULUM SILVERING AND WORKING.

[20867.]—I have, for the last four or five times of silvering, tried Mr. Calver's suggestion to use double the quantity of reducing solution given by Mr. Brashear, and I find the decided advantages of 1st—The silver is quicker deposited, which leads to a second advantage—viz., less bloom on the surface to be polished off, and this bloom is more easily got off. A third advantage seems to be an extra hardness and density of the deposited silver. I am much obliged to Mr. Calver for the above suggestion.

In answer to "Orderic Vital" (46940) I am happy to say that it is easy to trace, on my machine, the figures given by the point of a pencil as the result of the various motions. I have done so repeatedly when studying the curious effects of different combinations of parts and motions. I shall be pleased to send to "O. V." tracing, if he will let me know what he wants exactly to help him in his study. Our obliging correspondent "L. L. L." has suggested the same mode of studying the motions, and I have been trying it for the last month or more, but I do not think much can be gained by it; the better mode I find is to work the speculum, omitting one motion after the other, and studying the effect under testings at the centre of curvature: by this means we get at the exact effect of each motion or variation of motion, which I find a great help to me in deciding in a scientific manner the proper motions, &c.; but this process is very tedious, and requires a great amount of patience, but I am quietly mastering it. **H. A. Wassell.**

STANDARD SCREW-THREADS AND GAUGES.

[20868.]—"B. S. W." (20819) touches upon a very important subject, and as I happen to have a copy of Sir Joseph Whitworth's table of screw-threads, published by himself, and therefore undeniably accurate, I beg to inclose you a copy, in the hope that you will be able to find space to print it, as I think that not only "B. S. W.," but very many more of your readers will be glad to have a copy of the table for reference in "ours."

I am only speaking from recollection (not having searched back) in saying that I do not think the table in question has yet been published in these columns.

"B. S. W." will see that Churchill's sizes and numbers of threads were the correct ones. I may say, in explanation of the table, that those sizes in decimals in the first column, which are represented by blanks in the "number of threads to the inch" column, do not refer to screws, but only to cylindrical gauges. I have also Sir J. Whitworth's "Tables of Gas-Threads," and "Watch and Instrument-Threads," and proposed Decimal Wire-gauge, copies of which I shall be very happy to send.

Whitworth's Standard Cylindrical Gauges for Engineers, with Screw-Threads for the Various Sizes.

Size in decimals of an inch.		Fractional size.	No. of Threads per inch.	Size in decimals of an inch.	Fractional size.	No. of Threads per inch.
—	·03125	1/32	150	·750	¾	10
—	·0625	1/16	80	·875	⅞	9
—	·09375	3/32	60	1·000	1	8
·110	—			1·125	1⅛	7
·120	—			1·250	1¼	7
·125	—	⅛	40	1·375	1⅜	6
·135	—			1·500	1½	6
·150	—			1·625	1⅝	5
—	·15625	5/32	32	1·750	1¾	5
·165	—			1·875	1⅞	4½
·180	—		26	2·000	2	4½
—	·1875	3/16	24	2·125	2⅛	4½
·200	—			2·250	2¼	4
—	·21875	7/32	24	2·375	2⅜	4
·220	—			2·500	2½	4
·240	—			2·625	2⅝	4
·250	—	¼	20	2·750	2¾	3½
·260	—			2·875	2⅞	3½
·280	—			3·000	3	3½
·300	—			3·250	3¼	3¼
—	·3125	5/16	18	3·500	3½	3¼
·325	—			3·750	3¾	3
·350	—			4·000	4	3
·375	—	⅜	16	4·250	4¼	2⅞
·400	—			4·500	4½	2⅞
·425	—			4·750	4¾	2¾
—	·4375	7/16	14	5·000	5	2¾
·450	—			5·250	5¼	2⅝
·475	—			5·500	5½	2⅝
·500	—	½	12	5·750	5¾	2½
·625	—	⅝	11	6·000	6	2½

A. A. Myall.

SCREW-THREADS AND LATHE-NOSES.

[20869.]—In your notice of the Amateur Mechanical Society's meeting the question of lathe-noses comes to the front. Is it to be understood that Mr. Evans makes ten threads per inch the standard for all size lathe-heads, say, up to 7in. centres? Should not there be a proportionate scale for the various sizes?

Whitworth's ten per inch is ¾ dia. (which is rather small for a lathe-nose for slide-rest work), and as the numbers vary so do the diameters.

In the discussion which took place some time ago in the "E. M." on this subject, Dr. Edmunds objected very much to the 9·45 per inch division, and in the result it was not satisfactorily demonstrated why that mystic number is used by lathe-makers. I think a clue will be found in Vol. II. of Holtzapffel's work, p. 673.

"Between the years 1790-1800 the author's father made a few varieties of taps, &c. . . . . These, when measured *many years afterwards, were found* nearly to possess in each inch of their length, the threads and decimal parts that are expressed in the following table. Approximate value of J. J. Holtzapffel's original screw-threads No. 3 = 9·45."

And, of course, other lathe-makers followed his lead.

It is not quite clear to me, from the description, whether Mr. Evans' spiral apparatus for conical work produces a graduated curve of correct proportions, according to the degree of taper of the cone, or one of equal pitch from end to end. If the former arrangement, perhaps, if I am not asking too much, Mr. Evans will give us a description of the movements he has introduced to effect that object. **W. A. Barber.**

92, Cleveland-street, W.

THE TIDES.

[20870.]—The difficulties connected with the explanations of the tides, as given by some of your correspondents—that notably by a Fellow of the R. A. Society (page 272)—are by no means so slight as they are reputed to be. Granted that the Moon's attraction is greater on the surface of the Earth than it is at its centre, and on the opposite side of the earth than on its surface, in the proportion stated by your correspondent, let us direct our attention, say, to the 10th meridian of longitude W. and lat. 45°, or about the centre of the Bay of Biscay. Let us suppose for a moment that the motion of Earth and Moon is stopped. The Moon attracts the water under her, in a certain proportion, more than she does the centre of the earth: the waters rise up, therefore, to a certain height (say, 12ft., the figures are not at all material). As the earth is not an elastic body like a ball of india-rubber, which may be raised on both sides by being squeezed mid-way, this elevation must be due to a flowing of the water, east and west of the meridian, to the point of greatest attraction. But the earth, moving in a direction from west to east, this elevation must travel on towards the next degree of longitude, which it would reach in about four minutes of time. What is the behaviour of the water under these circumstances? The attraction of the Moon must extend to the bottom of the Bay of Biscay. Is the whole of the water under the 10th meridian carried bodily forward to make the elevation? The attraction necessary to raise the water to the height of 12ft. must have given a great momentum to its body, and it must be still impelled on to make up the elevation at the next meridian. This tidal wave, then (not making any allowances for friction), would make the circuit of the globe in nearly the same time that it revolves on its axis. What would be the consequences when it broke, for instance, on the shores of America, supposing its velocity to be anything like what is indicated? The question at once occurs, Does the wave travel in this manner? It seems to me that some part of it must do so, or the elevation would fail to arrive at each successive degree at its appointed time. There is no analogy between this tidal wave and those raised by successive blows of the wind on the surface of the ocean, though even those are known to travel at a considerable rate. The waves in a storm are multitudinous, and proceed from an unequal balance and the mobility of water; but the tidal wave is a continuous one, and the hold of the Moon on it never relaxes.

Again, with reference to the tide on the opposite side of the Earth, "the Moon," it is said, "will attract the centre of our globe more powerfully than she will the opposite extremity of the terrestrial diameter, through both bodies, and, so to speak, pull the Earth away from the water on the opposite side, which will hence be left, as it were, heaped up."

Then we must infer that when the Moon has pulled the water up on the 10th meridian, it pulls the Earth up also to the same (as one of our correspondents says), or nearly equal, height of 12ft., and the water on the opposite side of the globe has rushed in on both sides to fill up the hiatus; for there cannot be a hollow space left between the bottom of the sea and its surface. The consequences of this rush would seem to me to be prodigious. But if the whole Earth—for we know it is not elastic—has thus been pulled 12ft. towards the Moon, *when does it go back again!* When it has arrived at Long. 10°, the surface of the Earth—that is, the bottom of the ocean—must also be pulled up 12ft., and so on, for every portion of the Earth that is directed towards the line of attraction of the Moon. Is this, in any degree, its course of motion in its orbit? Or are we to believe that when the whole Earth has been pulled towards the Moon to make this particular tide, it goes back again by some method unknown? **Angulus.**

TELESCOPICAL — SCREW-CUTTING — THE LATHE, &c.

[20871.]—I venture to send you the following in answer to Mr. Wassell's appeal. I am sorry it is of so little value.

I may say that matters telescopical have long been a hobby of mine, and it was this hobby that first brought me in contact with our Mechanic, and though I have contributed nothing since the earlier vols., I have greedily devoured the communications of others, and shall, some time or other, perhaps, have something to say on these earlier writers and their work or theories; at present I would merely say that I consider Mr. Wassell's ideas by far the most original that have been brought before us of late, though all honour to the names of Blacklock, Bell, Barnes (whose slab suggested Blacklock's glass tool), Key, Calver, above all the pioneer Purkiss, and even "Arcturus" (his master), who, in spite of his errors and troubles, was the first practical teacher in our pages, and in whose recommendation of a spherical curve lay, possibly, the germ of the great truth (first definitely stated for *us* by Tydeman, I believe), that a regular spherical curve is the one great thing to aim at, and that to one who can with certainty get this, "opening out" the curve is comparatively child's play. These men, and more, deserve our warmest thanks. I wish I could help them, but I have not been very successful hitherto in practical work, though, I believe, I could compile a very decent history of processes, if only from our pages.

Some one asked about old mirrors of Herschel. When at Stonyhurst, some time back, I was told a reflector in the library was one of his make. I had not time to look at it, much as I wished, and do not know if my informant was correct in his statement; but I could, perhaps, learn more of it.

In connection with the Melbourne telescope, the name of Kingsley is given as recommending a metal containing zinc, of which a small speculum was made. Is Mr. Kingsley living, and a reader of "Ours"? He was a practical amateur, and ground mirrors (I think); one of which I have examined and looked through—a Cassegrain. It had, I believe, been injured, and the definition was not first-class; but if, as I suppose, his experience is great, he could help us in the present discussion on this form of telescope.

As regards Mr. Wassell's appeal (my real object in writing), I will do what I can by telling him that I remember three valuable papers in the Cambridge Philosophical Transactions, on, respectively, "The Achromatisation of Eyepieces," "The Spherical Aberration of Eyepieces," and "The Grinding of Lenses and Mirrors." These papers were, I believe, in the earlier volumes, but which I do not remember. There were, however, only four of them in the Bedford Library, and all three papers were in these consecutive volumes. I said three valuable papers—perhaps two would have been more correct, as the third is useless now, however interesting; the first two are classical, so to speak.

In this third paper the author (I forget who) claims to be one of the first, if not the first, to use machinery for his purpose. I can sketch his machine, if desired; but someone who has access to the paper could do so more easily and correctly; suffice it now to say that both tool and lens (or mirror) revolved slowly, while a straight stroke (really in a small circular arc) traversed the lens over (?) the tool, as in modern machines, the lens being between the legs of a wooden V, instead of the Ross ring, the plane of the V being horizontal and moving as a vertical pivot or centre at the angle. Pressure of lens on tool was provided for by a weight and a system of levers of the third order, the end of the long arm of the last resting on the centre of the lens, the object being apparently to produce pressure, without interfering with freedom of motion in the horizontal plane. The circular motions were by grooved pulleys, not ratchets, and there was, I think, no side motion.

I have reason to believe the machine was theoretical only; I think no result of its action were given.

At the end of the paper the author suggests that, by removing part of the pitch, it might be possible to convert the spherical into a parabolic curve, and he investigates the curve that should bound the edge of polisher to produce this effect. I forget the equation, and don't feel equal to attacking it myself now, but the shape of pitch came out as follows, Fig. 1, when either the black or white—I forget which—represents the surface of polisher left intact.

The writer goes on to suggest that as a parabolic mirror cannot fit a parabolic polisher, except when their axes coincide, perhaps the circular motion would have to be increased, keeping only sufficient cross-strokes to prevent rings.

As I said before, I believe the machine was hypothetical merely, but the paper was interesting, if only for containing the germ of the invention of the graduated polisher, which, I believe, was afterwards the independent invention of Mr. With or Mr. Cooper Key.

Now I come to think of it, there was an excellent paper by the then Astronomer Royal on telescopes made with reflectors silved *at the back*, the curves being adjusted to destroy colour and throw the image reflected from the front surface to a harmless distance. The form was, I suppose, Cassegrainian (it was that or Gregorian), and the glass of both mirrors alike—crown. There was a failure in carrying out the theoretical results (if numerically correct), for the instruments made were not a success. There was, I fancy, however, and the curves were spherical (?). Would this paper help the discussion on Cassegrains?

Some time back, when Mr. Brown was giving methods of boring cylinders, I sketched a method used by our engineer for boring pump-barrels and large-sized model cylinders, up to 5in. by 2¼in., and even over. The principal is a *true* boring-bar, revolving in bearings (or false ends), attached to the cylinder, which was pulled along the bar as the boring proceeded, the bar forming the guide. The drawing is neat enough for the engraver, and is still in existence, if anyone wants it. I fancy the method is old; but it is good enough for most amateurs, and easier than most, as a true bar is all that is required. Curiously enough, the method has only once been hinted at (to my knowledge) in "ours," though Mr. Brown gave its converse among many others. Possibly everybody considers it too well known.

I never sent the drawing mentioned. With it were my experiences of telescope work; and now the dispute is over, the remarks are worthless for the purpose intended. As they may help others, however, I may say that I found (and still find) that, with a good 2¼in. Wray, I could never reach Polaris or Rigel (the companions, I mean), though the views of planetary and lunar detail were excellent. I have seen the shading on Saturn's belt where Ball's division should be. May not some eyes have the nerves on the retina so distributed that points of light may be invisible, while masses of light and shade may be clearly seen; their relative brightness even exaggerated.

"J. K. P." has returned to us. Let us all rejoice; he gave freely of his wealth of experience, and hard indeed it was to catch him tripping. I have been discussing dies with a clever friend and a not particular clever "practical man" or two, and think there is room for a very good chapter or two on dies and taps, if "J. K. P." would undertake to supplement Holtz, Vol. II. Of course, we agree with him that, "for the purpose to which dies *should* be applied, the better ordinary forms of two-part dies are as good as any," or, rather, good enough; still, "J. K. P." improved them once, and why not again? Two questions I have, if he will answer them, dealing kindly with my inexperience.

He says "D. H. G.'s" and Cameron Knight's "odd dies" gave an excellent rake, the finest I obtained"; but "I consider they cut too greedily" at the end of the cutting. Query, Do they more so than his own, and if so, why?

Next, has he tried a spirally-fluted tap, and what does he think of them? From models and discussion, I think the principles of their action might be well considered by practical men. I have not made many, and my "practical friend" only had once used one.

Screw-mania has died out at last. It did have a day, about Vol. VII., and produced a crop of designs as plentiful and absurd as the velocipedes in their milder moods (almost!); it revived about Vol. XVI.

I think, when Mr. Wenham gave his own method—a really valuable contribution to the subject—its last effort was in "J. L.'s" paper a few vols. back. Strange to say, one device, partly worked out, and afterwards mentioned once, seems not to have attracted notice; this was one in which a screw on mandrel drives a tangent-wheel, connected by a string to the chaser. It seems to me this might be made to work, with a cone of different sized pulleys attached to the tangent-wheel to give different pitches, the string, a fine steel pianoforte wire, either attached direct to the chaser, or (?) to lessen the error due to varying angle, to the far end of a bar placed parallel to the work, the near end of bar holding chaser, which would rest on the T-rest. What does "J. L." say? Some guide is wanted for those who cannot afford the slide-rest and "D. H. G.'s" overhead, or its more costly and correct rival the screw-cutting lathe.

I have a device for grinding skates. Does anyone want it. The principle is an old broom without bristles, planed so that the stick, or handle, is normal to bottom, on which skate is fastened as to a man's boot. The skate-iron is laid along the rest of a grindstone (or better, a small emery-wheel in a lathe), the broom-handle being also horizontal and at right angles to the line of centres, supported on a table, or something suitable and firm. If a screw be put through the handle into the table-top, we get a guide to grind to any radius. I do not know how skates are usually ground—possibly with a slide-rest and template, which latter might be used in my method as an additional security; but I managed to grind two decent edges with the method above, and a little common-sense. Does anybody know the best average angle for the cutting edges. It and the best radii might be embalmed in the Mechanic.

I trust you will be able to read this. At college I had an unenviable notoriety, "One of the two worst writers in the Senate House"; but age should improve me.

Perhaps I had better at once apologise for the crude screw-mania suggestion. Mr. Fred. Carre is so dreadfully rough on us all, that I feel tempted to withdraw my humble communication. Surely he might cultivate the *suaviter in modo*, for this is not the first time he has used stronger language than many of us consider desirable in friendly paper controversy. Nevertheless, we have known him long (the "Derf Errac" of early vols.), and he has done us good service once and again, and if the *suaviter in modo* is beyond him, why, we must bear the bitter for the sake of the sweet.

The fact is, Sir, we none of us know how others will take our words. I am not sure that he will take this as it is meant, and if I had not known "Derf Errac" of old, I should have considered some of his remarks on "J. L." to contain very unpleasant insinuations.

"J. L.'s" canon of criticism is a good one—"Bowl at the wickets, not at the man"—but there is a difficulty sometimes in applying this, since we cannot always tell which a man is doing. This difficulty is common enough in all definitions, notably in "Euclid and Science"—*e.g.*, the def. of parallel lines, and tangents, and proportionals, which impractical defs. are laid aside as standards after one application, to be replaced by other simpler working tests for ordinary use.

Has "J. L." ever tried the planer he suggests? My question arises from this fact—I find he (?) suggests the same thing in Vol. V. or thereabouts, so that if he has tried the method during these years, it is anything but a crude and ill-digested idea, but a very practical suggestion. **Bow.**

"MAKE YOUR OWN GAS."

[20872.]—Mr. Fletcher's remarks under the above heading, demand some notice from me, as advertiser, whose conduct is by implication somewhat impugned. I became the owner of the apparatus some months ago from an advertisement in your private columns. Circumstances, quite apart from the merits of the apparatus, have prevented me from bringing it into use, or even from putting it into position to test it. But I have done what we all have to do when we have any information to glean, or any difficulty to encounter. I submitted to *our* editor a general rough description of the apparatus, asking his opinion thereon. You, Sir, if you will pardon my erratic transitions from third to second person—were good enough to favour me with a reply in the correspondence column of our journal, wherein you stated that you believed such an apparatus was a thorough practical affair, and advised me to write Mr. Fletcher. I did so, inclosing the statement I received with it, which asserted that by it good gas could be made from petroleum and benzoline, while the highest results were obtained from gasoline. Mr. Fletcher very strongly denied the truth of the former statements, but, while he expressed some doubt as to its being his apparatus, he did not venture to deny that good results might be obtained from gasoline. I now will submit a rough description of the apparatus, and, as I venture to think, it is a question of more than personal interest, I trust it will call forth an authoritative opinion of its merits that will be decisive one way or the other. The motor is a heavy weight, wound up by wire rope, like the weight of a clock. This actuates a framework of geared wheels, which in turn set in motion two bellows—or foot blowers I presume they would be called in technical phraseology. These are connected with a small box which is furnished with valves to prevent the return of the air. There is, further, a much larger box with a bellows division in the centre, presumably intended as a reservoir for the gas. The generator itself is like one shown in Mr. Fletcher's catalogue of petroleum apparatus, and it bears the name on a brass label:—

Thos. Fletcher, Museum-street,
Warrington.

Being unacquainted with this class of goods, and not having the advantage of seeing the apparatus at work, my description is necessarily a meagre one, but, I think, sufficient to call forth a decisive reply as to its merits. **John Bate.**

Bellroughton, Stourbridge, Dec. 18th.

MICROSCOPE NOSES AND SCREWS.

[20873.]—I doubt, when you see so much said about these, and one screw fitting a number of microscopes, if people in general are half careful enough about the proper centring and adjusting of their lenses. I don't believe that one screw that is turned to fit one body, and is properly adjusted, will really be so for another body. The slightest error makes so very much difference, especially when there are two or three lenses in a power, but I may be wrong. **Edward Thomas Scott.**

Erratum.—Nitrogen.—In letter 20846, p. 340, "grains" should be "grams."—E. A. W.

Any reader fond of stirring sea scenes and representations of heroic adventure cannot do better than send to the South Kensington Fine Art Association for the two pictures of the Ramsgate Lifeboat, advertised in this number. They are very good, and wonderfully cheap.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48290.] — **Daytime Observations, &c. — Making R. A. and Declination Circles and Verniers.**—In continuation of my reply on p. 190, we will suppose the edge or limb of the Declination circle to be divided into 360°. If you wish to read by vernier to 6′ (minutes of arc), the space occupied by 9° must be divided into 10 on the vernier. To read to 3′, the space of 19° must be divided into 20; and to read 2′, the space of 29° must be divided into 30 spaces for the vernier. To read closer than this it is advisable to divide edge of circle into smaller quantities than degrees, rather than to increase extent of vernier. For the Right Ascension circle, if we suppose it divided into 360°, each of the 24 hours will embrace 15°, and each degree equal 4min. of time, or 240sec. Now, to read to 30sec., take the space of 7° on circle, and divide into 8 for the vernier; and to read to 15sec., take the space of 15° and divide into 16 divisions. Let Fig. 1 represent part of Right Ascension circle; A B part of limb, showing degrees, and reading hours (as shown), and 20 and 40min., as shown by the two dots; C D is the reading length of vernier, and *supposed* to be divided into 16 spaces, and to read quarter minutes. The line D, with arrow-head, is called the index; and when exactly coincident with any line on the limb shows the time in hours and minutes; but if the index-line be between any two lines, we look along the vernier till we find a line on the vernier which coincides with a line on the limb. Now, if this were at the 1st line after the index-line it would equal 15 sec.; if at the 4th past, it would equal 60 sec., or 1min.; and so on to the 15th, when it equals 3min. 45sec., and at the 16th it equals 4min.; but it would also be found that *then* the index-line was again coincident with one on the limb, and the whole value can be read off there. The index-line is either marked O, or understood to be so. The 4th line from it in this case is marked 1min., the 8th marked 2min., and the 12th marked 3min. Now, as the graduations on the Declination circle are degrees, and are used as such, the reading by vernier is different. If we take 9 divisions on the circle, and divide that space into 10 on the vernier, the 1st line after the index, if it be coincident with the line on the limb which the index has just passed, will show a value of 6′; the 2nd line, if coincident, would equal 12′; and so on till we reach the 10th line, which will bring the index to the next degree. It would be advisable to mark the middle line on the vernier as 30′, where figure 5 is placed in Fig. 2, if the vernier be a simple one. To divide the vernier fix it upon or against the limb of the divided circle at the precise distance from the centre that it will subsequently work, then mark upon it the limit of, say, 9 spaces on the limb A (see Fig. 2: this is a much exaggerated form); take away the vernier and draw a line truly along from the exact centre to each of the 10 division marks which inclose the 9 spaces. It will now be found that a little nearer the centre R—that is, just within the limb divisions A—there can be drawn a portion of a concentric circle S, on which the 10 spaces, where they touch it, will just equal the limit marked on the vernier, and by means of these divisions the vernier can be marked off. This is not the orthodox plan, I dare say; but it will suit the amateur, and is free from any appreciable error, on account of the small difference in the radii of the two circles. There is an "improved vernier" figured at p. 84, Vol. XXXIV.; but it presupposes an amount of very accurate work quite beyond most amateurs. "Tyro" would derive some information from Heather's "Mathematical Instruments" (1s. 6d., Lockwood and Co.)—how much I do not know, as I have not the book; and in Horne and Thornthwaite's "Hints," 1s. (advertised on front page generally of the "E. M."), he will find several forms of verniers in various positions. A magnifying glass of about 1in. focus will be found of great use in marking; and if he will draw a portion of the circumference of, say, 24in. radius on stout white paper, divide 2in. of it into 8 quarter-inches, then take the space of 7 of these on a separate piece of paper for the vernier (and bearing the same curve), and then mark that into 8 divisions or spaces, this will read to 32nds of an inch; or take 3 divisions and divide into 4, this will read 16ths, — he will learn more in a few minutes as to the use of the vernier in an elementary way than he might possibly do with an hour's reading. I may add the Declination circle vernier is often doubled in its extent, the middle line marked O, and north declination read off on one side of it, and south declination off on the other side. If "Tyro" does not understand this, I shall be pleased to help him further.—J. C. L.

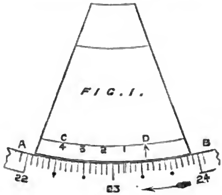


FIG. 1.

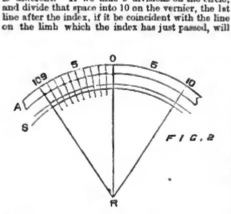


FIG. 2

[48321.]—**American Loco. Tenders.**—I hope "A.M.B." will be able to obtain the required information from the following description. I have not sent a sketch, as, to render the construction of the truck at all intelligible, more than one view would be needed, and drawn to such a scale that they would occupy far too much valuable space. The P. and R. tenders are carried on two four-wheeled trucks, very similar in construction to those used under the majority of passenger cars. The truck frame is made up of four light iron planks, bolted together at each corner. To this frame the pedestals are bolted, and their lower ends are connected by pedestal stay-rods. Near the centre of the truck, and a little distance apart, two iron transoms stretch across between the frames, a distance of 6ft. 0½in. The truck is what is known as a "swing bolster" truck—i.e., the plank or bolster on which the weight of the tender-rests is supported, through the medium of a triplet of elliptic springs, by a transverse beam called the spring-plank. This plank is supported at each corner by an iron hanger, secured at the other end by a bolt, attached to the transoms already mentioned. Thus, the truck bolster lies right between the two transoms. It will be seen that the truck bolster is, in reality, a part of the spring plank. The object of this arrangement is to eliminate, as nearly as possible, any jolt of the truck by causing the bolster, and, therefore, the tender, to move laterally. Now, as soon as the cause tending to displace the truck sideways ceases to exist, the spring-plank, and, consequently, the whole body resting on it, comes back to its normal position without the help of the springs (as in the case of the Adams truck.) The truck-wheels, 33in. diam., are spokeless, and made of cast iron. The weight on the wheels is equalised by means of a wrought-iron equaliser, resting at each end on the top of the axle-boxes. The equalisers (of course, two to each truck), are not pivoted to any centre; the equaliser-springs, I think, of rubber, being arranged so that they bear against the under side of the truck-frame and the top of the equaliser. There are two equaliser-springs to each equaliser, and are 2ft. 1in. apart from centre to centre. At each end of the truck-bolster is a piece of iron projecting up above the level of the bolster. These projections are known as side-bearings. Their object is to prevent too much tossing of the tender while travelling. The wheel-base of each truck is 5ft. 4in., and, I think, but am not sure, that the bearings are 8in. by 5in. The tenders which are carried by these trucks are abnormally large, having a water capacity of 4,000 U.S. gallons (231 cubic inches = 1 gall.) These tenders are very easy riding. The Pennsylvania R. R. use what is known as the "Diamond Truck." For a description of this I must, however, refer "A. M. B." to Mr. Dredge's interesting work, "The Pennsylvania Railroad." I may add, in conclusion, that many of the Western roads in this country use "swing bolster" tender trucks. The size of tender axle bearing recommended by the Master Mechanics' Association is 7in. by 3½in.—Guide Yoke, U.S.A.

[48402.]—**Slide-Rule.**—On line C take 7; then count 8 of the divisions towards the right; then half the next division will be 5 (that is, 785), which is as near as can be got on the ordinary slide-rule. The rule is much easier set for finding areas of circles by setting 22 on D to 28 on C, when the numbers on D are diameters, and those on C their areas.—Tyke.

[48402.]—**Slide-Rule (U.Q.)**—The slide-rule may be set approximately thus:

A		14		
B		11		
	3·14			·7857
D	2		·	1

Set 11 on B to 14 on A, then for any diameter on D the area may be read off on the lower edge of B, or C as it is needlessly marked on most slide-rules. The setting is in slight excess, ·7857 instead of ·7854.—A. D. L.

[48438.] — **Gearing.** — If your correspondent wants *one pair of wheels* to gear at so many angles, he will be disappointed. Bevel wheels, excepting mitres, when one pattern will do for both wheels, are made in pairs for every variation in angle or diameter, and therefore will seldom be got to run well with any other wheel.—Tyke.

[48469.] — **Musical-Box (U.Q.)**—The best thing to be done in this case is to send the old comb as a pattern to any musical-box manufacturer, and he will send you a new one. I do not think there is any possibility of having new teeth put in the comb. As regards the steel pins in drum, they will be required to be punched out and replaced by new ones, a job requiring considerable care, as in doing this you may injure some of the other pins. In my opinion, the best proceeding to take is to send it to a musical-box manufacturer as it is, that is, if you consider it worth the necessary expense. If it is in such a dilapidated condition as you describe, I should hardly imagine that it was.—G. Fryer.

[48472.]—**Harmonium Pedals.**—If Mr. J. B. Burston will advertise his address in "Address Column," I will endeavour to help him out of his difficulty.—G. Fryer.

[48476.]—**Metropolitan Railway Locos.**—These engines have single inside frames, outside cylinders, four coupled behind wheels, a leading four-wheeled Bissel truck, and side tanks. The chief dimensions are:—Cylinders (inclined), 17in. by 24in.; coupled wheels, 5ft. 9in. diam.; truck-wheels, 3ft. diam.; from centre of truck to centre of drivers, 9ft. 11in.; from centre of drivers to centre of trailers, 8ft. 10in.; truck-wheel base, 4ft. 4in. Boiler, 11ft. 3in. long; 4ft. inside diam. 166 tubes, 2in. diam. Grate area, 19 square feet. Total heating surface, 1,014 square feet. Length of tanks, 15ft. 6in. Extreme length of engine, 31ft. 7½in. Working pressure, 130lb. per square inch. The width of the coal-bunker at the back end of the engine varies on different classes from 1ft. 6in. to 2ft. 6in.; and, consequently, the weights of engines, otherwise identical, vary. The following weights are for an engine of the 19 class, having bunker 2ft. 6in. wide:—On truck, 10tons 15cwt.; on drivers, 16tons 11cwt. 2qrs.; on trailers, 15tons 15cwt. 1qr.; total, 43tons 2cwt. The chief points of interest about these engines are their large grate area, great weight on drivers, and their free steaming qualities. They are fitted with Smith's vacuum brake. On the Midland Railway there are, I think, six engines almost precisely similar to above. They are said to be the heaviest engines on the line. Mr. Kirtley's engines on this road have inside cylinders, inclined 1 in 11, four coupled in front wheels, a trailing four-wheeled truck, and in and outside frames. The leading axle has outside bearings. The driving axle in and outside; and the truck axles inside only. Mr. Johnson's engines have inside cylinders, 4-coupled in front wheels, a trailing four-wheeled truck, inside frames, and inside bearings to all wheels. Following are the chief dimensions of these two classes, No. 1 being Mr. Kirtley's, and No. 2 Mr. Johnson's:—

	1.		2.	
	ft.	in.	ft.	in.
Diam. of cylinders		17		17
Length of stroke		24		24
Diam. of coupled wheels....	5	1	5	6
,, of truck-wheels	3	0	3	0
From centre of leading to centre of driving-wheels..	8	0	8	0
Ditto, driving to centre of truck	12	3	11	3
Wheel base of truck........	5	0	5	0
Boiler, length	11	0	10	6
Diam. outside	4	3	4	2
No. of tubes	167		—	
Diam of ditto..............		2	—	
Length of con. rods........	6	6	6	5⅞
Ditto eccentric rods	5	6¼	4	7⅛
Inside firebox length	4	6¼	4	9$\frac{3}{16}$
,, ,, height	5	3¾	5	8 (mean)
,, ,, width	3	6	3	4¼
C. line of boiler from rails ..	6	3	7	0⅞
Top of chimney from rails..	12	6	13	2

—Guide Yoke, U.S.A.

[48486.]—**Mercantile Dictionary (U.Q.)**—I thought some one more able than myself would have answered this query; but as I find it has got into the "Unanswered Queries" column, I venture to recommend "A Counting-house Dictionary, by Richard Bithell," published by Routledge at 5s., which most likely would suit "Grip."—Pont de Bois.

[48502.]—**Astronomical (U.Q.)**.—In answer to "T. R.'s" second question I may say that it involves the erroneous idea that magnitude is dependent solely upon distance. As 61 Cygni is very much nearer to us than Capella or Arided, we can instantly recognise that there is no truth in such an idea. In the case as put by "T. R." a star would obey the ordinary law, and its light would diminish in the inverse square of the distance—at distance 2 light would be $\frac{1}{4}$; at distance 3, light $\frac{1}{9}$; &c. According to the researches of Pogson, a star of a particular magnitude has 2·51 times as much light as a star of the magnitude next beneath. Dr. Galle, in Humboldt's "Cosmos," says. "The decrease of our ordinary star-magnitudes (1, 2, 3 . .) is approximately as if a star of the 1st magnitude were placed successively at distances of 1, 2, 3, ... whereby, according to photometric law, its brightness would have successively the values 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$. . . . . ." It was in order to make the accordance still closer that Sir J. Herschel proposed his "Photometric" scale.—S. M. B. Gemmill.

[48509.]—**Varnish or Polish**.—There is no varnish or polish that is really proof against heat which is also transparent—except enamel, and that is not usually called varnish, nor is it applied to wood. Your correspondent should use pale copal or French polish, and put a mat under his teapot. The "lacquered tea-trays" are really japanned—the japan being a sort of black varnish, which is "stoved" on in a proper oven.—Essar.

[48517.]—**White Metal**.—There are several alloys suitable; but which is best cannot be said without more particulars. For instance, equal parts of brass, tin, bismuth, and antimony. If too costly, try various proportions of tin and antimony, or mixtures of lead, zinc, antimony; the same with the addition of tin, or ordinary type-metal with the addition of a little extra antimony—something like stereo-metal, but not so brittle.—Nun. Dor.

[48521.]—**Harmonograph**.—You will find a lot of information about this instrument in back volumes under the above title, "Sympalmograph," "Lissajou's Figures," &c. Perhaps the description on p. 18, Vol. XXV. will suit, or that on p. 93, same vol.; but I know if you look up the indices you will find a great deal about it.—S. C. T.

[48522.]—**Polishing White Wood Plates**.—As these are painted, great care will be necessary. They should be carefully sized—preferably by dipping them bodily, as a brush might disturb the colours. Then coat with pale paper varnish or amber varnish, or use clear French polish. The polish is applied by making a tuft of cotton; soak that in polish, then cover with a clean rag and put a drop of linseed-oil on it; apply in circular strokes; but you should look up back numbers for the art of French-polishing—some capital papers in Vol. XXXII., I think.—Essar.

[48526.]—**Cyclops Fan for Organ-Blowing**.—I do not pretend to know much about the regular pressures obtained from fan-blowers, but am of opinion that if you have a gas-engine it would be the best to apply the power to a three-throw crank connected to three separate feeders, and supply your organ bellows that way. You must bear in mind, organs, as a rule, do not want an extreme pressure, but quantity of wind. We have a three-manual organ at work daily, worked by a gas-engine, the wind supplied as explained above. If "C. B." is located anywhere in the north and would care to see it at work, he could do so if he would advertise his address.—Uranium.

[48526.]—**Cyclops Fan for Organ-Blowing**.—Fans are useless for organ-blowing. You want something with a dead-beat valve, which opens to let wind pass, and then closes against its return. If you had a fan, the valve would have to be always open, and there would be a variation in pressure according to the demand made on the bellows. In an organ you must have a steady pressure.—Organon.

[48540.]—**Coil for Transmitter**.—Any of the little coils (some are sold as low as 2s. 6d.) will answer for a transmitter.—T. P.

[48553.]—**Oval Mounts**.—I have some recollection of a machine being described in a back volume; but, as a rule, they are done so quickly by hand that it is doubtful if the machine paid. Cut with a brass gauge on a piece of beech, using a short, sharp knife.—Nun. Dor.

[48555.]—**Fire-Lights**.—A steam fan to keep the rosin melted, and a crank and dolly to mix up the sawdust with it. When mixed, run into moulds, which may be kept warm until filled, when they are removed to cool.—S. Mayer.

[48556.]—**Pellety Castings**.—Probably the castings are poured without a sufficient head, and no vents are provided for the escape of gas. I would suggest the employment of a skilled moulder and foundryman.—J. T. M.

[48567.]—**Tripod Stand**.—Several stands have been described in back volumes, but the best way of all is to get a look at one, and then improve on that. I prefer the style in which the lower leg slides between the two portions of the upper.—T. J. N.

[48580.]—**Skin of Feet Peeling**.—Does not "F. E. L." understand that there must be some special cause for such an effect, and that no one whose advice would be worth taking would prescribe a remedy without having an opportunity of examining the patient?—M. D.

[48584.]—**American Cloth becoming Sticky**.—You can try washing over several times with milk; but it would be better to recover with what is known as dull-grain cloth.—C. M. P.

[48588.]—**Gas-Engine**.—Cannot be used for working by gas, but might be used with water—that is, if there is sufficient pressure.—Essar.

[48592.]—**Electric Light**.—Answers very well, I believe. Faure's accumulators are used, and they are charged by being brought into connection with a dynamo.—V. S.

[48672.]—**Sand-blast Files**.—I am much obliged to "E. H." for his reply, and the trouble he has taken to make a drawing. From his expression "new sand-blast files" (p. 303), I thought some method of cutting files by means of the sand-blast had been devised, whereas it is only files finished by the sand-blast that was meant. The process and its effects on the file were fully described in this paper so far back as Vol. XXVII., on p. 437 of which Figs. 2 and 3 show the teeth of a hand-cut file, and the effect of the sand-blast on them. Does anyone know whether any attempt has been made to cut files with the sand-blast, or to do the work of the files themselves by an application of Tilghman's invention?—Nun. Dor.

[48689.]—**Lathe-Bed**.—If "On Guard" will read my query again, he will see that I said nothing about face drawing a lathe-bed casting, I alluded to castings in general. Also, I don't say that it is not possible to plane a casting straight. Allow me the use of a good machine, and I will plane a bed as true as "O. G." But I say, again, I have seen many beds that have been very far from what they ought to be. I am blessed with more time than money, otherwise I should prefer planing, most decidedly, but, as I said in my query (remembering what we as mechanics, 30 years ago, were in the habit of doing with chipping and filing), I have no hesitation that if I can get a good casting, I will chip and file the bed up to more than the average truth of lathe-beds. The other remarks of "On Guard" mostly agree with what I said myself—his way of fixing bed for planing is the ordinary method a good workman would adopt. I may say, as a hint to workmen, that I had some tools made for finishing off large flat surfaces 1¼ or 1½ broad; these made very sharp and with a light cut left very little for the scrapers to do. The answers of "C. S." and "Tyke," are more to the purpose, but still hardly sufficient. Will some moulder used to lathe-bed casting say, shall I make the pattern straight on the face and let the moulder strickle his bed to his own judgment, or will someone tell me how much to make the face round? Or does it require to be round at all, remembering that it is to be a gap bed.—E. P., Liverpool.

[48690.]—**Magnetic Storms**.—Of course the bosh sent over from America was received in the usual way and printed in a lot of papers, whose editors should have known better than to have been caught napping. Now, I want to know from some of our readers in America, what really did take place during the last magnetic storm. The Mechanic is read very much throughout the States, and I, for one, should be very pleased, indeed, to have a true unvarnished tale of what actually did take place during the storm. We had nothing here at all, to compare with the 8 h.-p. light; this was rich, and must have been concocted by some punster. I am more surprised at the gullibility of some, than by the 'cuteness of these American gentlemen who think the English will believe anything.—W. J. Lancaster.

[48704.]—**Microscope Lamp**.—You can easily make a candle-lamp to burn, say, one hour and a half, and to fold up into something like 5 by 1¼in. I shall be pleased to give you a drawing of such a lamp, if you care to make one. It is a very simple thing, and very efficient.—W. J. Lancaster.

[48710.]—**Electric Indicator**.—The better way is to couple indicator and bell on same circuit, and use all the cells. This is far more certain than making a relay for bell. The distance is so small that it is not at all worth while making a relay. I would advise for line wire a good double wire insulated with either indiarubber and paraffined cotton, or one guttapercha insulated wire inclosed in another insulation of guttapercha with a second wire.—W. J. Lancaster.

[48718.]—**Electric Switch**.—The best switch you can have is one that, in using it, will keep its surfaces clean. Perhaps a couple of lines and dots will show the arrangement as well as a drawing. Thus, the two dots on the left are connected to one series of wires, and the two on the right to another series. The two lines represent two brass plates working on a joint, and connected to main wires, and of course insulated from each other by a piece of ebonite prolonged to form a handle, so that it can be moved over. The dots and lines are here : =: the centre falls down between two upright springs of brass, which clip each side when pressed down to the bottom.—W. J. Lancaster.

[48726.]—**Cornice**.—If "Doouram's" cornice is a lacquered one, there is no way of restoring its original tint and brightness otherwise than by having it relacquered. This he could get done at any respectable gas-fitting firm, and would not cost much. If he is unwilling to do this, let him try washing it with oxalic acid and vinegar diluted with water; rinse off with clean water, and dry with a cloth or cotton waste; this will clean it, although the effect cannot be very lasting; also the parts which are green will appear of a different tint to the rest when cleaned.—Gas-Engineer.

[48727.]—**Rancid Butter**.—According to "Cooley's Receipts," rancid butter may be restored by well washing first with new milk, and next with cold spring water; butyric acid, on the presence of which rancidity depends, being freely soluble in new milk.—E. G. T., Plymouth.

[48727.]—**Rancid Butter**.—If required only on a domestic scale, the following process will succeed:—Take a couple of handfuls of solid wood charcoal; wash well till all small particles are removed; tie up in a muslin bag, which should be immersed in the water containing the butter. It will not only purify the butter, but will also prevent it from turning rancid.—Pi.

[48729.]—**Oysters**.—The question is not an easy one to answer. I have on many occasions endeavoured to find a trace of life immediately after cutting an oyster open, but I have never been at all rewarded by the faintest glimmer of life, and personally, I believe the oyster is dead the moment it is cut open.—W. J. Lancaster.

[48732.]—**Indicator Diagrams**.—Will our two friends, "Labor Omnia Vincit" and Fred. Walker compare conclusions, and then look at query again. Brevity is a good thing (sometimes), but if F. W. is a reader of the "E. M." he must have seen the request for more information when sending his diagrams, or you might, Mr. Editor, say how much reduced to fit the column; but if querist would take the trouble to mark on diagram the extreme pressures, a scale could be made to suit your figure. But will "F. W." explain what is a simple H. pressure engine, with *Cornish valves and link-motion?* I have no conception of how Cornish valves are worked by link-motion. I have Cornish valves on my engine, but they are operated by cams, worked by bevel gear from main-shaft; and if such is "F. W.'s" case his gear-wheels have been changed, as, taking Fred. Walker's view, the steam admission is very late, and exhausts the same; so that if there is an exhaust cam, as well as steam admission cam, by bringing one right the other will follow. But I hope "F. W." will favour us with more particulars, and so get satisfactory information.—J. O. E.

[48734.]—**Electricity**.—I should like to understand your query; the first part is clear, but the latter half I am afraid contains some error. Do you mean that one cell only being used charged with water it decomposed by its current water very fast? I cannot believe you mean one cell, because one cell of any kind will not decompose water fast; in fact, it will hardly decompose it at all. There is no difference between the electricity of one cell and any other in a series. Of course, coupling them in series will give a greater intensity to the current.—W. J. Lancaster.

[48747.]—**Lunar Photographs**.—The greatest essential for lunar photography is an equatorial telescope with driving clock. If you have this, I will tell you how to proceed. You can take solar photographs with an ordinary telescope. I have lately made a special solar camera for photographing sunspots, &c. Shall be pleased to describe it if you would care to photograph spots, &c.—W. J. Lancaster.

[48749.]—**Induction Coil and Water**.—To Mr. Lancaster.—You cannot obtain any advantage by interposing a coil of any kind in the circuit. I thought I had said so before. You will decompose a much larger quantity of water with the current alone from the cells. You may use any electrodes you please, but platinum ones are the best for simply decomposing water.—W. J. Lancaster.

[48752.]—**Tea.**—The statements of "F.R.C.S.," on p. 275, call forth a few comments, which I trust you will insert in your next issue. Tea. "F.R.C.S." dwells at length on "dirty water," "rob a poor man of his beer," &c. While agreeing with him in nearly all the points he has elucidated, there is one on which he has not touched sufficiently—viz., *adulteration of tea*. In plaintive tones he speaks of "poor" people having to drink dirty water with a little brown sugar in it. It is no use beating about the bush. Now, this staple plant, of which we hear so much murmuring, is at the present time being adulterated to a large extent, not only in China and other tea-growing (save the mark) countries, but also in India, tea being forwarded from the Assam and Darjeeling districts to Calcutta, and manipulated there. Those who have been to these places will agree that these observations of mine are correct, coming, as they do, from the lips of influential tradesmen, both in Calcutta and Singapore. Having visited Calcutta some few years ago, I heard it reported that a large quantity of Indian herbs and leaves of trees—catechu, &c.—are dyed and fabricated to imitate tea-leaves, and in that state large quantities *are* forwarded to Europe, and other parts of the world, and palmed on to the tea-drinking public as pure Assam and Darjeeling teas. Green tea, also, is faced with blue and yellow matters, the blending of which gives the tea its green appearance. Now, it would appear to the careless individual that it matters little to the Government whether pure or impure tea comes into consumption. If the adulterated tea to any large amount were brought into general consumption by being offered to the public, what would be the result? It would have the effect of making them squeamish, and drive them to some other beverage, and then the *Government* would eventually be a loser through the decreased consumption. Is it according to the laws of British, or any other, rule that a Government should charge a duty on an *adulterated* article? Is it right or honest that a Government should allow merchants to import spurious tea, to receive a duty on such teas, and allow the merchants to dispose of it to *retail* dealers, and by them to be foisted on the public? By all that is holy, who shall we say is the guilty party? I will leave the question to my brother subscribers to think on. What is required is a *competent* analyst, who shall examine all teas, and other duty-chargeable articles, before being allowed to come into consumption. If any dealer were afterwards found possessed of spurious tea, he would *then* suffer the penalty of the law.—A.A., B.S.P., Sheffield.

[48757.]—**Portrait Lenses.**—A portrait lens will give a rounder picture than a view lens as ordinarily used, but if you will use a very large stop *f*·8 with the view lens you will be able to get an excellent portrait. An ordinary stop will give every part of the picture sharp; this will make it flat, very much like a painted landscape, in which the whole of the picture, including distant hills, are all as sharp as if cut with a knife. You can soon tell the difference between a good landscape and a bad one, and there is as much difference between a round and a flat photo.—W. J. Lancaster.

[48766.]—**Photography.**—You can either obtain the positive by contact printing or in the camera; the former is the easiest method, but you must obtain your negative first, and you cannot use either of the lenses belonging to your lantern for the purpose; better get a cheap achro lens, made on purpose for photographic use. Let me know the kind of lens you intend using, and I will give you instructions.—W. J. Lancaster.

[78780.]—**Crank-Shaft.**—Having noted the remarks in reply to above query, I consider the remedies of "L. O. V." very good. I have had the experience of a crank journal getting hot, and tried these remedies quite useless. I tried all degrees of slackness and plenty of lubricants, to no avail. Being quite cool at the start, it would not run two minutes without any load on the engine without being so hot you could not touch it. At last, after all these trials, my remedy was taking out the brasses and filing sideways the opposite to the wear without touching the bottom at all, after which it could run an entire day without more heat than blood-heat. Not having seen this remark to above query, I consider it might be of service to readers of "E. M." The cause being the wear, the brasses are consequently oval, and, as it were, grind themselves into a bed. Then, at the least neglect of oil, brass and journal get corded. When journal gets heated it jams itself in the brass, and thence arises the heating. Should all the former remedies given fail, I think you may try this to advantage, which I can speak for as stated from practical experience.—Ducrow.

[48802.]—**Photos. for Stereoscope.**—Instantaneous sea photos. have been done many years, some of the finest being by "Breese." You should endeavour to buy any you can get done by "Breese"; he has been dead some time, but his slides can be picked up now and again, and are really a good investment.—W. J. Lancaster.

[48814.]—**Grinding Glass.**—You can get the right sort of grinding stone at any large tool dealers. Tell him the kind you want, whether for rough or fine work. Bilston grit is one of the best kind you can use.—W. J. Lancaster.

[48818.]—**The Weather.**—For years I kept meteorological records, until I became thoroughly disgusted with the whole thing. In four or five years I believed I knew something about it, and people used to continually send to me to ask what kind of weather we should have. I could give a good guess, and managed to forecast splendidly when it came true, but once or twice it came wrong, and I gave it up. This September I was in Wales, and the published forecast read "Wind N.W., very fine." I paid some £4 for tickets, &c., for a Snowdon tour, and went. The weather was simply frightful, rain and wind evidently contending for supremacy. My moral was, If the Meteorological Department don't know the cause, how should I?—W. J. Lancaster.

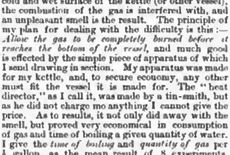
[48819.]—**Casting Blowpipe Solder.**—The article in question is made or cast as follows:—Procure a small ladle, punch a small hole—say, ⅛ or less, in one side near the top; get also a flat slab of stone, or iron plate will do; lay this perfectly level, fill up the ladle, and start to pour from the hole, carrying the hand from left to right with an easy motion. A little practice will soon show you how to do it. If your solder is too dull when cooled, you may add more tin: in fact, for blowpipe solder, there should always be more tin than lead, and do not use compo in your alloy. Experiment till you get it to your own liking.—Gas Engineer.

[48820.]—**Smell from Gas-Stoves.**—"Gas-fitter's" ring-burner will be difficult of cure, according to his description of it. I should think it is an atmospheric one, and all those kind of burners give off an unpleasant smell. I should advise him to use a plain ring instead—i.e., without the air-hole. This will perhaps smoke the bottom more, but the smell will not be so unpleasant. After considerable experience with liquid heating burners of every description, I have found nothing better.—Gas-Engineer.

[48820.]—**Smell from Gas-Stoves.**—Having got a gas-stove into my house some months ago, I was at first troubled by the smell which arose when a cold kettle was put down upon the flame, and set myself to correct it, happily with success. First, as to the cause. When a vessel full of cold water is brought down upon a gas-flame, a large quantity of water is condensed upon the bottom of the vessel (this water, of course, is formed by the combustion of the hydrogen of the gas). Now, when the mixture of gas and air impinges upon the cold and wet surface of the kettle (or other vessel), the combustion of the gas is interfered with, and an unpleasant smell is the result. The principle of my plan for dealing with the difficulty is this:—*Allow the gas to be completely burned before it reaches the bottom of the vessel*, and much good is effected by the simple piece of apparatus of which I send drawing in section. My apparatus was made for my kettle, and, to secure economy, any other must fit the vessel it is made for. The "heat director," as I call it, was made by a tin-smith, but as he did not charge me anything I cannot give the price. As to results, it not only did away with the smell, but proved very economical in consumption of gas and time of boiling a given quantity of water. I give the *time of boiling* and *quantity of gas* per ½ gallon, as the mean result of 8 experiments, 4 with each:—

	Time.	Cubic feet.
Old way....	24 min.	4
New way ..	15 min.	2¾

Thus the device is advantageous in every way—in fact, it is constantly used in my house now, and when I come home in the evening I am not made painfully aware of the fact that the kettle is boiling for tea the moment the hall-door is opened. In the sketch A A are studs to support the kettle.—Thomas Farrington, M.A., F.C.S.

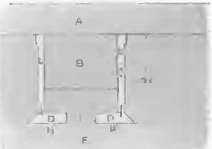


[48821.]—**Filtering Solution of Citric Acid.**—I should think that "One in a Fix" could get out of it by passing his solution through a filter made of well-washed calico (the finest he can obtain) and powdered animal charcoal, returning the filtrate until it passes quite bright.—E. G. T., Plymouth.

[48825.]—**Riveting Pottery and Glass.**—Permit me to refer this correspondent to several letters of mine upon the above subject. Possibly something useful may be found therein. See Vol. XXXV., Nos. 908 and 910, also Vol. XXXVI., No. 913.—Alfojoe.

[48829.]—**Lathe Bed.**—Let the sides of pattern be about ⅝in. thick. Now look at Fig. 2, which is a plan of part of lathe-bed. He will want two ribs, as B, to stiffen his bed. Let them be dovetailed into the sides so as to draw out easy. Now, Fig. 1, which shows pattern face down in the sand, rammed all round under and over, then the moulder will lift off the top box A, then he will draw out the ribs B. Next lift out the sand inside the pattern down to E, then he will take out the pattern C C. The two faces D D will be left in the sand, because in making the pattern they must be made loose and have two pins in each, as seen at D D, Fig. 1. These pins keep them in their place when moulding, and when the pattern C C is drawn from the sand they are left behind, and may then be drawn out sideways. If "W. H. S." clearly understands this description he will see how to make his pattern leave the sand with that freedom which a moulder requires. First, the ribs B will have to be thinner at bottom than top, then the pattern C C will have to be, say, 1-16in. wider at top than bottom, then the sand will lift out free; the outside of C C, being wider at top, will thus draw free also.—E. P., Liverpool.

FIG. 1.



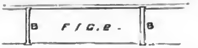
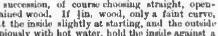


FIG. 2.

[48830.]—**Wood-Bending.**—The size of the piece of wood ought to have been stated, especially the width. Pine is best to bend, white-wood next, (American) cedar, poplar, honduras, walnut, ash, beech, chestnut, birch, elm, and oak, in their order of succession, of course choosing straight, open-grained wood. If ½in. wood, only a faint curve, wet the inside slightly at starting, and the outside copiously with hot water, hold the inside against a nearly red-hot stove pipe, till it scorches the wood slowly, then bend the wood over the jaws of a vice, protected with soft wood to prevent burning your inside. Keep wet woollen rags on the outside while you pull the pliant wood as much as you can. In about half an hour's time you may bend a piece of ¼in. pine or cedar 18in. wide, 2ft. long, to a curve of 5in. or 6in. You will find the curve irregular, being more bent at the middle than the edges; it is, therefore, best to plane a starting-curve out of ⅝in. stuff, on two edges A A, and a hollow out of the inside, B, thus. If you have your stuff 2in. or 3in. wider, all the better. Bend more curve than you need: it will sure to go back in cooling. How does "R. P." propose to secure it bent? If by nailing or screwing to a framing, I may be able to save him from splitting his wood in fixing it, if he wants the information.—J. Charles King



[48835.]—**Fusible Plugs.**—In reference to above in last week's I may mention, about three years ago, an instance that came under my knowledge regarding fusible plugs. About every six months the boiler was washed out, plug examined, and top scraped, but never found any scale adhering on it. I noticed the fusible alloy bulged up over the brass of the cap. I may remark it was of the style of a cap, with several holes bored therein, and filled with alloy. At one time I thought there was an appearance of this alloy being eaten away in some of the holes. I therefore took the cap off and examined it, but could not notice any trace of anything particular on under side, which was next the furnace. However, I decided to melt out the alloy and renew it myself. I put it in a clear fire, and when I saw the cap becoming slightly red I removed it, but, to my astonishment, the alloy was not melted or removed. I therefore replaced it again in the fire and took a strong wire that would pass easily through the holes; heated this wire, and, while the brass cap lay in the fire on the clear coals, I tried to push out the alloy with the heated wire, but all the pressure I could put on it they would not move, so at this time the cap having become red again. I removed it from the fire and had to bore out the alloy of each hole. I do not know if ever the like came before any reader of the "E. M." If not, it may be of service to some readers.—Ducnow.

[48853.]—**To "Alfojoe," &c.**—"E. H. E." no doubt thinks his request a very modest one, but I must tell him that to give full and complete instructions for fitting hairsprings would entail the writing of not one but several letters, and necessitate a few carefully-engraved illustrations. I think it would be impossible to give complete instructions without, and furthermore, everything pertaining to it would have to be drawn on a much larger scale than the actual sizes. The difficulties attendant upon writing succinct and intelligible instructions has, I am sure, been one reason why the work of hairspringing has been so lightly touched upon in the past, and, to tell the truth, I feel rather diffident about undertaking the task. Anyway, I am willing, as I have always been, to do anything that will be of use to my brother-readers and promote the welfare of a journal from which I personally have derived much benefit. I cannot enter into the subject off-hand, because drawings must necessarily be made, and the subject arranged and elaborated on paper before bringing out. I regret that I have so little time at my disposal just now. On that account I have been compelled to ignore several correspondents and barely reply to a few. If our indulgent Editor will permit me, I will do what I can for you shortly, if no one else "comes to the fore" before.—Alfojoe.

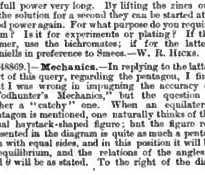
[48862.]—**Chilblains.**—Of these painful spots I can speak feelingly, for I suffered most severely in my juvenile winters and until I went to school, where a clever elderly housekeeper doctored me (with others) to good effect. For the itchy, inflamed spots before the skin cracks, use salt dissolved in vinegar on a saucer, over a small pan of water. Lave the inflamed spots, whether on hands, feet, or ears, in this liquid, as hot as it can be borne—the hotter the better; it must be poured on, again and again, with a spoon, letting it spill back into the saucer, and as its effect is to shrink the flesh, it, therefore, cannot scald (blister) the tenderest skin; at the same time, I beg a little pity for the patient, not to make "it" scream overmuch. Use it for a few nights at bedtime; oftentimes one application cures. When broken and suppurative, say a toe, wrap old, fine linen round the toe, so that three layers cover the sore spot; tie the rag on the toe with soft woollen thread so firmly that the knot will not untie, and this rag is not to be changed; procure an ounce of strong tincture of myrrh, and pour some out of the bottle on to the toe, till the rag is quite saturated; it smarts very fiercely for half a minute—no more; wrap more soft rag over the other, tie snugly, and muffle up the limb in silk or flannel. Do this twice a day, removing the second rag every time. When the application of the tincture of myrrh no longer gives pain, the sore is healed; and now the foot may be bathed in tepid water, wiped in warm towels till very dry, and Dr. Edmunds' most admirable advice (page 339) attended to about clothing and boots (or slippers). Beds should be warmed such weather as this, and none but really hardy children subjected to the torture of getting into a cold-sheeted bed, and there shivering for a quarter of an hour, with knees and chin touching, thus impeding circulation and producing the very ills complained of. Making a child comfortable and happy is not pampering! It will afford me extreme pleasure to learn that many sufferers (and what if some of our good friend Dr. E.'s own patients?) have benefited by the above remedy, thus having a chilblain to "run its course" in three days, often less, if the tincture is strong and good.—An Old Seventy Year.

[48865.]—**Animal Charcoal.**—This is made by burning bones at a red heat in a closed vessel. This forms bone-black, or crude animal charcoal, which may be purified by digesting it at a moderate heat for two days in about twice its weight of diluted hydrochloric acid (one part of acid and two parts water); the charcoal should then be collected on a calico filter, and well washed with water, and finally dried and heated to redness in a covered crucible. The charcoal, which is usually taken for dyspepsia, however, is not "animal," but good wood charcoal, which, I should think, would answer "Odin's" purpose as well, if not better than, the less easily-prepared animal charcoal.—E. G. T. Plymouth.

[48866.]—**Astronomical Apparatus.**—The advice given by "A Young Astronomer" is good, but hardly complete. Nothing is said about books. In the notes upon this subject in Chambers' "Descriptive Astronomy," notes for this purpose are divided into "essential" and "very desirable." Under the first head are enumerated an "Ephemeris," a "Manual of Celestial Objects," a "Set of Maps," and a notebook. Under the second are named a "Book of Logarithms," one or more standard star-catalogues, one or more general treatises, and a "Manual of Practical Astronomy." "W. S. W." will probably not require all these; but Webb's "Celestial Objects for Common Telescopes" he should certainly have; it is published at 9s. For an atlas he should have Proctor's smaller one (5s.), or Gall's "People's Atlas of the Stars" (1s., marvellously correct). If "W. S. W." is willing to pay more he should get Proctor's "Star Atlas for Observers and Students" (15s.) A most valuable addition to his library would be Barley's "Stars in their Courses" (15s.), as it contains a catalogue of 1,500 stars, and gives the magnitudes as given by Argelander and Heis. All stars in the "Atlas Cœlestis Novus" of the latter, down to the 5-6 magnitudes, are included. If "W. S. W." is not thoroughly acquainted with the face of the sky, he should get Proctor's "Easy Star Lessons" (6s. 6d.), or Gall's "Guide to the Constellation" (1s.). G. F. Chambers' "Descriptive Astronomy" (28s.), and Herschel's "Outlines" (10s. 6d.), are the best "treatises" in English. In addition, I would remark that a good opera-glass is very useful, especially for inspecting comets and estimating star magnitudes.—S. M. B. Gemmill.

[48867.]—**Battery Power.**—A six-cell bichromate battery would be very much more powerful than the same battery of Smee's cells. I suppose "J. C." knows that the bichromate does not retain its full power very long. By lifting the zincs out of the solution for a second they can be started at a good power again. For what purpose do you require them? Is it for experiments or plating? If the former, use the bichromates; if for the latter, Daniells in preference to Smees.—W. R. Hicks.

[48869.]—**Mechanics.**—In replying to the latter part of this query, regarding the pentagon, I find that I was wrong in impugning the accuracy of "Todhunter's Mechanics," but the question is rather a "catchy" one. When an equilateral pentagon is mentioned, one naturally thinks of the usual haystack-shaped figure; but the figure represented in the diagram is quite as much a pentagon with equal sides, and in this position it will be in equilibrium, and the relations of the angles ϕ and θ will be as stated. To the right of the diagram, half of the figure has been enlarged to enable us to take the moments round the point of suspension at the vertex. Call the weight of one side w. It will be seen that in the left leg, taking the moments, we get $b \times x = (a / 2)\, w + a\, (w / 2)$, or $x = (a / b)\, w$. Again, taking the right leg, we get $d \times x = w\, .\, (c / 2)$, or $x = (c / 2d)\, w$. The horizontal elements x are equal to each other, by a law of statics, that all the vertical or horizontal elements acting on the joints of a series of rods in equilibrio are equal to zero when added algebraically; the horizontal elements at the vertex cancel each other when the figure is at rest; hence, the remaining elements x must be equal and opposite; hence, equating the values of x, $(a / b)\, w = (c / 2d)\, w$, or $b / a = 2\, (d / c)$, or tan. $\theta = 2$ tan. ϕ.—M.I.C.E.



[48879.]—**Sphygmograph.**—I do not think you can make a cheap form of above; I tried to do so, with the help of a watchmaker: it cost 25s., and is unsatisfactory. There is a good deal of fine work about it, and it is difficult to get the weight, spring, &c., properly balanced. The new form of the instrument is illustrated in "E. M." in beginning of October, '81 (my instrument was on a slightly larger scale); the cost price is £2 10s.—R. B.

[48880.]—**Working Models by Electricity.**—You may, perhaps, work your models by an electromotor engine. It should not have less than 8oz. or 1lb. of covered wire; if No. 16 is used, one quart Bunsens will be the best battery. Many engines have recently been described in back numbers. You may make any you like: its performance depends on the workmanship. It is possible to make a paddle-boat 6in. long go by electricity. You would fail in your first attempt; but if you like to try, I will give you any information I can.—J. Sutcliffe.

[48885.]—**Watch-Case Repairing.**—Within the last few months I replied at half or three-quarter column length to an exactly similar query, and if the instructions there given are followed, I should say failure is impossible (that is, of course, if the ability to follow instructions exists). If your solder "runs all over the knuckle," you must have put borax all over it first, or you made it too hot. As I understand, you soldered with the joint-pin in the joint. This must not be; leave the joint-pin out. You will hardly succeed in drilling straight through the pin, as the silver is most likely softer than it, and the drill will run into the silver. If you value your time, and want to make a good job, file away the whole joint, and put a new one; that is the only sensible way of getting over your difficulty.—Os.

[48888.]—**Locomotive Bridge.**—The brick arch in a locomotive firebox is there for various reasons; but the chief objects of it are (1) to burn the smoke as much as possible; (2) to protect the tubes from the fire; and (3) to assist in generating steam.—Thunderbolt.

[48897.]—**Montgolfier Medals.**—You do not say what metal it is that your medals are made of. I suppose they are in bronze; if so, the No. 1 was struck in honour of the ascent of the great Lyons balloon, "Le Flesselles" on the 19th January, 1784, which carried seven persons, one of the number being Joseph Montgolfier, brother of the inventor of the balloon. The cost of the experiment was raised by a public subscription, and the balloon was 102ft. diameter and 126ft. high (old French measure.) The medal No. 2, with the Latin inscription, is in honour of the brothers Montgolfier. The medal No. 3, has the date in error, or has been given so—it should be 1783, and is on account of the first gas-balloon made of oiled-silk. This balloon was constructed by means of a public subscription, advised by M. Faujas de Saint-Fond, to whom much of the success that attended the early balloon experiments is owing.—J. Sutcliffe.

[48905.]—**Rewiring Grand Piano.**—The strings should have been measured between the bridges. The probable size of steel wire will be No. 8 for the treble octave, and a size larger for each octave below until the short bass bridge is reached, when the steel wire should be changed for brass of about Nos. 12 and 13 music-wire gauge.—W. H. Davies.

[48910.]—**Storm Glass.**—I should say these act only by change of temperature. Perhaps, however, pressure has some effect, as pressure would alter the density of the liquid but not of the solid matter—certainly not so much. If this is the case, increased pressure would cause the crystals to rise, and *vice versâ*; so that quantity of solid matter present would indicate temperature, and their rise and fall would indicate an alteration in atmospheric density.—Os.

[48917.]—**L. and N. W. R. Locos.**—Diomed, 821; Baltic, 2151; Isis, 2153; and Odin, 1164, are of one class, with 6ft. (coupled) driving-wheels, and cylinders, 16in. by 20in. Herald, 765, and Bucephalus, 780, have 6ft. 6in. (single) driving-wheels, and cylinders (inside) 16in. by 21in. Archimedes, 989, has 7ft. (single) driving-wheels, and cylinders (inside) 16in. by 22in. Isabella, 403, has 6ft. 6in. (coupled) driving-wheels, and cylinders 17in. by 24in.—Thunderbolt.

[48917.]—**G.N.R. and L. and N. W. R. Locos.**—Diomed 821, Odin 1164, Baltic 2151, and Isis 215, have 6ft. coupled-behind drivers, inside 16in. by 20in. cylinders, and each weighs 26 tons 2cwt. Herald 765, has 6ft. 6in. single drivers, and 16in. by 22in. inside cylinders. Isabella 403, has 6ft. 6in. coupled-behind drivers, inside 17in. by 24in. cylinders, and weighs 29 tons 4cwt. Archimedes 989, has 7ft. single drivers inside, cylinders 16in. by 22in., and weighs 28½ tons. I do not give their dates, stations, and further particulars, as they are not asked for. In my reply to query 48505, "2282 and 2282" should have read "2282 and 2288"; and in my reply to 46759 (not 48759), "The majority of the engines, cabs," should have read, "The majority of these engines have cabs"; and in the twelfth line in same reply, "444" should have read "44," 444 being a curious passenger-engine stationed at Shrewsbury.—Prometheus.

[48919.]—**Fire Annihilators.**—"Sebrach" will learn full particulars as to the apparatus required "to be ready for instantaneous use where a hand-pump or L'Extincteur would not be available," by addressing the original inventor. See advertisement.—W. H. P.

[48920.]—**Dog-Cart Brakes.**—From what I could glean about drum-brakes for dog-carts in a reply which a correspondent sent to the English Mechanic, it seems to me that the drum is fixed on the axle by the side of the wheel, as in tricycles. I should, however, advise W. Lodid to inspect some tricycles which are both front and rear-steering (I mean, of course, those which have hand-brakes), and he will see exactly how they are managed.—W. Scotland.

[48927.]—**Magneto-Electric Machines.**—To "Sigma."—In the common tubes the smallest diameter consistent with efficiency should be used. Electrically, it is of no consequence, or probably the reverse even would be the truth. But friction is in the ratio of the diameter, and this means wasted energy, as well as needless wear and tear.—Sigma.

[48928.]—**Astronomical.**—1. According to Sir W. Herschel the ratio of the polar and equatorial axes of Mars is as 98 to 103, or as 15 to 16. Schröter estimated them at 80 to 81. It is now agreed, however, I think, that his polar compression does not differ much from that of the Earth, but the quantity is too little to be accurately measured on a globe of Mars' small size. No polar compression has been observed on Venus. 2. The inclination of Mercury's equator has not been ascertained, but Neptune's is inclined about 29°. 3. Not ascertained. 4. η Cassiopeæ 220 years (Doberck), 195 years (Grüber), or 176 years (Dunér), ξ Boötis 117 years (Herschel II.), 169 years (Hind), or 127 years (Doberck). β Cameli is undoubtedly a binary, but I don't think its period has yet been ascertained. With regard to ι Leonis, ε Boötis, and α Piscium are only suspected binaries, and their periods are obviously unknown. On the other hand, Webb says decidedly η Orionis is "fixed," and I can find no mention of δ Herculis as a binary.—A Young Astronomer.

[48931.]—**Chadwick's Oxygen Apparatus.**—In answer to "Exhibitor," I would say I have used one of these machines for four years, and never had a single mishap; they only want care and cleanliness. Also, see that the cakes of chlorate of potash and oxide of manganese are mixed in the right proportion—viz., 1 to 4; see that the spent cake is well cleaned off with an old knife, and the fronts that "Exhibitor" has been grinding, only want well wiping with a cloth after each cake, with a twist back and forward to make sure it is fairly on its seat. After each cake is expended, turn the gas under retort down; the cover, after a few minutes, will come off without any trouble. I shall be glad to give "Exhibitor" any further information if he will write to me.—J. Schofield, Rose Cottage, Heaton Mersey, Manchester.

HOUSEHOLD HINTS.

Christmas Festivities.—Few people of middle age view with equanimity the festivities the present season brings with it. This often makes them unjust to those who at the extremes of life are able to enjoy the good things if only indulged in with moderation. Middle-aged prejudice is unusually severe against plum-pudding; yet, says the *Lancet*, this article is a highly-efficient food, yielding a force equivalent to 250 foot tons. It is also an admirable vehicle for the administration of fat, an article of diet as a rule usually objected to by children. Plum-pudding, in reasonable quantity, is certainly to be preferred to the so-called "wholesome" cakes, which have little fatty matter in their composition. A good wedge of cold plum-pudding is not an unwholesome lunch for young and growing lads to put in their pockets when out for a day's skating or hunting. Elderly people, too, are often able to compete with the younger members of the family in the enjoyment of Christmas cheer in a manner that amazes and discourages their middle-aged relations. The fact is, as has been happily pointed out by Professor Michael Foster, the digestive elements are long preserved, so that a man who in the prime of manhood was a martyr to dyspepsia, by reason of the sensitiveness of his gastric nerves, in his later years, when his nerves are blunted, and when, therefore, his peptic cells are able to pursue their chemical work undisturbed by nervous worries, eats and drinks with the courage and success of a boy.

The Growth of Children.—Growth varies in different children. Some increase in stature so rapidly that their clothes are outgrown long before they are worn threadbare, while others grow very slowly. A table prepared by a French savant gives the following data: During the first year after birth the growth in stature is about seven and one-half inches; from two to three it is four or five inches; from three to four, an inch and a half; from four to six, about two and a quarter inches annually; from seven to eight, two and a half inches; from eight to twelve, two inches annually; from twelve to thirteen, one and eight-tenths; from thirteen to fourteen, two and a quarter inches; from fifteen to sixteen, two inches; from sixteen to seventeen, nearly two inches; and after this, though growth continues until twenty-one and sometimes for years after, its rate rapidly diminishes. If mothers would measure their children regularly on their birthdays and preserve the record, they would thus accumulate valuable data for statisticians. Progressive increase of stature is a sign of good health, as increase in strides shows weakness of constitution or imperfect health.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last G. Fryer has replied to 48460; Pont de Bois to 48486; S. M. B. Gemmill to 48502.

48202.	Shive-making Machine, p. 145.
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48508.	Stains in Sulphur Bleaching, p. 236.
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48541.	Measurement of Height of Waves, 236.
48547.	Cording Machine, 237.
48551.	To "A. S. L.," 237.
48559.	Dynamo, 237.
48562.	Cartridge, 237.
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48570.	Circular Bellows Making, 237.
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48582.	Granule Cells, 237.
48583.	Indicator, 237.
48585.	Oil and Fat, 237.
48587.	Extracting Copper, 237.

QUERIES.

[48942.]—**Needle Telegraph Inst.**—How can I lessen the oscillations of my needle after the current has ceased? The pointer is 2¼in. long. The needle of my line galvanometer rests much more quicky. The pointer is 2in. long only. Would taking off ¼in. each end of pointer have the desired effect? I have tried the paper weight on the pointer; but this rather increases the oscillations.—Reginald Hannen.

[48943.]—**Nasal Discharge.**—To Dr. Edmunds.—Will you kindly favour me with a few lines in reply to the following?—My eldest boy, who is 10 years of age, is troubled with what appears to be a constant discharge of mucus from his nose, and, as a consequence, has to freely use his pocket-handkerchief! His general health appears to be tolerably good; but he is not strong and robust, but somewhat thin. I have had him examined by a doctor, who thought he had a small polypus in his nose, and ordered a nasal douche. This was used twice a day for several weeks, without any or very little effect—the discharge continuing. He has recently been examined, and the doctor says now that he cannot find any polypus. Still the discharge goes on.—An Anxious Working-Man.

[48944.]—**Obesity.**—To Dr. Edmunds.—Will you please give a remedy for the above? I should like to get rid of all redundant weight. I take plenty of exercise—walking, bicycling, &c. Would abstemiousness be effective, without danger of impairing the health? Age 24; height, 5ft. 7in.; weight, 12st. 6lb.—Compositor.

[48945.]—**Rig for Small Boat.**—Will some kind reader give me a few hints as to which will be the best way to rig, and how much canvas to put on a boat 25ft. 4in. keel, 29ft. on deck, 6ft. 9in. beam, 3ft. 6in. draught, 12cwt. on keel, and 6 or 7cwt. inside. She will have to sail about 18 miles before there is much room to sail in. I should like to be able to do a little trawling now and then with her. She will also have to tow an 11ft. punt.—Wm. Booth.

[48946.]—**Froude on the Resistance of Fluids.**—In the course of Mr. Froude's experiments made for the Admiralty some years ago upon the resistance of bodies moving in fluids, he proved, I believe, that in a solid wholly immersed, a given rate of speed once attained, that the power required to maintain such speed equalled surface friction, and that if it were possible for that to be absent that such power would equal 0. I want to know what were the exact words, and what was said as to the form of such immersed body?—R. C. L.

[48947.]—**Rainband Spectroscope.**—I tried the spectroscope for three years for weather-warning, and append the result of each year:—First year: West coast of Ireland—result, promising. Second year: West coast of Scotland—result, utterly untrustworthy. Third year: West coast of Ireland—result, generally. No dependence whatever could be placed upon it for foretelling weather. Can any one give better results?—R. O'H.

[48948.]—**Diffraction Rings in Astro. Telescope.**—In 20880, "F.R.A.S." says, "They must be there." Is this absolutely the case? In my notes for August 31, 1881, I find, "Clear, dark night. 94 Aquarii. Clear ringless discs," &c., &c.—R. O'H.

[48949.]—**Steam and Exhaust Ports of Compound Engines.**—Will any of our practical readers tell me what size the steam and exhaust ports should be for a small pair of compound engines? Diameter of cylinders (high-pressure), 2in.; low-pressure, 3in.; length of stroke, 3in. Also what size of air-pump and condenser shall I require for the same? I propose to work at 80lb. pressure in boiler.—Mountaineer.

[48950.]—**To "Sigma."**—Would you kindly say how I can make a battery of one cell that shall give an E.M.F. of one volt?—G. P.

[48951.]—**Drawing.**—Will some kind fellow-contributor inform me how I can obtain correct "outlines" of photographs?—whether there is not some rapid means of acquiring the same by a newly-invented reflecting contrivance?—A. A.

[48952.]—**To Mr. Wetherfield—Glasshouse.**—I wish to construct a glasshouse on roof of my kitchen, which is built in rear, and attached to my house, and backs also on my neighbour's kitchen. How high above party-wall may I carry it? It will in no way interfere with my neighbour's light.—H. B.

[48953.]—**Toning Bath.**—Will Mr. Lancaster or Mr. Robinson advise the best way to test a gold bath for acid, and if too acid, how to neutralise, and to what degree? Also process for testing when too alkaline, and how to remedy? When using ready prepared paper for printing, is it necessary to render alkaline the washing water, and how? Is one grain of gold, 30 grains acetate soda, and 5oz. of water, the usual strength for general studio work? And is that an enconomical way of preparing a toning bath?—Ouvrier.

[48954.]—**Legal.**—Will some one tell me whether a coachmaker employing 16 hands, including apprentices, and advertising as coach factory, comes under the Factory Act?—Country.

[48955.]—**Paper.**—Will some fellow-reader inform me how I can put a glaze on paper, so that it may be flexible, and yet shine?—Captain.

[48956.]—**Legal.**—Would Mr. Wetherfield kindly say if it is necessary for a local board who wish to light their streets only by electricity, and have engines and boilers ready, to apply to the Local Government Board for a license?—W. L.

[48957.]—**To Mr. G. Tolman.**—I have made a dynamo-machine (as your sketch), which is ready for winding the wire on. Will you please to give me instruction how to wind the wire, so as to make one north pole and the other south pole? Also how are the wires from the armature connected to the commutator, and how is the wire from the field-magnets connected to the commutator springs? Also should the field-magnets be isolated before being wound? A sketch of the winding, also the connections, would oblige—W. Wright.

[48958.]—**Polygons.**—I shall be glad if any correspondent can give me the multipliers for polygons (if there are such); that is, what number must I multiply the side or diameter of a circle by to find the length of the side of the inscribed polygon?—Tyro.

[48959.]—**Weighted Governors.**—Would Mr. Booth or others kindly give the rules and sketch for calculating all kinds of weighted governors (which once appeared in the "E. M.") again? Having had the misfortune to lose the whole of my back numbers of "E. M." by fire, and am told that the said numbers are out of print, they would, no doubt, be useful to new subscribers and others, and very much oblige—A Very Old Subscriber.

[48960.]—**Terra-Cotta Statuettes.**—I want to recolour a pair of terra-cotta statuettes. I shall be glad if any reader can inform me how to do this.—E. L.

[48961.]—**Watch-Dial.**—Will any reader of "ours" kindly tell me how to fill up broken watch-dial with enamel?—Colliba.

[48962.]—**Safety-Valve Graduation.**—I have seen many questions about safety-valves in the "E. M.," but I have never yet seen a plain and simple way to graduate a safety-valve lever. If I know the weight, and what it blows off at the end of lever, why can I not find the other graduations by Rule of Three? An answer to this riddle, and full instructions, will oblige—A Corn Miller.

[48963.]—**Sciatica.**—A few weeks ago I had a slight stiffness at the hip. I took little notice of it, and it passed away. It has returned, and I have an acute pain at night from the hip to the foot, disturbing my rest, and I only get relief by altering my position. I am under medical treatment, and after two or three bottles of medicine, I find no relief. I am advised to use friction to the leg. I experience very little pain in the day beyond an aching. I am troubled very much with cold feet, and my circulation is feeble; and besides, I have just come to reside in a much colder part of the country to what I have been accustomed.—Anona.

[48964.]—**Brake Failure.**—Will Mr. C. E. Stretton kindly give opinion as to why, after the fracture of a coupling on a passenger-train, and a disconnection of the brake-pipes, that the brake did not apply itself automatically, and stop the train? I am a constant traveller on the Midland, and on Friday, Nov. 24, left Liverpool for London at 4.5 p.m. After leaving Market Harborough, this train was stopped at the next station (as I afterwards ascertained), owing to the driver thinking something was wrong with the brake apparatus. Upon an examination of the carriages, it was discovered that a coupling-screw had broken, thereby causing the brake-pipes to become disconnected, which, in my opinion, should have stopped the train at once. Being in a similar accident near Bishop's Stortford on the Great Eastern Railway, our train was pulled up in a few yards with the Westinghouse air-brake. I shall be pleased to hear from Mr. Stretton why the brake failed to act in this case.—G. J. Calvert.

[48965.]—**Water-Wheel Grease.**—Can any one give me recipe for same—one that will stick well to the wheels?—J. S.

[48966.]—**Honeycombed Gun-Barrel.**—How can an amateur remove the pitted appearance from the inside of a breechloading gun-barrel without hurting the shooting powers of the gun?—T. H. C.

[48967.]—**Price for Weaving Cloth.**—Can any of your numerous readers answer me the following question?—I am weaving cloth, 16 reed × 16 pick, per ¼in., 58 reed, Stockport counts (I am paid by the Blackburn Standard List). Whether I should be paid for a 64 reed or a 58 reed?—A Weaver.

[48968.]—**Ordnance Survey.**—Can any correspondent inform me how to get to be a member of the Ordnance Survey? What opportunities are there for promotion in the Royal Engineers and Sappers and Miners? Any information on this subject will greatly oblige—F. C. T., Birmingham.

[48969.]—**Legal.**—To Mr. Wetherfield.—Last summer the representative of a sheep-dipping firm pressed me to give him an order, which I did, and signed it. The following verbal agreement was made before doing so, however: First, goods to be sent off at once, carriage paid, and I was to be the sole agent here. The goods arrived about three months after, not carriage paid, and I found that another party in town was selling dips made by the same firm, and was also distributing bills with his name attached as agent. Well, I refused the goods, as I considered the contract was broken, and deemed the verbal agreement as binding as the written. I was written to by the firm for payment, as the goods were (and are) still lying at the station. I wrote to them, and stated that they were at the station at their risk. I have got a written agreement from the party who sold the dip, agreeing to take over the goods at the expiration of this year. Again, some time ago a party wished me to be agent for paint, which I declined to have anything to do with; but he sent it off along with the invoice, and I did not try to sell it until several months after. A short time ago I sent them a remittance for what I had sold as well as the part unsold. They took the cheque as part payment, but refused to take in the goods. Your best advice on the two preceding questions will oblige. I may state that I paid carriage on the paint, both ways.—F. S.

[48970.]—**Watch Repairs.**—Will one of our practical watchmaking friends give me a few particulars in turning watch pivots? I have bought the turns, but I do not know what other tools are wanted. For instance, if I wanted to turn a balance-wheel pinion to a verge watch, how should I proceed, and what are the names of the tools required? Also, supposing I wanted to fit a pivot without putting a new pinion, what tools should I require? I have tried to drill into a pinion, but cannot get the drill to keep in the centre? In my turns there seems nowhere to hold the piece to be turned. Must I drill some small holes for the purpose?—X. Y. Z.

[48971.]—**Organ Specification.**—I should esteem it a favour if some of your readers could oblige me with a specification of the organ recently erected and opened at Holy Trinity Church, Derby?—Pont de Bois.

[48972.]—**Bleaching Fat.**—Will some of your able contributors give the best and simplest formula for bleaching animal fat, discoloured by the vegetable matter from the entrails? What is the best work on the technology of oils and fats?—Jim.

[48973.]—**Flow of Water.**—"Tyke" answers a question (48865) on flow of water; but not having seen previous papers, do not know the original question. I would be obliged by him or some other correspondent giving calculations for flow of water through pipes. Say reservoir or head of water, 60ft. above outflow, length of pipe 450 yards, and diameter of same 2in. and 5in. respectively. How much would each pipe deliver per hour, with abundance of water?—Cistern.

[48974.]—**Permanent Way.**—To "M.I.C.E."—I shall esteem it a great favour if you will instruct me with regard to putting in railway points and crossings. I am at a loss to know how the angle of crossing, radius of reverse curvature, also distance from point of switch to point of crossing are arrived at? Would not the angle made by a line drawn from point to point of switches, whether roads are parallel or diverge from each other, be the proper angle for crossing?—Thos. Hardcastle.

[48975.]—**Organ.**—Having the space of 4ft. 4in. square, and 7½ft. high, would some of our organ-building friends tell me what stops to use in fair-sized room, and how to arrange a two-manual chamber-organ—top manual to work swell organ? A hint on the size of bellows, arrangement of soundboards, pipes, and fittings, would oblige one that tries to shorten winter evenings, and, no doubt, others that would like to possess an instrument.—Organus, Manchester.

[48976.]—**To Clean off Liquid Gum.**—Will any correspondent be kind enough to explain a cheap and expeditious method of cleaning bars of iron which have been used in stirring up a very tenacious liquid gum or glue, or whether the bars can be covered with any material to which the gum will not adhere?—B. R.

[48977.]—**Concrete.**—I have river sand and gravel. Will this do with cement for concrete floors—what proportion and what kind of cement is the best for this purpose? What should it cost in labour to lay down one floor 30ft. × 2 ft.?—Lano.

[48978.]—**Organs.**—Will any reader of "ours" kindly inform me as to the probable cost of the large organs in the following public buildings?—Albert Hall, London, Crystal Palace, Alexandra Palace, St Paul's, St. George's Hall, Liverpool; Town Hall, Birmingham. —G. Fryer.

[48979.]—**Water - Motor.**—Would any of our readers answer the following?—What size of motor should I require to work 1-h.p.? Also the size of feed-pipe I should require? The water supply is by gravitation. I can get 130lb. per square inch. State the most economical motor, as the water will be by measurement. —Water-Motor.

[48980.]—**Unhappy Marriage.**—To Mr. Wetherfield.—A. marries B., and through quarrels caused by B. drinking, B. leaves A. six times in seven years, and comes back again. A. wants to break B. of this; as B. has no proof of ill-usage or want of proper treatment. All A. does is to prevent B. from drinking too much spirits. B. has property in her own right, which enables her to get brandy at her leisure. Which is the best way to compel B. to come back to her home? If a suit in the Divorce Court, what would be about the cost? Can A. enter an action against anyone who harbours her?—A Miserable Husband.

[48981.]—**Tempering Dies.**—Will some experienced reader kindly inform me the best way to temper dies for screw-cutting? I made some out of an old file, and hardened them at a cherry red, and afterwards let them down to a deepish straw colour; but they all cracked. I should be glad to be told the cause, and how to avoid it. —Bungler.

[48982.]—**Gower Bell Telephone.**—Would a correspondent please give us an explanation of the connections of this instrument, as illustrated on p. 510, Vol. XXXII., and which appears to have a relay for (I presume) bringing both batteries into play to ring bell in calling?—G.

[48983.]—**Neuralgia.**—Perhaps Dr. Edmunds, when writing on the subject of rheumatism, will kindly give some advice on the following:—I am married, age 38, have had five children. Since the birth of the last (stillborn), six years ago, I have suffered continually with neuralgia or rheumatic pains on the top of the head. I had tonic medicines for two years to no effect. I have since hoped time would be the best cure; but the pain is still the same; the sensation is usually one of having been severely bruised. When the pain is more severe, there is a feeling of heat at the top left-hand side of the head, with sharp pains extending down to the ears, across the eyes, and sides of the nose. Sometimes also the outward parts of the ears are so tender that I cannot rest on either side at night. I do not suffer with either earache or toothache. My general heath is good. I am active, fond of outdoor exercise, and have a good appetite. I have a bad attack about once in two months, which lasts three days, when I am quite unable to attend to my household duties. Any advice that would give relief I should be most thankful for?—J. E. H.

[48984.]—**Street Medical Coil.**—I have made a coil and indicator from information given by correspondents; but I now want a little further information respecting the attractive part. How is the wheel made that strikes bells as it turns, or tapper that just strikes one bell and then another—seen on different makes—and are they driven by a separate battery? Also, is granule carbon the same thing as broken gas carbon?—M. R.

[48985.]—**Legal.**—If I make eau de cologne or scents with methylated spirits (having disguised or removed the unpleasant smell of the latter), must I pay full duty, as if I used pure spirit?—Ozone.

[48986.]—**Microscope.**—Not having a more than small amount of cash to spare, and being in want of a really serviceable instrument, I have got out the patterns for one, taking Swift's "Challenge" as my model. I intend to purchase the optical part, and am only attempting the stand. Will, therefore, some kind reader give me a drawing, with hints of the fine adjustment (lever) full size for a 1⅜in. tube? Please also state the diameter of that part of English eyepiece which fits in draw tube.—Solus.

[48987.]—**Covering Straw Boards.**—I should be glad to know how straw-boards are covered with paper (as for box-making), and if any machinery is used for the purpose?—E. Gray.

[48988.]—**Coils.**—Would some practical coil-maker answer the following questions?—(1) What numbers, and what lengths of primary and secondary wire, should be used for Ruhmkorff coil to give 1½in. spark in air? (2) What should be the length of coil? (3) How much paraffined paper between each layer of secondary? (4) Should the coil have partitions? If so, how many? (5) How many sq. ft. of tin-foil in condenser? I would use battery equal to two pint Groves.—Apprentice.

[48989.]—**Medical.**—To Dr. Edmunds.—What is the action of cod-liver oil used externally? Will it improve muscular tissue, and would an increased flow of blood to the part, by means of electricity or heat, aid its action?—Junction.

[48990.]—**Principals' and Masters' Rights.**—To Mr. F. Wetherfield.—I was engaged on the 27th Dec., 1875, by the vice-principal of an establishment as resident French master, who wrote to me then as follows: "With regard to the notice to be given before vacating the situation, I think you suggested that the first term (that is till Easter) should be considered a trial term; that is, that either party should be at liberty to terminate the engagement at Easter." At Easter ensuing my principal handed me a cheque for my salary, and expressed his satisfaction for my services, and without any further reference or any written agreement as to my engagement I remained in the establishment until last July, 1882, when I begged (for courtesy's sake only) for leave of quitting at once to go abroad, and after having written several times as well for an account of £18 11s. 3d. due to me for private tuition (which ought to have been paid to me in September last), a solicitor wrote to say that "I was indebted to my principal for a sum much exceeding the £18 11s. 3d. for which I applied, by reason of having quitted him without giving the requisite notice, and having, moreover, broken a distinct engagement during the vacation, and if need was, legal measures would be taken against me to recover the same, &c." Am I to consider myself so not entitled to my private tuition account, and if so, can you recommend me a lawyer who will at once take my case in hand?—X.

[48991.]—**Equatorial.**—I have an equatorial telescope by Wray, but no circles to it. Now I want to adjust it. On looking at instructions in books and in ours, they all presume that there are circles attached, and instruct accordingly. Would "F.R.A.S." or Mr. Pearson tell me how to go about adjusting mine as it is, or must I make circles first, and if so, how am I to know how to affix them? A few plain instructions would be a boon to —E. R.

[48992.]—**Drill for Glass and China.**—To "Antique China."—I have been watching the "E. M." for some time to see if I could discover what kind of drill would be best for glass and china; but your answer to "Broken Pots" (48825) is private. Would you, or some other reader, kindly give me full particulars?—Jack Ashore.

[48993.]—**Yellow and Red Timber.**—I should be glad to know if there is any difference between yellow and red stuff, and if so, what difference? I have always supposed that they were in reality identical, and that the only difference existed in the name—what is termed yellow by carpenters being called red by timber merchants. However, I am told that they are not the same; but that the yellow is much dearer than the red? May I be allowed to request information on this point?—Devoniensis.

[48994.]—**Screw-Cutting.**—Can some of our mechanical readers give me any information how, in a simple way by hand or foot-power, to cut threads in cast-iron pipes up to 2in. dia. (bolt-and-nut form)? Also of a simple and quick drilling-machine up to 1in. hole?—A. Z.

[48995.]—**Curvature of Earth.**—What is the curvature of the earth usually estimated at? For instance, supposing an arc of a circle of the same radius as the earth to have a chord = 2 miles, what will be the versed sine?—Glatton.

[48996.]—**Hydraulic Problem.**—Two tanks, 10ft. diam., are connected by a pipe, the diam. of which is unknown. It is found by experiment that if, when there is a difference of level in the two tanks of 15½in., communication is opened between the tanks by a cock in the intermediate pipe, the level will become the same in each at the end of 3½ minutes. What is the maximum rate of flow in cubic feet per minute between the tanks; or, supposing the difference of level (= 15½in.) to be kept constant by suitable supply and waste-pipes, how many cubic ft. per minute will pass through the connecting-pipe? If this can be answered without the use of the calculus, I should prefer it; but shall be glad of an answer in any form.—Glatton.

[48997.]—**Marmalade.**—Could any of your readers describe the means adopted by the large makers of marmalade in cutting up the peel? A description would oblige—F. H. Croasdale.

[48998.]—**Drills.**—Having to use these useful tools a great deal in all sizes, from 1-32in., or smaller, up to about ¾in.; though, as a rule, between 1-16 and ¼in. are more in my way. The style I use is the fiddle drill, as it is called. The drills are made something the shape of an ordinary flat file, with the shoulder shaped down gradually to the end of tang. Length about 5in.; one end pointed to fit hole in breastplate; the other filed into drill about ¾in. long. These drills (of which I have to keep a large number) necessarily use a lot of steel, and each has to have a whirl or reel fitted to it, so that to keep them anyhow so as to be found at hand when any particular one is wanted, takes up a lot of space wanted for other tools that should be handy. Also, I have tried the Archimedean drills; but they do not drill half so quickly, and are rather inclined to shake about in working. Can any reader advise any other kind? Also, can "Alfojoe" say how he makes "Cohen's Drilling-machine" work? I cannot do anything with it. I can make splendid cutting drills, so that the Archimedean style not answering is not from any failure in the making. I make them in "Alfojoe's" style, not "Tubal Cain's," as I am not a chemist, but a cutler.—Dertla Selim.

[48999.]—**Electric Light.**—What number of three to five-candle power, and what number of twenty-candle power, incandescent lamps can be well lighted by a battery of 40 Bunsen cells, each zinc cylinder exposing 32 sq. in. of surface to action? Also which is the best incandescent lamp, and would the above battery light a Jablochkoff candle?—W. E. K.

[49000.]—**Firewood Cutting.**—"Old Rosin" is looking for a cheap machine to cut out wood. His steam-saw cuts ½in. boards into tablets of 6in. square. What he wants is a small and rapid machine to chop these tablets into chips, ready for the bundlers. The tablets are never thicker than ¾in., so that no great resistance would be met; and he thinks a small machine worth from £10 to £15 ought to do the work. Can anyone oblige him with instructions how to make one?—Old Rosin.

[49001.]—**Clock-Chain.**—Can anyone tell me how to get the size of a chain for a 30 hours English clock other than by trial? Is there any way of calculating the size of the links? I have had a deal of trouble with one clock, owing to the chain sticking fast.—Clock-Jobber.

[49002.]—**Clock.**—Can any correspondent tell me the cause of American clock cords "running" off the barrel when being wound up? I generally put a piece of wire on one of the brackets which hold the movement to make the cord form a second layer. It is a difficult job. Can anyone suggest a better?—Clock-Jobber.

[49003.]—**Steam-Blast Cupola.**—I believe cupolas for melting pig-iron are sometimes arranged so that the blast is produced by means of a steam-jet instead of fans. Can any reader inform me whether the plan is economical, and whether hot metal can be thus had suitable for very light castings? Any information respecting them and their working will be gratefully received.—Moulder.

[49004.]—**Comets a and b. Calculation of the Increase of Light of Comets.**—Can any of ours inform me?—(1) Whether polariscope observations have been made on either comet? (2) Whether any "jets" have been seen? (3) Whether, in the case of b, any other, beside the sodium ones, among the "many bright lines" seen at Dun Echt and at Palermo, have been measured and identified? (4) Whether comet b has exhibited any peculiarity in the diminution of its light? (5) What is the law, according to which I is computed? —Civiola.

[49005.]—**Medical.**—As far as I can understand Dr. Edmunds' letter in p. 320, No. 924, he says that wine retards, not assists, digestion, and intimates that the same is the case with spirits. What is the reason, then, that alcohol is so often, and with such good effect, taken to correct indigestion, "spasms in the stomach"? Also why do so many medical men recommend the drinking of light wine during meals? And as to hot water, is it not a valuable means for producing vomiting, when necessary?—Housekeeper.

[49006.]—**Bichromate Battery.**—What ought to be the size of plates, number of cells, proportions of chemicals for a bichromate battery to light a five-candle Swan incandescent lamp?—One Wanting to Know.

[49007.]—**Heating by Steam.**—Can you inform me how many feet of 4in. pipe heated by waste steam would be required to raise the temperature of a room 25ft. long × 16ft. wide × 10ft. high, 30° F., say, to maintain a temperature of 70° F., with the external temperature at 40° F.? The room is inside another; so few or no currents of air require taking into account. —J. R. R.

[49008.]—**Beer.**—I have a brewing of beer (racked in butts) of a very sweet flavour, caused by not increasing the temperature by means of attemperator during fermentation, thereby causing a non-sufficient attenuation. Can any reader inform me how to remedy the evil, in order to make it palatable?—W. S.

[49009.]—**Softening Steel.**—I have tried the means named in our columns lately, and I cannot get cast steel easily softened and fit for boring without great trouble. I have also heated it in a fire to a clear red, and covered it up in fine ashes for an entire night.—Jumbo.

[49010.]—**Hardening Plaster Casts.**—Having call sometimes for plaster casts, I find they take a great deal of time to dry and harden, and even then there is a softness in them if they get much handling, and regularly crumble away, even with fresh plaster cast immediately after weeks of drying. Is there any remedy to harden like cement?—Alfonso.

[49011.]—**Whitening Ceilings and Sizeing Walls.**—What is the really best means for this, or is there any better process than appears in back numbers?—Alfonso.

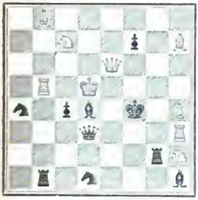
[49012.]—**Cement for China or Glass to Resist Heat.**—Can any reader give a good cement to resist heat? I have tried a good many, and also the bought cements, but they are all affected on by heat. I do not note any quite suitable in back volumes, although some are very good if kept from heat.—Percy.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCIX.—By H. F. L. Meyer.

Black.

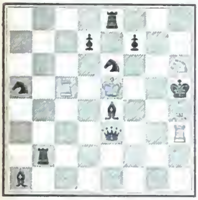


White.

White to play and mate in two moves.

PROBLEM DCCCX.—By H. F. L. Meyer.

Black.



White.

White to play and mate in two moves, under the condition that Black shall threaten as many checks as possible.

Note.—The statement about "maximum checks" with regard to Problem 774 is not made in Meyer's "Guide" (p. 26); but the author has now endeavoured to construct the maximum position, and has obtained *first* a threat of 30 checks when the first move is not a check, and *secondly*, 45 checks, when the first move is a check.

Solution to 805.

White.	*Black.*
1. Q-K 5	1. R-Q Kt 3 (best)
2. Q takes Kt	2. P-Q R 5 (best)
3. Q takes P (ch)	3. P takes Q
4. R-Q R 5 mate	

Solution to 806.

White.	*Black.*
1. R to Q B 4	1. Anything
2. Mates accordingly	

The following solution has been forwarded by "Cockney":—

Mr. Pierce's *pear* problem revolving for solving,
Hi've apple-y it hit, I'm sure;
But to try to enjoy all its juices no use is,
Till the *rool* makes a peck at the *core*.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 802 by W. T. Bayne; to 803, 804 by H. Mackay; to 806 by W. T. Bayne, J. H., of Boxford, and Schmucke; to 807 by Schmucke.

H. F. L. M.—Problems received with thanks.

H. D.—We have already pointed out *twice* that the Kt at Q Kt 7 in 802 should be the K. Some of our correspondents saw this at once; and certainly it was pretty obvious.

T. P. J.—Thanks for the problem, though it is like Mephibosheth.

Two numbers of the *Sussex Chess Magazine*, conducted by Mr. Mead, have now been published. The second contains Mr. Crake's (one of the judges') awards in the *Brighton Guardian* Problem Tourney, and is, therefore, of special interest. The magazine is published fortnightly, and may be obtained, post free, of Mr. Mead, 22, Charles-street, Brighton, for six months, on receipt of 2s. 4d.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 20, and unacknowledged elsewhere:—

R. G. Jackson.—J. Drage.—J. P. Strangman.—Rev. J. Hyng.—Captain Wormald.—H. L. Thuron.—C. F. Clough.—T. E. Espin.—J. Graham.—Sefton.—Jimbo.—H. R. O.—J. Coxon.—Engine Cleaner.—Manufacturer.—H. L. H.—W. A.—L. B.—Wanting Steam.—H. R. T. S.—Clyde.—Horatio.—Dandie Dinmont.—Bologna.—Anti Jerk.—Scotch Working Mechanic.—A. R. Molison.

J. W. Wilson. (An answer to your query would involve a reply which would be a decided advertisement. You have all the information required in our back volumes, and in our advertisement columns. A gas-engine when running light consumes very little gas indeed, and its working cost is approximately one penny per hour per horse-power.—A. B. C. (We must refer you to the indices. It depends on what you mean by "spotted." 2. The instruction runs through many volumes. What part is it you require?)—Amateur. (Spider-lines are fixed by just a touch of varnish or gum. See pp. 41, 125, Vol. XXVIII.)—J. P. Lee. (If we understand you, there is only a flue of iron pipes—no hot water. That will not do at all. You must either have the heat from a fire or use a gas-burner to heat water.)—B. B. (Boil the tar until all water is expelled; when cool, thin with turpentine.)—W. W. (Should say what process is adopted. Possibly they require polishing up by shaking with sawdust.)—F. H. Croasdale. (The dimensions depend on the length of the matches and the number you wish it to hold. They are placed horizontally.)—F. Gallaher. (See p. 291, last volume, for railway grease, and various recipes in back volumes for the dyes.)—J. Bailey. (Any good stout printing paper will do. 2. Use shoemaker's heel-ball.)—Electrician. (See the indices.)—Amateur Bookbinder. (See p. 377, Vol. XXX., and the indices generally.)—H. A. H. (You must take iron filings out with a magnet. The usual fluxes are glass dust and charcoal dust, with a little borax.)—H. Bramell. (You should consult the back volumes. There is Wanklyn's book published by Trübner, we think, and many papers on the subject.)—Ossieus. (From Africa, the best; then India. The fossil ivory comes chiefly from Russia. 2. The only preparation is steaming or boiling.)—Arthur Green. (We have entered it in the list of back numbers given in this column the first week in every month. The proportions vary, but glue 1, glycerine 4, makes a good one.)—612. (The data are not sufficient. For instance, the weight of the rail would depend on the weight to be carried, and then if you know that, it is simply a sum when you have obtained the price of the rails. If you refer to Clark's book on "Tramways," you will find the cost of several lines and as many systems.)—Dyspepsia. (See the indices under heads "Indigestion" and "Dyspepsia.")—Joan. (They will probably go away soon. Take plenty of fresh vegetable food and occasional doses of Epsom salts.)—T. C. W. (Dr. Edmunds answered questions about acne on p. 513, No. 881.)—Donald. (On the contrary, you will find full information in back numbers. Use ordinary black ink thickened with gum. If you persist in using lampblack, you must mix it with printer's varnish, or must varnish the labels when finished.)—W. T. O. (Dissolve in bisulphide of carbon or mineral naphtha. Apply with a brush.)—O. M. M., New South Wales. (You will find much information in back volumes; but the particulars required are to be known only by calculation, with a full knowledge of the work to be done.)—E. G. T. (The only one is an aniline black, but that is not very successful. If a black were easily obtained, violet would not be so extensively used.)—Student Civil Engineer. (You should procure the syllabus of the Science and Art Examinations from South Kensington, price 6d.)—E. O. B. (All the questions have been answered recently. Daniells. 2. Greased or plumbagoed. 3. Solvents for asphaltum given so recently as p. 71.)—Comet. (They mean longitude of perihelion, distance of perihelion from node, longitude of node, and inclination of orbit.)—A Machinist. (We do not know of any suitable books. The qualifications are a knowledge of electricity and mechanical engineering.)—One who Hopes to be Relieved. (You must consult a medical man.)—H. H. (There is a short reply on the subject on p. 599, last volume. The query is of rather too commercial a nature. 2. You can see the "grate" at Messrs. Archibald Smith and Stevens, 48, Leicester-square, W.C.)—A. J. and J. R. Turner. (For instructions in dulcimer-making, see pp. 87, 168, present volume, and the indices generally.)—Anglicans. (Try again; the process is quite correct. We suppose you scarfed the ends down, and filed up to a proper thickness when brazed.)—E. Waite. (For platinising silver, see pp. 268, 289, last volume. 2. Yes. 3. It is simply a trade name. No one can say definitely without knowing what is meant.)—A. W. Newman. (No. 2. Tension. 3. Cannot say, but Swan's is as good as any.)—Artisan. (Several replies in back numbers give ordinary black ink thickened with gum and sugar. A pencil is used, not a pen.)—G. P. (It is simply a glass tube containing mercury, the lower end being turned up so as to receive an iron float, which rests on the mercury. A cord attached to the weight passes round the spindle on which the index is carried.)—M. C. H. (Oiling has been recommended, inside and out. Several recipes in back volumes. Good dubbin.)—F. G. (Nitrogenous matters, fat, and mineral matters, about 30 per cent., the remainder water. No analysis reduced to elements so far as we know.)—CollVictist. (See pp. 221, 246, 269, Vol. XVIII., and many other places in back volumes. If of ivory, soak for a few minutes in water containing a little nitric acid, and then boil in an infusion of cochineal or Brazil wood in liquor of ammonia.)—G. C. Batt. (Usually a month's notice. From your remarks, there are probably special circumstances which might render six months' notice necessary. We do not undertake to supply information to persons apparently so well provided with authorities.)—L. L. (We know of no such system. We never learned a language ourselves in a fortnight.)—Geo. Rathbone. (Quite legal. We hope you will be satisfied ten years hence. We should prefer employing a lawyer.)—J. R. T. (Probably asthma; no one could say certainly without seeing you. Consult a medical man.)—G. H. W. (The saw arms are moved by a pin in a continuously revolving wheel, which is the equivalent of a crank. You have omitted the long spring attached to the back leg of the table, which is connected by a strap to a thimble on the spindle of the small wheel. The strap to treadle is coiled round a sleeve on the main spindle, which is loose in one direction only. The machine is used chiefly for cutting thick stuff. You will find it in Churchill's catalogue.)—E. W. F. (Recipe for ginger-beer in Vol. XXXIII., p. 482.)—H. Hill. (Sue him in the County Court.)—Perplexed. (If they will not part with the money, you must, of course, take legal proceedings. The loser will have to pay costs, if he can; if he cannot, you will. The lawyers will take care of that.)—Scientific Executant. (Yes.)—Pulsation. (Unhealthy! No! Some people find all work "unhealthy.")—Fitter. (Don't trouble yourself about your "weak heart." Follow your medical man's advice, live temperately, and don't worry, and the sensation complained of will pass off.)

Action of Stannic Salts upon Animal Matter.—When silk is steeped in a solution of stannic chloride and then thoroughly washed, in order to remove the excess of uncombined salt, it is found to have increased in weight, and to have absorbed a quantity of stannic oxide proportioned to the concentration of the solution and the length of immersion. If the silk is then passed into boiling suds, washed and replunged in the bath, it fixes a new quantity of tin, and by repeating these operations its primitive weight may be doubled. This furnishes a ready method of loading silk with a colourless oxide, in order to receive a permanent dye of any hue that may be desired. The weight of silk which has been thus loaded with stannic oxide may be increased still more by putting it in a solution of any tannic material. This cannot be done, however, where delicate shades are required, because the impurities of the tannin produce a muddy tint. Skins which are treated with solutions of bichloride may be tanned in a very short time.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

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The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

USEFUL AND SCIENTIFIC NOTES.

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Experiments with Lights.—Dr. Koenig has been making a number of experiments on the quality of different kinds of light by means of the leukoscope, an instrument of his invention. It consists of a rhomboid of calcspar, a quartz plate, and a Nicol's prism. When a ray of light enters the star it is split into two rays, polarised at right angles. These traverse the quartz and Nicol. When analysed they show two spectra of absorption bands, and the peculiarity is that where the bands occur in one, the other spectrum is of pristine brightness, so that the two spectra overlaid give a continuous spectrum. The number of bands is increased by increasing the thickness of quartz, and they can be shifted by rotating the Nicol. It is possible, therefore, by rotating the Nicol to make the colours in each spectrum produce white light together. When different kinds of light are examined by the instrument, different amounts of rotation of the Nicol are required to bring the two spectra into conformity, and the angles of rotation are a gauge of the colour-quality of the light examined. According to results communicated to the Physical Society of Berlin, Dr. Koenig finds that the angle for stearin candles is 71·20°, for gaslight 71·5°, for electric arc light 79°, for magnesium light 86°, and for sunlight 90·5°. For burning phosphorus and the Drummond limelight, the angles were between gas and the electric light. It thus appears that the magnesium light more closely resembles sunlight than that of the electric arc—a result confirmed by the fact that the aniline dyes, hardly distinguishable by gaslight, can all be distinguished by the arc light, except a few "bronzes," and even these are clearly distinguishable by magnesium as by sunlight. Dr. Koenig has also tested Swan and Edison incandescence lamps, and finds that the luminosity increases at first in a much greater rate than the current increases. Doubling the strength of current very largely increased the luminosity. The highest angle reached was 78, or very nearly that for the arc lamp. These researches of Dr. Koenig are of much interest, more especially as so little has been done in this direction. They also show the suitability of magnesium as a standard light giver.

Indiarubber Oil.—Dr. Beckert, of Spandau, has patented in Germany an indiarubber oil, which is intended to serve as a protective against rust. According to the description published in the German technical press, the rough oils obtained in the dry distillation of brown coal, peat, or other bituminous substances are subjected to a further distillation. Thinly-rolled indiarubber, cut into small strips, is saturated with a fourfold quantity of this oil, and is let stand for eight days. This mass thus composed is subjected to the action of vulcan oil or a similar liquid until a homogeneous, clear substance is formed. If this substance is applied in as thin a layer as possible on a metal surface, it forms, after slow drying, a kind of skin which insures an absolute protection against atmospheric influences. The durability of this covering is said to be most satisfactory. Indiarubber oil is also said to be effective in the removal of rust which has already been formed, though we do not see in what way it can operate to do this.

There were 190 patents granted in Germany between May and October for inventions connected with electricity. Telephones are being adopted on a scale of increasing importance in that country; there being now—according to the statements made at a recent meeting of the Berlin Electro-technical Society—telephonic arrangements in eighteen German cities, comprising 3,788 different stations. The total length of the telegraphic lines used in the above telephone service is 540 miles, these lines comprising single wires 4,017 miles in length.

At a recent meeting of the Physical Society, Mr. W. R. Browne read a paper on the conservation of energy and central forces. He showed that the doctrine of the conservation of energy necessarily involved central forces, and could not be proved unless on the assumption of a system of central forces. This involved the hypothesis of Boscovich that matter consists of a collection of centres of force, and the author criticised the objections of Clerk Maxwell, Tait, and others to Boscovich's theory. The paper will appear in the *Transactions* of the Society.

Throat Irritation.—Soreness and Dryness, Tickling and Irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d., tins, 1s. 1½d., labelled "James Epps and Co., Homœopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, Gordon Holmes, M.D., Senior Physician to the Municipal Throat and Ear Infirmary."

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Mahogany **Camera**, complete, and pair of good opera-glasses, in exchange for Microscopic Objects, or Apparatus to value of 25s.—J. H. Forshaw, Rooley Lodge, Huyton.

Wanted, **Tricycle**. Will give 3in. back gear 2ft. Bench Lathe, with treadle, all from V steel, what offers?—Basson, Queen-street, Colchester.

Spinal Instruments, 2, cost £7. Exchange for Conjuring Apparatus or Lantern Slides; other offers requested.—"Ino," 26, Methley-road, Kennington, London.

Sextant by Imray, and complete set of nautical books; splendid chance for seaman or one commencing sea life. Offers.—Rase, Hanbury-terrace, Pontymoile, Monmouthshire.

I will exchange my central fire **Breechloading** Double Gun, with case complete, choke bore No. 10, for iron bed back-geared 5in. or 6½in. centre Lathe, with slide-rest and some chucks (self-centring indispensable), value £12.—Apply, J. Scammell, Clarendon-road, Southsea.

Micrometer, mounted in brass and ruled into squares for sun observation or microscope work, cost 21s. What offers?—E. B. Ferguson, Pallasgreen, Limerick.

Books.—Playfair's "Midwifery," Gray's "Anatomy," Erichsen's "Surgery," Fox's "Skin Diseases," Attfield's "Chemistry," Royle's "Materia Medica", for anything useful.—S. E., 60, Navarino-road, Dalston.

A pair of Governor **Gas Burners**. Value 3s. Offers.—P. Mitchell, Sydenham.

Six sheets of **Sensitised Paper**. Brilliant and good. What offers?—P. Mitchell, Sydenham.

Handsome Hall **Stove**, square, for coals, cost £3 10s. Offers to value £2 10s. Is in good condition.—P. Mitchell, Sydenham.

A good **Background Interior** by Sleavy. Cost £4 17s. six months ago. Offers to value 30s.—P. Mitchell, Sydenham.

Have 100 **Portrait Negatives**. All touched. Suitable for amateurs. Also some fine negs. of Weston-super-Mare. Offers.—P. Mitchell, Sydenham.

4 dozen **Dry Plates**, instantaneous. Value, 3s.—Offers to P. Mitchell, Sydenham, S.E.

Electric Bell and Signal, made for Exhibition. Continuous or single stroke; quite new, never been fitted up; in crystal case, suitable for large house, value £4. Offers.—P. Mitchell, Sydenham.

Photographs.—About 50 abbeys and cathedrals, 7in. by 4in. size, will take 4d. each, or what offers? Books.—Address, Photo, 182, Trongate, Glasgow.

Book on **Retouching and Films, Negatives**. Value 2s. 6d. Offers.—P. Mitchell, Sydenham, London, S.E.

4 **Oil Paintings**, framed, size 13 by 8, new. Value 16s.—Offers to P. Mitchell, Sydenham, S.E.

12 beautiful hand-painted **Photographs**, on rich mounts, for Christmas. Value 6s. Offers to P. Mitchell, Sydenham, S.E.

A gross of **Cabinet Scraps**. All very good subjects. Value 24s.—Offers in electrical goods.—P. Mitchell, Sydenham.

Splendid £15 **Air Pump**. Want spectroscope, resistance coils, apparatus, or offers.—Sharp, 3, Lothian-street, Edinburgh.

Glass Cylinders for Electrical Machines. One small, one large. Both fitted with caps, also supports. What offer in exchange?—Address, 125, Coltman-street, Hull.

What offers for 2lbs. best thin **Ivory** for inlaying?—H. C. Fall, Market Rasen.

What offers for 6in. Cabinet **Rolling Press**, nearly new, cost £2 10s. Exchange to full value.—H. Fall, Market Rasen.

Cabinet Lens (Ross), cost £12 12s. (second hand). Will exchange for astronomical telescope of equal value.—Lewis Cooper, Holt, Norfolk.

Batteries.—30 cells in exchange for Cuttriss' (Leeds) or Paterson's 4-cell automatic lever battery for sewing machine motor. See Sale Column.

Launch Engine, 5 by 5in. cylinder. Will exchange for tubular boiler, suitable for 5in. cylinder. Must be in good condition. Must not exceed 3 feet, and not below 18in. dia., either horizontal or vertical.—James Holland, Amble, Acklington, Northumberland.

Wanted, the single number of **Cassell's**, relating especially to colley dogs, or a book on colley dogs.—Geo. F. Firth, Kirkgate, Wakefield.

Exchange a good **Silver Watch**. Approval if necessary. For photograph apparatus complete. Any size shape.—Wm. Pickles, No. 30, Livesey-street, Whitefield, near Manchester.

Iron **Lathe Bed**, 5 feet long. Planed and scraped, on wood standards. Double crank and roller bearings. Would exchange for either of the following: Good magic lantern, Photographic camera and lens, or hand drilling machine.—J., Lower Eaton, Hereford.

Complete set of **Drills** to fit ½ Chuck, from ¾ to 1-16. Exchange for good model locomotive.—J. Stafford, Junior, Tallow Chandler, Longford, Coventry.

What offers in exchange for a **Flutina**, slightly defective? Useful tools wanted.—Tarver, 1, Acacia Cottages, Basing-road, Peckham.

Piano (cottage), walnut and gold, iron-plated, 7 octaves, nearly new, 20 guineas. What in exchange?—13, Ann-street, Linton-street, New North-road.

Will exchange my seven-guinea Silver **English** Lever Watch for good Breechloading Double-barrel Fowling piece (if with cartridge machine preferred).—Address, Jones, Clonakilty, Ireland.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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For Sale.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. (List Twopence.)

Electrical Depot and Manufactory.—Millar's, 136, Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Bells, 5s.; Batteries, 2s. Telescopes, Microscopes, Field Glasses, Spectacles. None better or cheaper.—Millar, as above.

Thirty Per Cent. Discount off Standard List of **American** Twist Drills. Sample 3-16 sent for 6 penny stamps. They are made of the very finest steel, by Bentall Bros., Maldon, Essex.

Fret Saws and Piercing Saws, 2s. 2d. per gross. 1s. 1d. half gross, post free.—Address, J. La Riche, Coventry.

Booth Brothers' **Mitre Cutting Machine** and Corner Cramps; likewise Joiner's Grip Vice. Sold by I. Gagen, 11, Sutherland-terrace, Pimlico, opposite the Monster Tavern.

Birmingham Goods.—Jewellery, Watches, Clocks, Harmoniums, Miscellaneous Goods. Agents wanted. Wholesale Illustrated Catalogue post free.—Address, Henry May, Birmingham.

Fretwork Patterns. New Designs (full size) sent free for selection, by Macmanus, 8, Northbrook-street, Birmingham.

Organ Materials, new and second-hand, pipes, wood and metal, keys, leather, wind-chests, &c.—R. Fuller, 184, Kennington-road, London.

Dynamos, 5—500 light. Efficiency and delivery guaranteed. Price from £10.—Oppermann Bros., 41, Old-street, London.

Inventors requiring use of Dynamos and Steam-power 60 H.-P., apply to Oppermann Bros., Old-street.

Charming "Smith" **American Organ**, eleven stops. Cost £30, price £16. Just new.—Hanna, 1, Lombard-street.

Violin for Sale, rich solo tone, fine model for lady or gentleman, labelled "Antonius Stradiuarius Cremona, 1650," good lock up case and Bow. The lot, 25s. Sent for 3 days' approval willingly.—Mrs. A. Stokes, 64, Campana-road, Poole Park Estate, Fulham.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 29, 1882.

SCREW-MANIA.

I HAVE been endeavouring, by means of a somewhat extensive correspondence, to obtain information upon the relative values of the old and the modern traversing-mandrel lathes, and also upon the question of the general use or otherwise of mechanical aids to screw-cutting. One of our manufacturing opticians of note—head, in fact, of the trade—tells me that all the smaller astronomical and scientific instruments have hand-chased screws upon their tubes and other parts, while the larger and heavier screws are done in a screw-cutting lathe. The objection to the traversing mandrel is, I am told, not only due to its costliness, but to the fact that it would take too long to put the apparatus into gear, and restore the lathe to its normal condition. This is the objection to all contrivances that have appeared in these pages and elsewhere, with one sole exception, *and that exception is the old pattern mandrel with guide screws cut upon it.* Any one who has stood beside one of the Tunbridge turners will have noticed that to turn back the centre screw, and raise the wedge into gear with its guide, is just the work of a second or two, and might almost be done with the eyes shut; and when the screw has been cut, all is again arranged with the utmost speed and facility. It is the same with the old brass Turner's lathe, as illustrated in Lardner's "Manufactures in Metal." These were made for workmen, and not for amateurs, and satisfied a workman's need.

As regards speed in use, it is a question whether it would not take longer to feel one's way, as even good workmen must, with a chasing tool, than to throw into gear the guide-screw and its nut, although, no doubt, some men, after long practice, do become very expert with the hand-tool alone, and then, naturally, scorn mechanical aid. But less skilful workmen—i.e., less skilful at this special work—and apprentices and amateurs, would gladly avail themselves of any good and satisfactory screw-cutting appliance; and, so far as I can at present ascertain, there is not one extant which offers the facilities of the old-fashioned mandrel. All others either require an overhead, or some sort of gearing, and this must be so unless the guide-screw is on the mandrel itself. There is, indeed, the cleverly-devised apparatus of a firm at York, in which there is no gearing; but here we are driven to cords and a weight, and to the necessity of rigging up a biggish affair, which I need only say would take much more time to set up than it would to throw into action one of even the modern traversing mandrels. Apart from this, the apparatus is cleverly designed and practically effective, and much used by the men employed by the firm. This, indeed, seems to prove that many workmen are not above using such apparatus, especially when, as in the case of the best instruments, accuracy—axial truth—is essential.

The screw-cutting lathe, for the special purposes for which it is designed, stands first as capable of producing all rates or pitches, but is unsuitable for general work —i.e., where such work is not confined to metal. Next in order, and "facile princeps" for general work, is decidedly Haydon's arrangement. There is, practically, no limit to its capabilities as an amateur's screw-cutting lathe; and its special feature is its striking gear, by which the traverse of a tool is instantaneously stopped while the lathe continues running. But not even this answers exactly the intention of a traversing mandrel, because it *must* have an overhead of special construction and a slide-rest. Then why has the old efficient and simple traversing mandrel become almost extinct?

FIG. 1

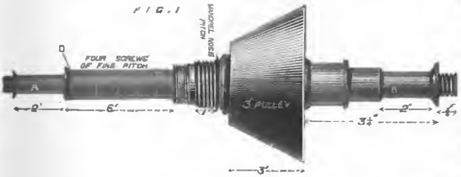


FIG. 2

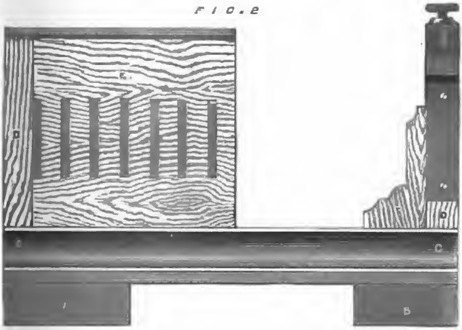
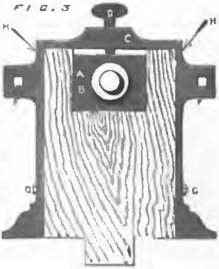


FIG. 3



First of all, I think, because wooden headstocks, on which they were fitted, are now seldom used, cast iron being so far superior. Secondly, because they need a mandrel headstock much longer than usual—a matter of little importance when the lathe-bed was of wood, but of some consideration if we are to pay £1 for each additional foot of iron bed. Thirdly, because it is a much neater plan which is now followed, in which separate screw ferrules fit upon the mandrel, which does not occupy more space upon the lathe-bed than one not made to traverse. But, on the other hand, the modern form, apart from the price, which prevents workmen from buying it, does, undoubtedly, occupy a great deal more time to get it to work than the old mandrel did. It is, therefore, not a workman's lathe, and is almost exclusively used by rich amateurs. I think, therefore, that before the old form is placed in hopeless limbo it would be well worth while to consider whether it has not a good claim to preservation as a true working-man's tool, quick in action, cheap to make, and efficient. To invent any device to supersede the traversing mandrel has proved a *pons asinorum* to all who have tried it; but the innumerable attempts to do so prove how

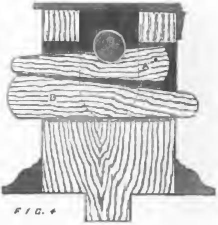


FIG. 4

very general is the desire for some screwing arrangement to assist the less skilful in the use of screw tools. It is an accepted doctrine, I know, that a traversing mandrel is not suitable for general rough-and-tumble work, but it is not a fact. I know, at any rate, of one of Holtzapffel's, some thirty years in general use, and not specially spared, which is as perfect as ever it was; and these older patterns were essentially intended for workmen's use, and were generally found in brass turners' shops before amateurs had attained to the questionable title of "legion." Rough work will not damage such a mandrel any more than it will damage one of the more usual form; and a long mandrel is, I think, confessedly steadier than a short one.

I do not know if it is generally understood that there are two forms of this mandrel. Holtzapffel, in Vol. IV., gives both, but all do not possess his books. The French mandrel has two parallel bearings, and during traverse it does not quit either of its collars. The Tunbridge one rests in one bearing, and is supported at the other end by a back centre, and the shoulder of this mandrel is on the inside of the poppit, the same as in one which does not traverse. To allow it, therefore, to move forward, the back centre is first unscrewed, and the mandrel pulled back a little way. It then traverses till its shoulder again touches its collar. During this time it is wholly supported hy the forward collar, and by the screw-guide or wooden half-nut on which it rests, and its parallelism depends on whether the wedge below has raised the half-nut to precisely its proper height. Nevertheless, these mandrels enable the workmen to cut screws rapidly, and are really working tools which stand a deal of rough usage. The workmen fit up the wooden headstocks, and the best of the mandrels which I myself saw were made by Holtzapffel. In Vol. XXIX. I drew, with great care, an illustration of the French mandrel. It was from one lent me for that special purpose, and had been very well made. It had six screw pitches upon it, and was in total length 18in. A part of this length was wasted in mouldings, and I have recently drawn for a lathe manufacturer one of 12in. for a 4in. or 5in. centre lathe, with an allowance of 3in. for the pulley, and four guide or pattern screws, each 1in. long, allowing a traverse of that extent. But even a 3in. pulley is not a matter of necessity, and 2in. would certainly suffice for three or perhaps four speeds. Probably 9in. will allow three screw-pitches and ample traverse, and three pitches $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{20}$, or $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{20}$ would suffice for most work in wood, ivory, and brass. As I wish to call special attention to this class of lathe, I will ask the editor to reprint the block, as it is possible that some of our readers are not acquainted with this pattern of mandrel, and recent subscribers may not have the back vols. If the block is destroyed, I must give a sketch sufficient to explain the details. It is, however, easy to understand the subject so far as the mandrel is concerned. Such mandrel is in cylindrical collars, and free to slide to and fro in its bearings, and is compelled to do so at a fixed rate governed by guide-screws cut upon it, each gearing with a half-nut of its own pitch below, such nut being raised hy placing a wedge underneath it. Now, these half-nuts are ranged in a row, and turn at one end on a wire or common pivot as a hinge, and each fits into a mortise in a block of wood, fixed to the base of the headstock underneath the mandrel. This was the old plan: The half-nuts were of wood, and the thread was cut in each by the several screws of the mandrel, when they were wedged up; and as they got worn, the wedge was driven in a little further. "Clumsy and obsolete, and worthy of Limbo," no doubt will be the dictum of the orthodox amateur, with his £150 Holtzapffel lathe; but I do not feel abashed by such verdict. All I will say is, Show me a better at the price? Workmen want a working tool; amateurs of small means want a cheap one, as well as an efficient one; and I could almost guarantee a large sale of a traversing mandrel lathe at a moderate figure. Moreover, while I freely allow that the modern form is as perfect as it can be, and far neater, and in every respect a higher-class bit of mechanism, it has, to the workman, the two defects of high price and too much time required to throw it into gear. In the old form, every pitch of thread is there ready for selection, and its wedge being raised the one selected is in gear. In the modern form the screw has to be loosened which retains the sleeve, the sleeve pulled off, the right ferrule selected and put on, and the fixing-screw returned. The segment or half-nut plate has then to be drawn up into gear; and if now another pitch is desired, all this must be repeated, and, if not, the ferrule must be removed, the half-nut lowered, and sleeve put on and secured before plain turning can be renewed.

All this to an amateur is not of much importance; but to a workman time is money, and I have no doubt that the great reason why workmen are shy of these lathes is because, as a rule, they know only the modern form, and judge from this of the time required for screw-cutting. If so, no wonder they will not use them. I do not propose to fall back upon wooden headstocks, nor upon the wooden block and wooden wedges and keys, because it would be easy to replace these by metal; yet it must be remembered that the Tunbridge men still use them, and if a workman could only afford to buy the mandrel and headstock, he should be able to do so, and rig up for himself at home the block and its fittings. I have lived much in the country, and have seen many men labouring to fit up lathes, out of all sorts of odds and ends, who, if they could have bought separate mandrels fitted with collars for wooden headstocks, would have really made useful machines. I think, therefore, these mandrels should hy no means be considered obsolete, but that they are worthy of being retained, especially with such improvements in respect of the half-nut arrangement as will probably occur to any lathe-maker who will renew the manufacture.

O. J. L.

ECONOMICAL STEAM-POWER.

On p. 329 we referred at some length to the remarks of Mr. Barnet Le Van in connection with economical steam-engines contained in a communication to the Franklin Institute. As the engine proper is not the only source of waste, it may be of some interest if we make a note of what Mr. Barnet Le Van has to say about boilers, especially as in one point he gives utterance to views which are heterodox. As his experience extends over some thirty years, we may suppose that he fairly represents the best American practice, and it is, perhaps, a matter for regret that he has so little to say concerning the actual construction of boilers. He, however, ventures to prophesy that the day is not far distant when pressures of 150lb. and 200lb. per square inch will not be uncommon. In this country pressures of 140lb. are common enough in locomotives, and recently an upward move has been made in connection with marine boilers; but it must not be forgotten that Sir W. Fairbairn suggested the use of a much higher pressure than 200lb. for ordinary factory purposes. that Perkins not only suggested, but actually tried, pressures which may fairly be described as extreme, and that at the very beginning of the century Trevithick used cylindrical boilers at a pressure of 100lb. and upwards. It is on record that he used cast-iron boilers at a pressure up to 145lb. Captain Dick, indeed, was the apostle of high-pressure, and had he lived at a time when the mechanical capacities of workshops even approached those of the present day, it would not have been easy to fix a limit to his daring—or his madness, as his rivals regarded his belief in high pressure. The century has reached its ninth decade, and except under very special circumstances it is doubtful whether many ordinary stationary boilers can be found in which the pressure reaches 100lb. The most economical engines hnown are worked by boilers having valves set to blow off at about 70lb., and, so far as modern experience teaches there is little inducement to go higher, for what is gained in one direction is lost in another. In the case of locomotives, and under conditions in which it is necessary to make the boiler as small as possible, higher pressures are adopted with advantage; but, so far as we know, no engineer has proposed to put down boilers of that kind when it is required to drive a large factory engine, or pump water for a town's supply. Whatever may be done in the United States, then, it is extremely doubtful whether much higher pressures will be adopted in this country, except under special conditions and with peculiar forms of boiler. That some reform is advisable in American practice is obvious, if there are many such boilers as Mr. Le Van describes; but, according to his showing, it is not so much the fault of the boilers as of their settings. Thus, he tells us that the deficiency of a large number of good boilers is due solely to their imperfect brick settings, flue connections, and improper proportioning of grate-surface to heating-surface. Some years ago he was consulted by a manufacturer who complained of the great quantity of coal consumed under his boilers, which, upon examination, proved to be so set that about 30 square feet of the most effective heating-surface of each boiler, immediately over the fire-grate, was rendered practically useless by being inclosed in brickwork. As there were five boilers in all, the aggregate loss was very great, and Mr. Le Van had little difficulty in so resetting the steam generators, that a saving of five tons of coal per day was effected—that is 20 per cent. ! In Mr. Le Van's opinion, steam-boilers, as now constructed, can be very little improved on; but in regard to their brick settings and flue connections there is a large field for improvement, especially in the construction of the combustion chamber, which should be so arranged that the combustion of the gases started in the furnace may be completed before they escape into the chimney. The ordinary combustion-chamber is, Mr. Le Van says, invariably made too small, both in height and width: it is so constructed as to give it the character of a large conduit, whose only function is to allow the gases to pass through it, rather than that of a chamber in which a series of chemical processes are to be performed. The chief deficiency he notes is the insufficient capacity above the fuel—the idea apparently having been to bring the surface to be heated as near as possible to the source of heat. Plain cylindrical boilers are often set too near the firebars, and the flue beneath the boiler is too cramped; but Mr. Le Van would scarcely ask for larger tubes in the Cornish and Lancashire boilers in order to obtain more capacity above the fuel. He takes, as an illustration, a plain cylindrical boiler, set about 12in. above the firegrate, with the flue behind the bridge-wall only a few inches deep, and shows how he would alter it by making the height of the boiler from the grate-bars not less than 20in. where the grate is 4ft. long, increasing the height when the length is greater. The formation of a combustion-chamber behind the bridge is recommended; but the floor must not be carried so low as to come in contact with damp soil, because aqueous vapour has a power of absorbing heat about six thousand times greater than that of dry air. Mr. Le Van lately reset a cylindrical boiler, having behind the bridge a combustion chamber, the floor of which was the ground. He altered this by making the bottom of the chamber an arch, turned over about 18in. from the ground, and saved about 10 per cent. in the coal. In another case, four cylindrical boilers with only 14in. over the grate, were reset by raising them to 24in., and arching over the floor of the combustion chamber behind the bridge; a flue was also carried along each side of the boilers, about 4in. wide up to the top of the water-line. The result was that a daily consumption of seven tons was reduced to five. The latest practice of Mr. Le Van, however, is to return the products of combustion over the top of the boiler, "thereby, to a great extent, reducing the steam down to nearly dew-point." That there should be no mistake about this matter, the illustration accompanying the paper in the *Journal* of the Franklin Institute, shows a plain cylindrical boiler, supported at its ends only, and with a flue along the whole length of the top, except such portions of the ends as are covered by brickwork. The division is made in the usual way by brickwork, which on each side rests against the shell to just below the water-line, leaving a surface of about one-fourth of the circumference exposed to the hot gases from the combustion-chamber. Such an arrangement, we need scarcely say, is opposed to the best practice, and would, we believe, be condemned by all the boiler inspectors in this country. We presume that only boilers of short length would be set in the manner described, but Mr. Le Van does not say so, and if his practice—his latest practice—is extensively followed in America there must be a large number of boilers set in a very dangerous fashion, for in the case in question not only are the heated gases allowed to play against the plates inclosing the steam-space of the boiler, but the whole strain of the weight is brought on the ring seams in the centre of the length, a part which, owing to its position, is subjected to the greatest amount of expansion and contraction. Mr. Le Van goes into the question of the number of heat-units produced by the combustion of a pound of coal, and he finds for Philadelphia anthracite, and taking an engine that gives an indicated horse-power per hour for 3lb. of coal, that he obtains only about one-fourteenth of the power he should. It is obvious that to lose thirteen-fourteenths of the actual thermal power of the coal leaves a very large margin for improvement; but it is well understood that with the most perfect arrangements it is impossible to utilise all the heat theoretically due to the coal—at least by means of the steam-engine. The temperature of the escaping gases, for instance, must exceed that of the steam in the boiler, or otherwise there will be a loss by radiation, and as a matter of fact, the temperature of the gases at the foot of the chimney must be high enough to create the draught on which the burning of the coal in the furnace depends. The only useful constituent of air in the furnace is oxygen; but for every 20 parts of that the engineer is obliged to provide for 80 parts of nitrogen—to expend heat in warming it up first of all, and more to expel it up the chimney, or rather to make it so light that the cold air can push it up. There are thus three sources of loss which cannot be got rid of, and the steam-user must take them as unavoidable if unwelcome guests. Something can be done in properly proportioning the chimney, and in so arranging the flues that the loss is reduced as much as possible; and it is here that the skilled engineer gains the advantage over the rule-of-thumb man. A rapid draught is essential to economy, because it enables more fuel to be burned in a given time, and raises the furnace to a higher temperature, when the heat is more rapidly imparted to the water. A low fire is never economical. Heating the feed is an obvious method of preventing some of the loss and utilising some of the heat which would otherwise be wasted; but studying the matter from every point, and making the best arrangements, it is doubtful whether in practice more than 12lb. of water can be evaporated per pound of carbon. Ten pounds, or a little over, is considered very good work on the part of the boiler, and as the best engines will need 16lb. of water per indicated horse-power, it will be seen that where each portion of the engine is the best that could be adopted, an indicated horse-power for each pound and a half of coal seems about the limit according to our present lights. Feed-water can be heated to 200° Fahr. by comparatively simple appliances, and the saving effected by using water of that temperature instead of 60° is about 12 per cent., while its use effects a further saving by removing from the water much of the solid impurity which would otherwise form incrustation, tend to prevent the heat reaching the water in the boiler, and damage the latter in the shape of burned plates and in other ways. Perfect combustion is another source of economy, and the frequent opening of the fire-door a loss, and also a cause of injury to the plates. Hence several ingenious minds have endeavoured to devise mechanical stokers, which will supply crushed coal to the furnace in such a condition and quantity that it is immediately put into a state of intense combustion, thus avoiding smoke and the ingress of a greater quantity of air than is needed to secure the complete oxidation of the carbon of the fuel. The temperature of ignition is not less than 800° Fahr., and it must be an object on the part of the engineer to heat the air supply as much as possible before it mingles with the gases of the fuel. In practice the air has been introduced at different parts of the furnace with equally good effect; but Mr. Le Van recommends the construction of a double passage in the brickwork on each side of the furnace, by which the air drawn in at the front passes the whole length of the side walls and back again to the fire, where it is delivered upon the fuel in the shape of a hot blast. We presume that some cold air must be admitted to the grate, or the bars will not last very long, unless they are of the water-tube type—a device which introduces its special disadvantages, as, indeed, do nearly all the schemes for obtaining greater economy than is now found in the best kinds of steam-plant. There can be, however, no "finality" while thirteen-fourteenths of the available power of coal are unutilised, and though we do not expect to do much better with steam-engines than get an indicated horse-power for each pound and a half of coal, it will be seen there is ample scope for invention; and if the steam-engine is superseded, we can afford to put it by as a good servant that has done giant's work in the advancement of the world.

ASTRONOMICAL NOTES FOR JANUARY, 1883.

In accordance with our annual custom, at the commencement of our Astronomical Notes for a new year, we have appended to such of our Tables as seem to require it a description of the manner in which they are to be employed; supplementing such description, where it seemed to be necessary, with numerical examples worked out at length.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. p.m	h. m. s.	° ′ ″	h. m. s.
1	0 3 45·10 ,,	18 46 56	23 0 51	18 43 11·02
6	0 6 2·55 ,,	19 8 56	22 30 24	19 2 53·81
11	0 8 8·56 ,,	19 30 45	21 48 51	19 22 36·59
16	0 9 59·42 ,,	19 52 19	20 56 43	19 42 19·38
21	0 11 32·51 ,,	20 13 35	19 54 39	20 2 2·16
26	0 12 46·34 ,,	20 34 31	18 43 19	20 21 44·94
31	0 13 40·25 ,,	20 55 8	17 23 28	20 41 27·71

The second column of the above Table gives the time which a perfectly regulated Mean Time Clock should show at Greenwich at the instant when the Sun is on the Meridian or due South, and a Sun-Dial, or similar instrument, marks 0h. 0m. 0s. The so-called "Equation of Time," to be added to the time of apparent or solar Noon is calculated for the Meridian of Greenwich; but it may be safely employed for any place in the United Kingdom, inasmuch as it only varies 1sec. in an hour of Longitude at the beginning of January, and about ·4 second at the end of it; and, of course, no sun-dial will show the time within several seconds. The third and fourth columns give the Right Ascension and Declination of the Sun when a Mean Time Clock shows 0h. 0m. 0s. at Greenwich; while column five exhibits the Sidereal Time, or Right Ascension of the Meridian, at the same instant. This latter quantity is one which is not unfrequently required with rigid accuracy for the Local Noon of some other Station; and when it is so required must be corrected by the addition of 9·8565 seconds for every hour (and proportionately for minutes and seconds) of Longitude when the place is West of Greenwich, and by their subtraction when it is East. For example:—What is the Sidereal Time at Mean Noon at Dublin on January 6th? The Longitude of Dublin is 25m. 22s. (or 25·367 minutes) West, so we say 60m. : 25·367min. : : 9·8565sec. : what we shall find to be 4·17secs. Now, the Sidereal Time at Greenwich Mean Noon on January 6th is 19h. 2m. 53·81s., and if to this we add 4·17sec., according to the precept (Dublin being West), we get 19h. 2m. 57·98s. as the Sidereal Time at Dublin Mean Noon on the day specified. Or, take a place to the East of Greenwich, say, Yarmouth, whose Longitude East equals 6m. 52s. (say, 6·807min.); then, as before, we say 60 : 6·807 : : 9·8565 : 1·13s., and subtracting this (Yarmouth being East) from 19h. 2m. 53·81s. we get 19h. 2m. 52·68s. as the Sidereal Time at Yarmouth Mean Noon on the same day.

Solar disturbance is still active, and spots, faculæ, and prominences continue to appear on the Sun's surface.

The Moon

Enters her Last Quarter 50·2 minutes after Noon on January 1st. She is New at 5h. 59·3m. a.m. on the 9th, and enters her First Quarter at 12h. 47·6m. on the night of the 15th. She will be Full at 7h. 15·5m. in the early morning of the 23rd, and, for the second time this month, enter her Last Quarter at 10h. 26·6m. a.m. on the 31st.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	21·8	5 39·2 a.m.
6	26·8	9 33·4 ,,
11	2·3	2 7·9 p.m.
16	7·3	6 29·5 ,,
21	12·3	11 2·3 ,,
26	17·3	2 10·3 a.m.
31	22·3	5 44·8 ,,

The Moon will be in conjunction with Venus at 8 a.m. on the 6th; with Mars at 4 p.m. on the 8th; with Mercury at Noon on the 10th; with Saturn at 7 p.m. on the 17th; and with Jupiter at 4 a.m. on the 20th.

During the year 1883 there will be Four Eclipses, two of the Sun, on May 6th and October 30th, both invisible at Greenwich; and two of the Moon, on April 22 and October 15, of which the latter only will be partly seen in this country. These will be noticed under their respective months.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	49 Virginis	6	1 33 a.m.	Bright	54	17	2 39 a.m.	Dark	259	227
4	B.A.C. 4896	6	6 5 ,,	Bright	65	48	7 25 ,,	Dark	257	252
5	κ Libræ	5	5 10 ,,	Bright	106	76	6 12 ,,	Dark	223	201
11	c¹ Capricorni	4½	6 6 p.m.	Dark	57	90	6 39 p.m.	Bright	350	25
12	κ Aquarii	5	4 52 ,,	Dark	114	133	6 0 ,,	Bright	299	327
13	15 Piscium	6½	6 53 ,,	Dark	124	153	7 57 ,,	Bright	285	320
17	29 Arietis	6½	1 4 a.m.	Dark	54	93	1 41 a.m.	Bright	324	1
19	ζ Tauri	3½	†2 3 ,,	S.	359	40				
19	B.A.C. 1651	6½	11 0 p.m.	Dark	44	70	11 54 p.m.	Bright	310	315
20	71 Orionis	5½	9 23 ,,	Dark	15	2	9 49 ,,	Bright	336	330
23	A² Cancri	6	‡5 13 ,,	Bright	55	19	6 3 ,,	Dark	283	244
23	60 Cancri	6	9 49 ,,	Bright	69	37	11 6 ,,	Dark	253	233
24	κ Cancri	5	5 39 a.m.	Bright	139	178	6 0 a.m.	Dark	180	220
29	ψ Virginis	5	3 0 ,,	Bright	62	39	4 21 ,,	Dark	254	255

† Near approach. ‡ Star below the horizon.

The Table of Occultations gives the Mean Times at which the Stars in it will disappear and reappear at Greenwich, and the points on the Moon's circumference at which such disappearances and reappearances will occur, as viewed in an inverting telescope. The "Angle from N. Point" means the arc included between the Star, when in contact, and that point of the Moon's Limb cut by a circle passing through the North Pole and the Moon's centre. The "Angle from Vertex" is measured from that point where a circle through the Zenith and the Moon's centre cuts her Limb. The former is the more useful for employment with an equatorially mounted telescope, the latter with an altazimuth. Be it noted that these angles are measured round the Moon's circumference to the right, and really start from the south point and bottom of her limb (observed with the naked eye) respectively; the Huyghenian eyepiece, of course, inverting these. In the case of Near Approaches, however, we give the *true* point of the Lunar Limb (as seen with the naked eye) to which the Star is closest, and for this reason: that in a case like that of ζ Tauri above, where the Moon, as seen from Greenwich, passes just to the North of the Star, it is evident that, as viewed from a northern station, this approach may be converted into an actual occultation.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	III	Tr I	5	51	A.M.	10	II	Sh E	9	7	P.M.	20	I	Oc D	5	43	P.M.
1	*I*	*Oc D*	6	52	,,	10	I	Tr I	12	22	,,	20	I	Ec R	8	44	5,,
1	II	Oc D	8	46	P.M.	10	I	Sh I	12	57	,,	21	*I*	*Tr E*	5	16	,,
1	II	Ec R	12	12	28,,	11	I	Tr E	2	37	A.M.	21	I	Sh E	6	5	,,
2	I	Tr I	4	11	A.M.	11	I	Sh E	3	13	,,	22	III	Tr E	6	35	,,
2	I	Sh I	4	34	,,	11	I	Oc D	9	30	P.M.	22	III	Sh I	7	15	,,
2	*I*	*Tr E*	6	26	,,	11	III	Oc D	10	41	,,	22	III	Sh E	10	1	,,
2	*I*	*Sh E*	6	49	,,	11	I	Ec R	12	19	59,,	23	II	Oc D	3	36	A.M.
3	I	Oc D	1	18	,,	12	III	Ec R	3	46	15 A.M.	24	II	Tr I	9	52	P.M.
3	I	Ec R	3	55	59,,	12	I	Tr I	6	48	P.M.	24	II	Sh I	11	36	,,
3	II	Tr E	5	39	P.M.	12	I	Sh I	7	25	,,	24	II	Tr E	12	37	,,
3	II	Sh E	6	29	,,	12	I	Tr E	9	3	,,	25	II	Sh E	2	22	A.M.
3	I	Tr I	10	37	,,	12	I	Sh E	9	41	,,	25	I	Tr I	3	54	,,
3	I	Sh I	11	2	,,	13	I	Ec R	6	48	44,,	25	*I*	*Sh I*	4	47	,,
3	I	Tr E	12	62	,,	15	III	Sh E	6	0	,,	26	I	Oc D	1	3	,,
4	I	Sh E	1	18	A.M.	16	II	Oc D	1	18	A.M.	26	I	Ec R	4	10	45,,
4	III	Oc D	7	21	P.M.	16	*II*	*Ec R*	5	23	25,,	26	*II*	*Oc D*	4	46	P.M.
4	I	Oc D	7	44	,,	17	I	Oc D	4	49	,,	26	II	Ec R	9	16	37,,
4	I	Ec R	10	24	47,,	17	II	Tr I	7	31	P.M.	26	I	Tr I	10	21	,,
4	III	Ec R	11	45	8,,	17	II	Sh I	8	59	,,	26	I	Sh I	11	15	,,
5	I	Tr I	5	3	,,	17	II	Tr E	10	15	,,	26	I	Tr E	12	36	,,
5	I	Sh I	5	31	,,	17	II	Sh E	11	44	,,	27	I	Sh E	1	31	A.M.
5	I	Tr E	7	18	,,	18	I	Tr I	2	7	A.M.	27	I	Oc D	7	30	P.M.
5	I	Sh E	7	47	,,	18	I	Sh I	2	52	,,	27	I	Ec R	10	39	33,,
6	*I*	*Ec R*	4	53	31,,	18	I	Tr E	4	23	,,	28	*I*	*Tr I*	4	48	,,
7	II	Tr I	4	3	A.M.	18	*I*	*Sh E*	5	8	,,	28	I	Sh I	5	44	,,
7	II	Sh I	5	3	,,	18	I	Oc D	11	16	P.M.	28	I	Tr E	7	3	,,
8	II	Oc D	11	1	P.M.	19	III	Oc D	2	3	A.M.	28	I	Sh E	8	0	,,
9	II	Ec R	2	47	57 A.M.	19	I	Ec R	2	15	18,,	29	*I*	*Ec R*	5	8	30,,
9	*I*	*Tr I*	5	55	,,	19	III	Oc R	4	42	,,	29	III	Tr I	7	25	,,
9	*I*	*Sh I*	6	28	,,	19	*III*	*Ec D*	5	11	29,,	29	III	Tr E	10	5	,,
10	I	Oc D	3	3	,,	19	II	Ec R	6	41	9 P.M.	29	III	Sh I	11	15	,,
10	*I*	*Ec R*	5	51	8,,	19	I	Tr I	8	34	,,	30	III	Sh E	2	2	A.M.
10	II	Tr I	6	12	P.M.	19	I	Sh I	9	20	,,	31	II	Tr I	12	16	P.M.
10	II	Sh I	6	21	,,	19	I	Tr E	10	49	,,						
10	II	Tr E	7	56	,,	19	I	Sh E	11	36	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Mercury

Is an Evening Star throughout the whole of January, attaining his greatest Elongation East (18° 32′) at 11 a.m. on the 22nd. About this time, and up to the end of the month, he may be caught with the naked eye on clear evenings close to the horizon in the W.S.W. His angular diameter increases from 6″ on January 1st to 9·4″ by the 31st.

Mercury.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	19 27·1	24 6·7	0 43·8 p.m.
6	20 2·2	22 35·8	0 59·2 ,,
11	20 35·8	20 27·1	1 13·0 ,,
16	21 5·9	17 48·4	1 23·3 ,,
21	21 29·1	14 59·7	1 26·8 ,,
26	21 40·3	12 39·6	1 18·3 ,,
31	21 34·8	11 37·3	0 53·1 ,,

The above Ephemeris shows that Mercury will travel this month from Sagittarius right across Capricornus, through a region, however, destitute of any conspicuous Stars.

Venus

Is a Morning Star during the entire month. She is not favourably situated for telescopic observation. The diameter of her beautiful crescent decreases from 46·8″ on January 1st to 29·4″ on the 31st. She will be at her greatest brilliancy at 3 a.m. on the 11th, and at this time, but for her unfortunately considerable South Declination (more than 17°), might be caught with the naked eye, even in bright sunshine.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	16 25·6	17 6·0	9 42·8 a.m.
6	16 31·8	17 1·6	9 29·4 ,,
11	16 41·1	17 13·2	9 19·0 ,,
16	16 53·1	17 34·9	9 11·2 ,,
21	17 7·2	18 2·5	9 5·7 ,,
26	17 23·3	18 31·8	9 2·0 ,,
31	17 40·9	18 59·5	8 59·9 ,,

The whole of the path thus indicated lies in the Southern part of Ophiuchus. At 4 a.m. on January 20th Venus will be in conjunction with η Ophiuchi, at a distance of 2° 21′ South of that Star.

Mars

Is quite invisible.

Jupiter,

Is an Evening Star, and from his great North Declination is visible all night long. He continues to be most favourably situated for telescopic observation, and is the most brilliant and conspicuous object in the night sky. His angular diameter continues slowly to decrease from 44·2″ at the beginning to 41·4″ at the end of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 35·7	23 0·6	10 50·8 p.m.
6	5 33·1	22 59·8	10 28·5 ,,
11	5 30·7	22 59·0	10 6·4 ,,
16	5 28·6	22 58·3	9 44·6 ,,
21	5 26·7	22 57·7	9 23·1 ,,
26	5 25·2	22 57·3	9 1·9 ,,
31	5 23·9	22 57·2	8 41·1 ,,

Hence Jupiter will travel in a retrograde direction a little to the North of ζ Tauri.

Saturn

Is an evening Star, is excellently placed for the observer, and is visible during all the working hours of the night. He is though, of course, best seen about the time of his meridian passage, which, as will be seen from the table subjoined, now happens at a tolerably early hour. His diameter decreases during the month, almost imperceptibly from 17·6″ to 16·6″. The ring is now slowly approaching its greatest opening.

Day of Month.	Right Ascension.	Declination North.	Souths
	h. m.	° ′	h. m.
1	3 11·1	15 26·8	8 26·6 p.m.
6	3 10·5	15 25·7	8 6·3 ,,
11	3 10·1	15 25·4	7 46·2 ,,
16	3 9·8	15 25·8	7 26·2 ,,
21	3 9·7	15 27·0	7 6·5 ,,
26	3 9·8	15 29·0	6 47·0 ,,
31	3 10·1	15 31·7	6 27·6 ,,

The scarcely appreciable pendulum-like path shown by the preceding ephemeris is described in that blank region of the sky to the South and East of δ Arietis.

Uranus

Is scarcely in a sufficiently favourable position for the observer until next month.

Neptune

Souths tolerably early now, but is visible during all the more convenient part of the long January nights.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 57·1	14 58·0	8 12·5 p.m.
6	2 56·8	14 57·3	7 52·6 ,,
11	2 56·6	14 56·7	7 32·7 ,,
16	2 56·5	14 56·4	7 13·0 ,,
21	2 56·4	14 56·4	6 53·2 ,,
26	2 56·4	14 56·6	6 33·6 ,,
31	2 56·4	14 57·0	6 13·9 ,,

Hence, Neptune will remain sensibly stationary not far to the South-West of Saturn.

Shooting Stars

May be looked for from the 1st to the 3rd inclusive, and again between the 15th and 19th.

Greenwich Mean Time of Southing of Sixteen of the Principal Fixed Stars on the Night of January 1st, 1883.

Star.	Souths. h. m. s.
α Andromedæ	5 18 17·94 p.m.
α Cassiopeiæ	5 49 45·41 ,,
Polaris	6 32 7·84 ,,
α Arietis	7 16 13·59 ,,
α Ceti	8 11 39·61 ,,
α Persei	8 31 26·18 ,,
Aldebaran	9 44 27·58 ,,
Capella	10 23 12·51 ,,
Rigel	10 24 3·36 ,,
α Leporis	10 42 39·67 ,,
α Columbæ	10 50 29·04 ,,
α Orionis	11 3 52·39 ,,
Sirius	11 54 53·23 ,,
Castor	12 41 54·41 ,,
Procyon	12 47 55·66 ,,
Pollux	12 52 53·74 ,,

If we assume that the Stars were absolutely fixed, any given one would South 3m. 55·91s. (or 235·91 seconds) sooner every day. With a very large proportion of them we may assume this to be true, so that to find the time of Meridian Passage at Greenwich of either of the Stars in the above list for any other night in January, we have only to multiply 235·91 by the number of days which have elapsed since the beginning of the month: i.e., by the day of the month—1 and subtract the result from the time given in our table. For example: At what hour will α Orionis South at Greenwich on the night of January 16th? Here 16 – 1 = 15 and 15 × 235·91s. = 3538·65s., or 58m. 58·65s. Taking this from 11h. 3min. 52·39s. we finally obtain 10h. 4m. 53·74s. as the Greenwich Mean Time of Southing of α Orionis on the night of January 16—a result true within ·001s. This accuracy, however, does not extend to Polaris or any close Circumpolar Star; although even in such cases it is amply sufficient for the purpose of obtaining Mean Time from their Meridian Passage. We may, moreover, wish to find our Local Mean Time of Transit of one of the Stars given above; and this we may do by taking 9·8565s. from the time given in our table for every hour of Longitude (and proportional parts for minutes and seconds) when our station is to the West of Greenwich, and adding that quantity when our Longitude is East. Thus: What will be the Penzance Local Mean Time of Transit of Aldebaran on the night of January 1st? Penzance is 22m. 12s. West of Greenwich. So we say 60 : 22·2 : : 9·8565 : what we shall find to be 3·65s. Penzance being West of Greenwich, we must subtract this, according to the precept, from the time given, and say 9h. 44m. 27·58s. – 3·65s., and the result we shall, of course, find to be 9h. 44m. 23·93s., which is the Penzance Mean Time of Transit of Aldebaran on the night required.

CART AND WHEEL-MAKING.

By J. Charles King.

(Concluded from p. 311.)

In making springs and fitting the plates together a level iron platform is essential. On this the curved main-plate is stood edgeways, and the second plate, while at a bright red heat, from end to end is pinched on to the main-plate, which is done in the following manner:—The smith's mate fixes a pair of spring pliers at his end, at the same time the smith fixes another pair on the other end. Both then commence nipping with tongs the soft hot steel on to the curve of the main-plate, taking care to pull the edge of the hot plate on to the other as the pliers are rapidly shifted until they finish at the middle. The spring pliers are released instantly, and the still red-hot plate is made about an inch more curve in the middle by the pressure of the smith's pliers, which are held in the right hand, while the plate is held by a pair of tongs in the left hand. It is then, without an instant's delay, plunged nearly perpendicularly into a tub of water which covers the whole of the plate. The mate must take care, at the same time, to cool the main-plate in water. The second plate thus hardened is nearly as brittle as glass, and must be "lowered" (as the term is for softening steel) until it can be bent by blows of the hammer over the jaws of the vice without breaking. This simple but critical process of lowering the temper of the plate for more complete fitting is effected in the following manner:—The plate is held within the hollow fire, without being allowed to touch the burning coal, until the whole of the plate is of one uniform heat. This uniformity is attained by keeping the plate continually moving backwards and forwards in the fire until the plate is sufficiently heated in every part to make sparks show on a piece of dry wood which is rubbed up and down the plate, or, in the absence of a piece of dry wood, a tallow candle is used by some spring-makers to try if the heat of the plate is just sufficient to cause the tallow, which melts on it, to burst into a flame. It is then of the proper heat for final tempering by again plunging it into a tub of water. Each other plate is curved and tempered in precisely the same way.

Now comes the close fitting of every plate, beginning again with the second plate, and making it 1in. more span than the main-plate; yet when pinched up to it with tongs at the middle, every part of the plate fits the next plate so closely that when held up to the light no traces of light are seen between the plates.

No. 3 plate is fitted to No. 2 plate with ¾in. more curve than the plate it is fitted to, and so on diminishing the extra curve on each plate. The whole of the plates are pinched together with powerful tongs, and screwed up in the vice and critically examined, and if every plate fits its fellow the job is done. The plates are faced on a rough grindstone—that is, the edges and visible surfaces; the fitting surfaces are left as they have been fitted unground, and are well painted twice to prevent rusting. The best paint is white-lead, a little lampblack, and raw linseed oil made up as thick as cream.

The following is a description of making open-heads to springs: these are exactly the reverse of pipe-eyes; in fact, they receive either shackles or pipe-eyes; just as the joint of one leg of a pair of compasses is inserted into the other.

The main plate is "upset" at the end to double its thick-thickness. The end is "scarfed" short and clean, and a piece of good iron is welded across the end like the top of the letter "T"; these two projecting ends are set down at right angles on a tool over which these ears of the open-head are worked at one heat, and finished off with a set hammer; the bolt-holes are drilled through the middle of both ears of the "open-head."

Having fully described these various processes of cart-ironwork making, there only remains to be described the simplest way of making a pair of wheels. Wheels are known in the trade as either machine-made wheels or hand-made wheels. For perfection of finish, especially those of American make, nothing can excel the appearance and finish of machine-made wheels; but from an inherent defect in the principles of their construction, premature failure often results. The same remark applies to many hand-made wheels. I, therefore, propose to describe the simplest processes of hand-work suitable for the guidance of a learner. I may here state that every separate part of a wheel—framed, tenoned, "dowelled," and dressed-up ready for putting together—may be bought at coachmakers' furnishers. This would be the preferable way for a learner to begin to get the complete parts of the proper sizes as follows: One pair of 7 by 7 elm hubs, Fig. 1, ready mortised; 14 ash felloes, cut out to curve for a 4ft. 8in. wheel; 28 oak or hickory spokes, 1⅝in. by 1⅝in., with tenons cut to fit into the mortises of the hubs. Some prepared American felloes are made out of a single piece of wood bent into a true circle. Some are semicircles, but only an experienced wheeler can attempt to use these whole or half-felloe rims; so I will confine my description to the short felloes, each of which takes the "tangs" of two spokes. If a learner has a strong lathe, his work will be truer by its use, and it can be applied to boring hubs and mortising them—"tanging" the spokes after they are driven into the hub, and boring the felloe holes for the tangs. Fig. 2 is of a hollow auger, for use in a large brace or in a lathe, or by a winch-handle, fixed to a frame on the bench, as shown by Fig. 3.

Having all the separate parts of the wheel prepared as much as you can, fix the hub on the pit, and assuming that a 2in. cone or "disch" is required for the finished wheel when braced with the tire, a gauge, or strip of hard wood, is screwed on the centre of the face of the hub, to turn round as the hand of a clock. The measure of the length of the spoke is marked upon the edge of the stick; from that mark to the front edge of the spoke is reckoned the distance required for the wheel to be 1¾in. disch, or cone, before the tire is braced on, which will bring it over to a 2in. disch when on.

The mortising of the hubs, Fig. 1, will be seen to be what is termed "jogged," that is, every alternate mortise is ½in. backwarder than the other; thus seven of the spokes have to be framed and shouldered into the hub at a greater angle than the other seven, and yet all of them terminate in a true plane at the felloe-rim. The obvious purpose of the "back-set" spokes is to resist the strain on the wheel, which is both vertical and lateral from the face of the wheel. What is termed the "forward spoke" is first fitted and driven slowly half-way into the mortise in the hub, and then tested by the gauge, to insure its being at its proper forward pitch, and a true radiation from the centre. The divergence of the radiation of every spoke is estimated and reckoned from the first spoke that is driven. No. 2 spoke, of course is a back-set one, and requires the shoulder to be about 1/16th of an inch more bevel than the forward ones. The learner then proceeds in the same way to put in the rest of the spokes, till the whole of the fourteen are framed into the hub, or, as it is technically termed, "speeched." The spokes of the wheel are then marked off with a cutting gauge fixed on the edge of the face-stick. The marks made by this gauge indicate the place of

FIG. 1

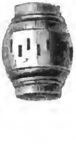


FIG. 2.

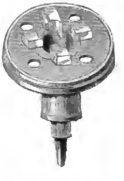
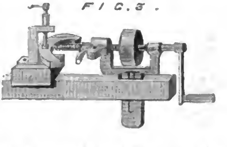


FIG. 3.



the shoulders on which the felloes rest for forming the rim of the wheel. The felloes are each bored with two round holes to receive two spokes, which have been shouldered down with what is termed a "tanging" tool (Fig. 2), which is often used in an ordinary full-sized brace. The tang of a spoke is otherwise the tenon of the spoke, which may be either round, oval, square, or "double-shouldered." The round "tang" is practically the best, and it is made about 1¼in. diameter to fit into holes slightly smaller, bored through the felloes with an ordinary screw-auger or boring machine (Fig. 3). The framing of the felloes on to the "tangs" of the spokes is one of the most essential and critical parts of wheel-making, and the operation for which the most costly machinery is manufactured in England and America, on such defective principles of mechanical construction, that it is the cause of the failure of many machine-made wheels. This will be obvious on reference to the illustration (Fig. 4), which shews a wheel with the spokes, the tangs of which, A, are shown to be cut at right angles with the vertical face of the wheel, thus weakening the "tang" by cutting obliquely across the grain of the wood, and placing the "tang" so that its line of resistance is altered from an end to an oblique side thrust, which is often the cause of the "tang" breaking off. Fig. 4, B, shows the upper spoke of a wheel with the "tang" of the spoke cut so as to resist the lateral thrust to which it is subjected during the wear of the wheel, and it has the whole strength of the wood unimpaired.

FIG. 4.

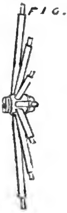
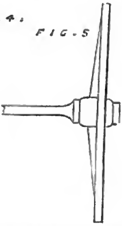


FIG. 5



The felloes are laid upon the spokes of the "speeched" wheel, and their joints fitted to each other, forming a circle, but every joint must be an eighth of an inch more open on the outer than the inner circumference of the felloe rim. To prevent the joints of the felloes from slipping sideways, a ⅝in. hole is bored 2in. deep into the end of each felloe, and a well-fitting, smooth, oak pin, called the "dowell," is driven into the end of one felloe and gradually into the hole in the next felloe, and thus every felloe joint is keyed together by a dowell. The ends of the "tangs" of the spokes which project through the holes made in the felloes are then cut off flush, and a chisel driven into the end of each "tang," splitting it open for receiving a wedge of wood, which, when securely driven in, fixes the felloes to the spokes. The felloes are then faced off ¼in. narrower on the front, at the outer edge, and ⅛in. at the back to suit the tire, which is mostly ⅜in. narrower than the felloe at its base. The inner curves of the felloes are then rounded off with the draw-knife and spoke-shave. Planing off the "sole" of the wheel is the next job. The learner must bear in mind that his wheel must not yet be a true circle, as each felloe is a segment of a slightly larger circle than a finished wheel, which makes the felloe rim an eighth of an inch higher at each joint, nor must every felloe rim-joint fit close to the next one, but a space of at least a ¼in. is allowed at some one of the joints for the purpose of the tire bonding the felloes on to the spokes, and making the wheel a true circle. The reason for this will be explained by the operation of tireing the wheel, which is done expeditiously by a special workman called a tire-smith.

A straight bar of iron, 1¾in. by ½in., is passed between three strongly-set rollers; the winding round of one draws the iron into a curve against the other two: or, in the absence of this machine, the tire is hammered over a hollow block of iron till a circle is formed. The ends of the iron are up-set, and "scarfed" and welded together.

To put the tire on thus would be wrong, although it is done by many coach-makers. The wheel being a cone, its edge has to be planed square with the felloe bearing on the ground, not square with the plane of the face of the wheel. Fig. 5 will show a wheel with a cylindrical tire, which bears only on the ground on the front edge of the tire, and racks the wheel at all its joints in going over rough roads.

Therefore, the tire should be coned to suit the "disch" of the wheel. This is done very simply by holding the tire on the anvil, and with a sledge-hammer beating on the inside of one edge, just as a barrel-hoop is stretched larger on one edge.

The tire is made ¼in. less diameter than the wheel; but when red-hot is ½in. more diameter, so that it drops on the wheels easily when it is fixed on a shoeing platform. These platforms are sometimes made to sink into a shallow well of water; but the hot tire may be quenched by two or three cans of water being kept pouring over it till it is cool. The sole or flat part of the tire has to be tapped with a heavy hammer, to send home every joint as the tire is shrinking, and bracing every part of the wheel together.

The final operation is drilling the taper holes in the tires and riveting-up with taper rivets and burrs on the inside rim of the felloes.

A well-made wheel will want but little dressing-off at the joints.

Being finished, to fix the "boxes," or "bush," of the axle in the hubs, is a work requiring care, to make the wheels spin true.

The middle of the hub is gouged out a little larger than the "box," and it dropped in its place; a thin chisel, 1¼in. wide, is driven into the hub at the back, about ¼in. from the box in six places, and thin oak wedges are driven down a little way; then the wheel is spun on the axle, and the hub is trued, and tire-edge at the same time, by driving home the wedges till the wheel spins truly. The front of the hub is served the same way, and a slight recess cut for the brass oil-cap in front. The wood and ironwork of the dog-cart is now completely finished for the painter and trimmer to decorate and furnish with paint and lining.

IMPROVEMENTS IN ETCHING ON GLASS.

IN Vol. XXXI., page 56, we gave a translation of an article by Dr. W. Gruene, of Berlin, describing an improved process of etching on glass, in relief or opaque. The process has been recently patented in this country by Mr. E. C. Hancock, of Worcester, as a communication from Dr. W. Gruene, of Berlin, on whose behalf protection is claimed for the direct result of a matted pattern by the corrosion of fluoric acid, and the process of vitreous etching described as follows:—Aqueous fluoric acid dissolves glass without exercising a visible influence upon the remaining surface, leaving it approximately bright. Profiting by this peculiarity in its corroding power, the inventor uses materials which have before been thought comparatively useless in consequence of their feeble resisting capacity. These substances if placed upon glass in very thin layers, and even dried and hard, will yield in a few seconds to a solution of fluoric acid in water if the solution is concentrated. Being simply used for the above purpose, very faintly marked, and bright results will be seen, but if powdered when placed upon the surface of the glass with very finely divided metal, copal, or other substances, resisting the action of the acid for a longer time, and allowing them to dry on after treating them with the acid, there is obtained at once a more or less matted result. The practical advantage of this invention is that the corrosive action being very quickly performed, those parts of the pattern required to be bright need not be covered by any resists whatever. Only feebly resisting substances being required, which would be useless for the ordinary method of procedure, not only all the well-known methods of drawing with a brush, pen, stylus, &c., can be used for putting the drawing on, but impressions by all available methods of mechanical printing, typography, lithography, glass, zinc and copper-plate printing, &c., as well as elastic stamping. Dr. Gruene takes advantage of thin and thick resists, using sometimes fine and coarse materials for powdering, obtaining thereby a matted appearance of different density or grain. In a drawing one can therefore obtain different and variegated shading by the simple use of various materials in the same drawing. In describing the *modus operandi*, he divides the process into two parts, firstly, the simple process by which a matted pattern or drawing is put upon the glass; and secondly, the double process, by which a bright pattern may be reserved upon the glass, the ground-work of the glass being matted or deadened.

Simple Process.—First, I put the drawing upon the object, either by hand, transfer, or direct printing, with almost any oil or varnish mixed with a little colour to render it visible. I then powder it by means of a brush or a tuft of cotton-wool, or in other suitable manner with pulverised metal, copal, or such similar substances. I find what is commercially known as "bronze powder" very suitable for the purpose. After having dried it, I dip it into fluoric acid, or that may also be put on with a brush, if desirable. After a few seconds the powder begins to shale off. I then wash it in water. It is not necessary to remove the greasy printing colour; the fluoric acid destroying it, it comes off in the water.

Double Process.—First, I paint, draw, or print the pattern in a material resisting fluoric acid, such materials being well known. When dry I oil over the whole surface by means of an ordinary printer's composition roller, with a greasy printing colour or oil varnish, powder; treat with acid and wash, as described in the simple process. I then remove the resist pattern, either with an alkaline solution, benzine, alcohol, or like solvent. Instead of applying the acid as a bath, or by a brush, I apply it in the form of fine spray. A very important feature of the invention is, that whereas other patterns or designs in vitreous etching are depressed below the surface, the "deadened" or "matted" portion produced by the above process is raised above the surface. The powdered materials allow the acid to flow between the particles, thus leaving a series of minute spots or holes between each particle, caused by the acid directly attacking the minute uncovered portions, and indirectly attacking the particles forming the resist (leaving them deadened) and thus a series of minute and imperceptible holes or depressions produce the deadened effect. The pattern may be be arranged to be bright and incised, while the ground-work is dead and intaglio; or the pattern may be in intaglio, and the ground-work bright and incised.

SIMPLE PROCESS IN QUANTITATIVE CHEMICAL ANALYSIS.

FILTRATION.—To separate precipitates we have recourse to filtration. This is done by passing the fluid containing the precipitate through filtering paper: the liquid passes freely, while the insoluble matter is retained. Swedish filtering paper, cut in circular form, is the best and most convenient. To prepare such paper for filtering, a single sheet is taken and folded, first, across the centre, then with another fold making a quadrant. By opening one of the outside folds a cone is formed, which should fit exactly into the funnel, without quite reaching to the top (see Figs, 3 and 4.) The beaker placed underneath the funnel in the

FIG. 2.

FIG 3

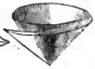


FIG. 4.

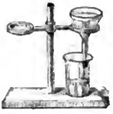
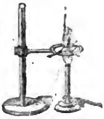


FIG. 6.



filtering stand should be so adjusted, that the end of the funnel comes in contact with its side: the liquid will then flow quietly during filtration without spurting. Before commencing to filter it is usual to allow the precipitate to subside a little, then taking up the basin in the left hand, and a stirring-rod in the other, hold the lip of the dish over the funnel, at the same time placing the stirring-rod in an upright position against it; cause the fluid to run down the stirring-rod into the filter, directing the stream against the thick side, not into the bottom, or a hole might be made in the paper. Of course it is absolutely essential that there should not be the slightest loss—the particles adhering to the rod must be washed off into the filter, likewise the remaining portions of the precipitate at the bottom of the basin, by means of the washing bottle. Do not allow the precipitate to quite fill the filter. Sometimes precipitates are in so fine a state of division that they partially pass through the pores of the paper. When this occurs, the first portions of the filtrate can be returned to the filter until it passes through perfectly clear. Before commencing to filter moisten the paper in the funnel with water.

Washing. — Decantation. — All extraneous soluble matter must be separated from the precipitate by washing. After allowing the bulk of the fluid to drain through the filter, by a gentle stream of hot water from the washing bottle, detach the precipitate round the upper edge of the filter until it collects in the bottom; more water is then passed through, and continued till the washings are entirely free of the substance which is being washed out. Precipitates which fall readily to the bottom of the vessel may be partially washed, previous to filtration, by decantation; the supernatant clear liquid is poured off carefully without disturbing the sediment; water is added; again allowed to subside, and poured off, and so on as often as necessary.

Ignition.—After the process of washing is complete the filter and contents should be dried before ignition, by placing them, along with the funnel, in the water-oven; or simply allowing them to remain on the filter stand, covered with a piece of porous paper as a protection from dust, until quite dry, or nearly so: the precipitate is then ready for burning. A platinum crucible is best for this purpose; but, with care, a piece of platinum foil, with the sides turned up, forming a small tray about 2in. square, as in Fig. 5, will be found very suitable in most cases. The filter with the precipitate is folded, laid in the centre of the foil, and the whole placed on a wire triangle, and supported over the flame of a Bunsen lamp, till the paper is entirely consumed, Fig. 6. When the substance suffers change by burning with carbonaceous matter, it must first be separated from the paper and the paper burned afterwards. A sheet of smooth paper is spread upon the table, and on this is placed the platinum crucible or foil, then, by very gentle friction applied to the sides, as much as possible of the precipitate is detached from the filter and transferred to the crucible. When this is accomplished, the filter is rolled up, a piece of platinum wire twisted round it, and, by that means, held and incinerated in such a way over the crucible, that the ash may drop into it; any particles left on the sheet of paper are likewise carefully removed into the crucible. When the precipitate has been ignited on platinum foil, it should be weighed in a tared watch-glass. If a crucible has been employed, they may be weighed together, and the weight of the crucible deducted.

Evaporation.—It sometimes becomes necessary to reduce the bulk of a liquid; this is effected by evaporation, either in glass or porcelain, over the flame of the lamp, or on the sand-bath. Actual ebullition should be avoided as much as possible, since it occasions loss by portions being projected over the sides of the vessel.

I think I have new given sufficient instructions in manipulation to enable the student to commence an exercise in analysis, and will proceed to describe a process for the estimation of calcium.

It will be advisable to repeat each exercise until the results agree.

The weights and results should be entered in a book.

Distilled water must always be used in analysis, and making the various solutions.

Estimation of Calcium.

Weigh accurately in a tared watch-glass one gram of white marble or chalk, which has been previously ground to a fine powder in the mortar, transfer to a porcelain basin holding about 10oz., add 50 cubic centimetres of water, then drop in cautiously hydrochloric acid till all effervescence ceases; stir it round with stirring-rod, and heat gently to boiling, either on the sand-bath or over the reduced flame of a rose burner. Prepare a filter, then filter the solution into a beaker, and wash with boiling water by means of the washing bottle. Pour the filtrate into a clean porcelain basin, wash out dregs from beaker; then add a solution of about 1·5gram of ammonium oxalate, and thereafter ammonia till the liquid smells of it; heat gently to boiling; then filter cautiously and wash the precipitate well with boiling water. Dry the filter and contents in the water-oven, and ignite on platinum foil or crucible, *at a low red heat*. A higher temperature tends to decompose the calcium carbonate, of which the precipitate now consists, into caustic lime. As a safeguard it will be well when it is completely incinerated to withdraw the lamp and moisten the precipitate while yet on the platinum with a few drops of ammonium carbonate dropped from a pipette or the end of a stirring-rod, and reheating at a low temperature. After allowing time to cool, cautiously transfer the platinum foil with the precipitate to a small flat plate, cover with an inverted beaker, convey to the balance and weigh. The weight represents the amount of calcium carbonate in one gram of the sample. From this datum the percentage of calcium (lime) is easily calculated. 100 parts of calcium carbonate ($CaCO_3$) represent 56 of lime (CaO).

Note.—It must not be forgotten that filtering-paper leaves traces of ash (about ·5 per cent.) when burnt. Before using any for the purpose of analysis, the quantity of ash which a given weight of it affords should be ascertained. In each analytical experiment the weight of the filter employed being approximately known, it is easy to estimate the amount of ash which it would yield, and to deduct this from the gross weight of the precipitate.

Esthos.

THE SCREW-GAUGE COMMITTEE.

THE preliminary report of the committee appointed by the British Association in 1881 to determine the best gauge to use for the manufacture of small screws has been printed, and those interested will have now the exact state of the question before them. As we stated on p. 10, the committee, at its request, was reconstituted at the last meeting of the British Association, and granted a sum of £20 for the construction of some gauges. From several letters which have appeared in our columns, it will be seen that the question of a uniform gauge for screws is of great importance to the manufacturing world; but although it is more than 40 years since Sir Joseph Whitworth first made known his system, it is unfortunately a fact that, so far as screws smaller than a quarter of an inch in diameter are concerned, the threads and pitches vary almost as much as the size of the buildings in which they are made. Perhaps some of this diversity is due to the fact that there is no uniform wire-gauge; but as there is a possibility that a standard for wires will be adopted shortly (the development of electricity rendering it more than ever necessary), a good opportunity will be afforded for also bringing about a standard gauge for small screws. The subject was brought before the British Association in 1881 by Mr. W. H. Preece, who pointed out that, although the Whitworth gauge is almost invariably adopted for bolts and screws used in mill-work and engineering, no general system has been applied to the smaller screws used in clockwork, philosophical instruments, or the now numerous electrical appliances. In fact, he said, gauges and screw-plates almost equal in number the makers engaged in the trade. An instance was brought under the notice of the committee in which a manufacturer had to execute an order for a number of railway signal appliances to three sample instruments, which contained between them twenty-one screws of different threads, not one of which matched the tools in the manufacturer's shop. There is, in fact, no recognised form of thread, no specified number of threads per inch, and the consequence is, great inconvenience in making repairs, which, of necessity, are more costly, and, as a rule, less efficient than they would be if a standard gauge were adopted by all manufacturers. The employment of some consistent and uniform system would facilitate the construction of apparatus, would render repairs easier, speedier, and cheaper, and would reduce the expense of equipping workshops with a needless array of rather expensive tools. That proposition does not admit of dispute, and the question is, What shall the system be? So far, the British Association Committee has been unable to do more than recommend that the unit of length should be the "mil" (that is the thousandth of an inch), while the decimal system should be adopted to express dimensions; and that the form of thread should be the Whitworth, not only because it is well known, but because experience has shown that it is unsurpassed. The committee, however, are not unanimous on all points, and would be influenced doubtless by the opinions of those directly interested in the question; hence, manufacturers and others should make their views known as soon as possible. Some little time ago the Society of Arts of Geneva took up the question, and issued a report in 1878, in which, having determined the mathematical equations to curves that most closely corresponded with the ratios of diameter to pitch found in practice, they adopted the set which most nearly represented the mean average proportions of the screws in various shops and in different countries. The Swiss committee took 1mm. pitch as the basis of their system. It was agreed that such a pitch was best adapted to a screw having a diameter of 6mm. The form of thread adopted was triangular, the angle being 47½°; the depth was three-fifths of the pitch, the top being rounded off by a radius of one-sixth, and the bottom by a radius of one-fifth of the pitch. The report contains a table of Swiss screws, giving the pitch and diameter in millimetres and mils, with the number of threads per inch, from No. 25 to 0. Each pitch of the series is nine-tenths of that which succeeds it: thus, No. 0 is 1mm., No. 1, 0·90mm., No. 2, 0·81mm., and so on. The Swiss system is very complete, but there are reasons which prevent the committee from recommending its adoption in its entirety. The committee point out that the slowness with which Sir Joseph Whitworth's system was adopted was probably due to the fact that it was put forward by an individual, and as an instance of the power of an association to secure immediate and universal attention, they mention the reception accorded to the system of units of electrical measurements sanctioned by the British Association: they express the hope that a similar result may follow their recommendations in respect to screw-gauges. The cases are not altogether on all fours, for where a manufacturing firm has a series of taps and dies suited to the work they turn out, there is little inducement for them to throw them on the scrap-heap, whereas they can alter their price lists with a stroke of the pen. Nevertheless, we believe that if the committee of the British Association, which numbers amongst its members, Sir J. Whitworth, Dr. Siemens, Mr. Stroh, Mr. Beck, Mr. Preece, and Mr. Latimer Clark, recommend a gauge which hangs together as well as the Swiss gauge, there can be little doubt that it will be only a matter of time for it to become universal throughout this country, and amongst those Continental machinists who are in the habit of copying the works of our engineers. The metrical system was not recommended because the manufacturing interests are wedded to the British inch, its multiples, and sub-multiples, and the committee thought it would be unwise to adopt a system which might jeopardise the introduction of that with which they are more immediately concerned—a uniform screw-thread.

FLEXIBLE WINDOWS FOR DARK TENT.*

MY invention—for, although there is not much in it that is actually new, I think I am justified in calling it an invention—is one which may be of very little use to professional photographers or to those amateurs who are possessed of plenty of means, and who can therefore easily procure lots of double dark slides or such a camera as that shown by our friend Mr. Wane at a recent meeting; but to amateurs, like myself, of limited means, fond of the art, and pursuing knowledge under difficulties, I think it may prove to be of some service. It is a window for a changing tent for open-air work, and I make it thus:—On a well-polished plate of glass I pour a film of plain collodion. While this is drying I dissolve twenty-five grains of gelatine, and four grains of bichromate of potassium in one ounce of water. Then I dissolve four grains of nitrate of silver in half an ounce of water, and mix the two solutions. This forms a dark red emulsion, which I filter to expel air-bubbles. I then warm the collodionised plate and pour on sufficient emulsion to form a film of the tint required, and set it aside to dry. When dry, I put over it another film of plain gelatine to strengthen and protect it. I show you the result. In its present state it would not stand much rough usage, and I therefore mount the window so made, on thin Turkey cotton with gelatine, and give it a coat of copal varnish, after which I fasten it in its place in the dark tent. I show you my completed window. As I have said, there is nothing new in any part of it; all the novelty I claim is the utilisation and combination of other men's ideas, and applying these to the object in view. My window has one thing to recommend it—it fulfils all the conditions necessary in an article of the kind. It is non-actinic—as perfectly non-actinic as anything short of total darkness can well be. I have exposed exceedingly sensitive plates under it to the full glare of the sun—of course for as short a time as possible—without a trace of fog. It admits quite sufficient light to enable the operator to change his plates. I show you a few prints from negatives changed in the light transmitted through such a window. It is cheap: the whole thing can be made for less than twopence. It is easily made: every one who dabbles in photography has the whole of the ingredients and apparatus at his hand, and the process is simple. It is perfectly flexible: it may be rolled up or folded with the tent in any way the operator chooses; and practically, with ordinary usage, it it indestructible. Light only improves it by rendering it more and more insoluble. It is waterproof: I had to take shelter under my tent once in a thunder-storm, and had to roll it up wet after the shower was over; it remained so rolled up all night, and was only thoroughly dried when I got home two days afterwards, and it is not a bit the worse. Indeed, the window in my dark tent, after one month's constant use, and pretty hard usage, too, is as good as on the day I put it in.

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* By A. B. Stewart, communicated to the Edinburgh Photographic Society.

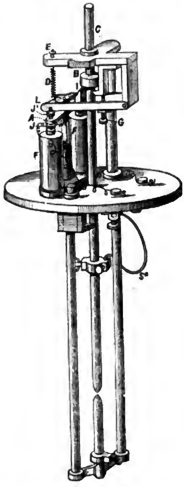
THE "LEVER" ARC LAMP.

THERE are a large number of arc lamps already in the market, each, of course, claiming certain merits of its own; but there is one to be seen in the Tropical Department of the Crystal Palace which attracts attention from its simplicity. The "Lever" arc lamp (patented by C. Lever, of Bowdon, Cheshire) differs from all others in several important particulars. In most lamps it is usual to have an electro-magnet or solenoid in circuit with the carbon points to separate them, thus forming the arc; and also a shunt electro-magnet, or solenoid, to regulate the arc in each lamp when several lamps are worked on a single circuit, technically called a "series." This is true of the "Brush," "Weston," and other well-known systems." One of the advantages of the "Lever" arc lamp is that it dispenses altogether with one of those magnets—the one technically termed the "main," and is regulated solely by the shunt magnet or solenoid.

This system claims superiority on the grounds of simplicity, reliability, steadiness, and regularity. It is also more economical as regards the current, since it does away with the useless resistance of the main magnet, or solenoid; hence a greater number of "Lever" lamps can be worked in single circuit by the same current than any of the ordinary type. Instead of allowing the carbon points to come into contact with each other before the electric current is sent through the lamp, as is usually the case, the process is reversed in the "Lever" lamp, and the carbons are separated from each other by means of a spring acting on a lever, which tilts a metal collar encircling the carbon holder, and thus raises the carbon to form the arc. A small bar of iron, having two iron screws passing through it, with large flat heads for the purpose of adjustment, is also fixed to the lever, and underneath this bar of iron, or armature as it is called, are the poles of the shunt electro-magnet. So simple is the construction that it can be made at a price from 25 to 30 per cent. below any other arc lamp now in the market.

In the illustration:—A is the armature, L the lever, D the spring, E is the nut for adjusting the tension of the spring D, and I is a projection attached to the lever L, which cants or tilts the clip B by means of spring D; G is the set screw for adjusting the length of arc. The iron screws J J, with large heads passing through the armature A, serve as adjustable pole-pieces, and can be secured by means of lock-nuts J^1 J^1; R is the dash-pot, and S S^1 are the binding-screws from which the electro-magnet F F is shunted or derived. The current entering at the positive binding-screw S passes through the insulated flexible wire or cable S^2 to the upper carbon holder C, from thence through the arc and lower carbon and through the frame of the lamp to negative binding-screw S^1. The side rods are insulated from each other, and the ends of the coils of the electro-magnet F F are connected to the binding-screws S S^1 thus placing the electro-magnet F in derivation from the arc.

The action of the lamp is as follows: The carbons in the lamp being separated, the only path for the electric current is through the coils of fine wire on the shunt electro-magnet, and as the entire current will flow through these coils the magnet will become very powerful and will attract the iron bar. When this takes place, the carbons come into contact with each other; for the lever will allow the metal collar to loosen the carbon holder, which slides through its bearings by gravity. The contact of the carbons, however, completes what is technically called the main circuit—i.e., it allows the current to pass through them, the proportion of the current in the two circuits (the main and the shunt) being inversely proportional to their resistance. But the coils on the shunt electro-magnet being wound with very fine wire, the resistance of the shunt circuit is much greater than the resistance of the main circuit through the carbons, so that nearly all the current goes through the carbons and very little through the shunt circuit. This causes the electro-magnet to lose nearly all its magnetism, whereupon the spring again pulls up the lever, and with it the carbon-rod, thus forming the arc. This action takes place almost instantaneously. When the carbons burn away, the distance between them becomes greater, or in other words, the resistance in the main circuit is increased. This causes more current to pass through the shunt electro-magnet, which, becoming stronger, again attracts the armature and lowers the carbon-rod. In practice, it is found that there is scarcely any perceptible motion of the lever when the arc is burning, for the shunt electro-magnet and the spring acting on the lever in opposite directions to each other make a perfect balance, or, in other words, establish an equilibrium resulting in a steady and regular light. It is this balancing of the antagonistic forces of the spring and the shunt electro-magnet on the lever and causing it to alter the position of the carbon points by means of the metal collar, which constitutes one of the peculiarities of the "Lever" lamp. Other methods of obtaining this result, without the use of the metal collar, are also claimed.



There is yet another important feature in connection with the working of the "Lever" lamp. Continuous-current dynamo machines—i.e., machines which always generate currents in one direction, are very much more economical than alternating-current dynamo machines, besides costing very much less to make—for the latter require a separate dynamo to excite their magnets. With the "Lever" lamp the cheapest and simplest form of continuous-current dynamo can be used, and in order that the machine may excite itself, although the resistance in the main circuit is too great for it to do so through that resistance when the carbons are separated, a simple electro-magnetic switch at the machine permits of its doing this in the following manner: Connected to the terminals or binding screws of the dynamo machine are the ends of two coils of wire, which are wound over the limbs of a horseshoe electro-magnet to a metal stud fixed on a board, which by means of a spring contact moving through an armature capable of rotating a short distance opposite to the poles of the electro-magnet on a pivot, allows the dynamo machine to excite itself through the coils on the electro-magnet. Now, when the dynamo machine has excited itself and is ready to supply the current, the electro-magnet, becoming magnetised, attracts its armature, causing the contact-piece to leave the metal stud and thus to break the current formed by its coils. Immediately this takes place the current goes through the shunt electro-magnets on the lamps—that is, when there are a number in series or single circuit—and causes them to form their arcs as already explained. Instead, therefore, of having an electro-magnet or solenoid in each lamp to form the arc, in the "Lever" system, there is only one electro-magnet to form the arcs for any number of lamps that a dynamo machine will work.

LATHE SPINDLES.[*]

ENDEAVOURS have been recently made to show the importance of using the *anvil*-principle rather than the *fiddle*-principle in designing machine tools. This applies with especial pertinence to engine-lathes, but the average lathe of to-day is found wanting not only in respect to the *inertia* of its parts, but in their actual *size* and *strength* to resist deflection. This is particularly the case in regard to their spindles, both "live" and "dead." As the dead-spindle slides in its bearing it must of course be parallel in form; of its size it is enough to say that it should be very much larger in diameter than usually made. There is no possible objection to this, except the expense of a few dimes' worth of extra metal. The increased size does not increase the friction in proportion thereto, as in the case of revolving shafts, and it is not in a position to be in the way of the lathe-carriage or, most generally, of the tool or the work. In special cases, where the "tool-support" requires to be set high and unusually far in, any interference that may occur can be obviated by an extra long dead-centre. This latter would not be springy, because the large spindles here recommended presuppose, and allow for, extra large centres—both live and dead.

Regarding live-spindles, missionary work among which it is the especial function of this article to perform, it is only necessary to examine a few popular varieties, with the aid of a pair of calipers, to have a horrible suspicion creep over one that their designers were, at particular times in their lives, afflicted with fits of temporary idiocy. The exceeding smallness of spindles may perhaps be considered a matter of inherited tendencies and of vicious example, from the fact that all designers make them in this respect nearly alike. The shape of them—that is, the relative diameters at different parts—varies so much with different makers that we are compelled in many cases to fall back upon the first mentioned hypothesis. If spindles were made enormously large, with a good deal of the anvil principle embodied, there would be such an excess of stiffness and strength that the exact proportions would be of little importance. As long, however, as they continue to be made with the present elegant slimness, would it not be well to let them give a hint at the ordinary laws which govern the construction of all levers and beams?

The principal strains developed in using a lathe spindle are transverse and torsional; the tensile, compressive and shearing stress being very slight. To resist torsion alone, a shaft should, of course, be parallel; but to meet the severe tranverse strains brought to bear upon the right hand end of a lathe spindle its theoretical axial section should be something like Fig. 1 in the accompanying drawings. This is of parabolic form, and is the shape a projecting beam should be, when fixed at the points A and B, to resist pressure, in a direction perpendicular to its axis, at the point C. The diameters shown are exaggerated, and are not in proportion to the lengths.

Fig. 2 represents a practical profile for a spindle that conforms as nearly as convenient to the dotted line, which is a fac-simile of Fig. 1. It will be noticed that no part of the profile is within the dotted line, and consequently the deflection at any of the three or four weaker points will be about equal.

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[*] By Oberlin Smith, in *American Machinist*.

In Fig. 3 is shown a type of spindle, used by a prominent lathe manufacturer, wherein the prevailing idea seems to be to avoid making a collar for the chuck to abut against, and to get a shoulder for the same by reducing the diameter of the screw, thereby weakening the whole structure at the point *d*.

In Fig. 4 is shown a more common fault, where the whole journal is reduced, and the weakest point is at *e*. This is a worse error than that shown in Fig. 3, as not only is the deflection of the chuck greater (on account of the leverage) but the bending of the journal within itself causes it to wear its boxes out of parallel, and thus make matters still worse by lack of a continuous bearing surface.

Another faulty design is shown in Fig 5, where the weak point is at *f*, just to the left of the large journal. This seems to have less reason for its being than either of the others, though perhaps it is apt to be the occasion of less harm. Proceeding still further to the left, to the small journal and adjacent parts, we rarely find the diameters much out of proportion—in fact, the size here is of comparatively little importance, on account of its being at the long end of the lever, whose fulcrum is at B.

Two of the above located faults are sometimes found combined in one spindle, which, of course, only adds somewhat to the degree of idiocy displayed. The writer has before him a sketch taken from the spindle of a beautifully finished and rather massive-looking nineteen inch lathe which was recently made by a house of high reputation, located not more than a thousand miles from a central city of Massachusetts. This spindle shows in a marked degree the faults delineated in both Figs. 4 and 5. The large journal is smaller than the screw, and is but 2⅝in. in diameter, while the size at *f* is only 1⅞in. The hub of the main gear wheel, which is keyed on at *f*, is unusually large, as is also the collar at *g*. Surrounding this wasp-like journal are enormously large and heavy brass boxes, the diameter of whose flanges is 5¾! The outside effect of all this was, as before remarked, massive, and the illusion was dispelled only when the thing was taken apart.

As in a murder trial (in the few cases where the prisoner is not evidently, and to the happy satisfaction of all sides in the case, idiotic or insane) a strong point with the prosecution is to show a *motive*, so we may ask regarding this murder of strength and rigidity in an otherwise very strong lathe: What was the motive? Even if the reputation of the maker did not leave such a suspicion out of the question, we could hardly attribute this construction to a desire to make a good show upon the outside and save the cost of metal within. An extra half-inch or so in the diameter of the spindle would not have cost much, if any, more than would have been saved by a larger bore in the iron and brass surrounding it: the outside dimensions of which were, as before stated, abundantly large. The saving could, at the most, have been but a fraction of a dollar, a very insignificant motive upon a five hundred dollar machine—as any engineering jury would undoubtedly "agree to believe." Shall we be obliged to fall back upon the unpleasant hypothesis hinted at in the second paragraph?

Another spindle worth describing (if not using) was made in a city not unknown in the State of Connecticut, by a prominent manufacturer, and belongs to a heavy-looking twenty-two inch lathe. The extreme diameter of the screw is 2¼in., of the large journal 2⅜in., and of the adjacent part, where the gear goes, 2 1/16in. This is of course weakest, as shown at *d*, Fig. 3, although it has a good-sized collar for the chuck to rest against. It is, however, chiefly noticeable for being much too small all over.

Joking aside, the true reason for the universal slimness of lathe spindles seems to be that the modern engine lathe has been evolved by a slow process of development, from an ancestor whose spindle was slim for a purpose—the ordinary hand lathe. This machine (which, in its turn, had descended from the prehistoric potter's wheel, with still less reason for a large spindle) could not well be run by foot power, at the high speed used, without reducing the friction in every possible way; and, of course, a small spindle was one of the most obvious means. Then, too, a large spindle was unnecessary, as the cuts were light and the work usually of a material softer than iron. That a development of "bigness" has not made more progress is because it has not chanced that any radical engineering mind has attacked the subject *de novo*, regardless of precedent. Probably one reason that our planers, milling machines, and some other modern tools are capable of taking heavier cuts than our lathes, is just because they *have no* ancestry to speak of, either flimsy or otherwise.

The evil of small spindles is, of course, not so great for centred work as it is for chuck work; but, as the latter has frequently to be performed by all ordinary lathes, it is from this standpoint that we must view them. A most convincing exhibit of his fallacies might be made to an advocate of small spindles by mounting the table of a small planer (say, 20in. wide) upon two vertical studs a few inches long, and of about the average diameter of a 20in. lathe spindle, inserted into each end of another table fitted to slide in the "vees" in the usual manner. Does any one suppose that heavy cuts could be taken upon such a contrivance? Yet the lathe-makers, with a *naïveté* which would be comical if 'twere not so sad, go on writing in their circulars about their "front spindle bearings" being so and so—usually naming some diameter very considerably less than 3in. for 20in. lathe.

Quite pertinent to this subject is a little incident recently related to the writer by a gentleman prominent in engineering circles, who, it may be said, is chiefly engaged in *rectilinear* pursuits. He had occasion to write to a well-known maker regarding a lathe (28in. or 30in., if I remember rightly) that he thought of purchasing. In the answer that he received, especial attention was called to the very large spindle bearing, which was, I think, 3¼in. in diameter by 10in. long. His reply was that, if it could be made 10in. in diameter by 3¼in. long, he would take it—otherwise not!

A natural principle to follow in determining the proper diameter for a spindle would be to let the bearing surface be about as far out from the axis as the tool—that is, let it have the same surface speed. That there would be no undue friction is shown in the familiar cases of plainers, shapers, and slotters, where the friction is at precisely the same speed as the cutting; or in drill presses, and sometimes in milling-machines, where it is at a greater speed. This principle is also used in certain boring mills where the table is lowered, so as to have a bearing under its outer edge, upon occasion of doing work of large diameter. Reducing a lathe spindle to lessen the friction is exactly upon a par with putting rollers under a planer table, on the plea that the bearing surface moves too fast.

Fig. 1

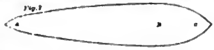


Fig. 2

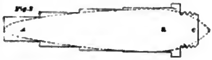


Fig. 3

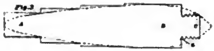


Fig. 4

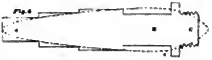
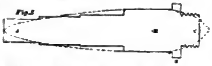


Fig. 5



Just here properly comes in the question, what is *the* size of work done in a lathe which has from eight to twelve changes of speed and which turns anything from ¼in. to 20in.? The answer is that here, as almost everywhere in machine design, there must be *compromise*. We must put up with too light a spindle for the work at the large end of the series, and with too great a bearing speed (and consequent friction) at the small end.

From the above we reason that if a lathe was to do all chuck-work, and if there was about as much large work as small, a very good rule would be to make the diameter of the right-hand spindle bearing equal to one-half the "swing" of the lathe. As, however, the majority of the lathes do a good deal of centred work, and perhaps more small than large chuck work, a further compromise would very properly reduce this proportion — perhaps in some cases to one-quarter the swing. It would undoubtedly be safe to work within the limits of the figures mentioned—making a 20in. lathe with a large journal 5, 6, 7, 8, 9 or 10in. in diameter, according to circumstances. The friction incident to such a large diameter would not count for both journals, as the left hand one may, on account of the leverage, be much smaller. A good rule would perhaps be to make it one-half the size of the large one. The length of the journals is also a matter of compromise. Probably three-eighths of the swing for the large and three-sixteenths for the small journal would be a safe rule.

If the writer were about to have a lathe designed to order for general work not knowing what particular kind would predominate, he would feel secure in striking an average between the sizes proposed, and would not object to sending in his specifications the following formulæ:

Let $D^1 = \frac{3s}{16}$; $D^2 = \frac{3s}{8}$; $L^1 = D^1$; $L^2 = D^2$ and $D^3 = D^1$; in which D^1 is diameter of left journal; D^2 of right journal; L^1 and L^2, lengths of the same, respectively; D^3 diameter of dead spindle in the tail stock; and s the swing of the lathe. Any modification that might be made in these figures should probably be in the direction of lengthening L^1. It should not be forgotten that an important incidental advantage of a large spindle is the opportunity to make it *hollow*, without practically weakening it—the metal removed lying immediately about the neutral axis.

Regarding material, there is probably nothing better than cast iron, both for spindle and boxes, *providing* they have such a great excess of strength (which is the case with the proposed diameters) as to be in no possible danger of fraction. Besides its inherent goodness, this metal possesses the valuable quality of cheapness; and if it is suitable for the bearings of all our planers and shapers, why is it not for our lathes?

The above views regarding cast iron were pleasantly corroborated on the occasion of a recent conversation upon Babbit-metal, brass &c., with one of New England's most eminent and experienced machine-tool manufacturers, when, the question being put, "Mr. ——, are there any better bearing surfaces than forged steel upon cast iron?" he replied: "Yes! cast iron upon cast iron; there's nothing equal to it."

In closing this appeal for a new departure in the direction of more efficiency and durability for that most noble and much-abused tool, the engine lathe, I wish to recall a question, and repeat it with a slight modification. Instead of asking who will make and who use a 20in. lathe with a 5in. spindle bearing, I will put it, who will do the same with a 7½in spindle? A prediction may as well be here recorded that within a score of years such a diameter will not be considered more out of proportion than 2¼in. is now.

ON A METHOD OF PHOTOGRAPHING THE SOLAR CORONA WITHOUT AN ECLIPSE.*

By William Huggins, D.C.L., LL.D., F.R.S.

PROBLEMS of the highest interest in the physics of our sun are connected, doubtless, with the varying forms which the coronal light is known to assume; but these would seem to admit of solution only on the condition of its being possible to study the corona continuously, and so to be able to confront its changes with the other variable phenomena which the sun presents. "Unless some means be found," says Professor C. A. Young, "for bringing out the structures round the sun, which are hidden by the glare of our atmosphere, the progress of our knowledge must be very slow, for the corona is visible only about eight days in a century, in the aggregate, and then only over narrow stripes on the earth's surface, and but from one to five minutes at a time by any one observer."†

The spectroscopic method of viewing the solar prominences fails, because a large part of the coronal light gives a continuous spectrum. The successful photograph of the spectrum of the corona taken in Egypt, with an instrument provided with a slit, under the superintendence of Professor Schuster during the solar eclipse of May 17, 1882, shows that the coronal light as a whole—that is, the part which gives a continuous spectrum, as well as the other part of the light which may be resolved into bright lines—is very strong in the region of the spectrum extending from about G to H. It appeared to me, therefore, very probable that by making exclusive use of this portion of the spectrum it might be possible under certain conditions, about to be described, to photograph the corona without an eclipse.

In the years 1866-68 I tried screens of coloured glasses and other absorptive media, by which I was able to isolate certain portions of the spectrum, with the hope of seeing directly, without the use of the prism, the solar prominences.‡ I was unsuccessful, for the reason that I was not able, by any glasses or other media, to isolate so very restricted a portion of the spectrum as is represented by a bright line. This cause of unsuitableness of this method for the prominences which give bright lines only, recommends it as very promising for the corona. If, by screens of coloured glass or other absorptive media, the region of the spectrum between G and H could be isolated, then the coronal light (which is here very strong) would have to contend only with a similar range of refrangibility of the light scattered from the terrestrial atmosphere. It appeared to me by no means improbable that under these conditions the corona would be able so far to hold its own against the atmospheric glare, that the parts of the sky immediately about the sun, where the corona was present, would be in a sensible degree brighter than the adjoining parts, where the atmospheric light alone was present. It was obvious, however, that in our climate and low down on the earth's surface, even with the aid of suitable screens, the addition of the coronal light behind would be able to increase, but in a very small degree, the illumination of the sky at those places where it was present. There was also a serious drawback from the circumstance that although this region of the spectrum falls just within the range of vision, the sensitiveness of the eye for very small differences of illumination in this region, near its limit of power, is much less than in more favourable parts of the spectrum—at least, such is the case with my own eyes. There was also another consideration of importance: the corona is an object of very complex form, and full of details depending on small differences of illumination, so that even if it could be glimpsed by the eye, it could scarcely be expected that observations of a sufficiently precise character could be made to permit of the detection of the more ordinary changes which are doubtlessly taking place in it.

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* Read before the Royal Society, Dec. 13, 1882.

† "The Sun," p. 239.

‡ *Monthly Notices*, Vol. XXVIII., p. 88, and Vol. XXIX., p. 4.

These considerations induced me not to attempt eye-observations, but from the first to use photography, which possesses extreme sensitiveness in the discrimination of minute differences of illumination, and also the enormous advantage of furnishing a permanent record from an instantaneous exposure of the most complex forms. I have satisfied myself by some laboratory experiments that under suitable conditions of exposure and development a photographic plate can be made to record minute differences of illumination existing in different parts of a bright object, such as a sheet of drawing-paper, which are so subtle as to be at the very limit of the power of recognition of a trained eye, and even, as it appeared to me, those which surpass that limit.

My first attempts at photographing the corona were made with photographic lenses; but uncertainty as to the state of correction of their chromatic aberration for this part of the spectrum, as well as some other probable sources of error which I wished to avoid, led me to make use of a reflecting telescope of the Newtonian form. The telescope is by Short, with speculum of 6in. diameter, and about 3½ft. focal length. A small photographic camera was fastened on the side of the telescope-tube, and the image of the sun, after reflection by the small plane speculum, was brought to focus on the ground-glass. The absorptive media were placed immediately in front of the sensitive film, as in that position they would produce the least optical disturbance. Before the end of the telescope was fixed a shutter of adjustable rapidity, which reduced the aperture to 2in. This was connected with the telescope-tube by a short tube of black velvet for the purpose of preventing vibrations from the moving shutter reaching the telescope. On account of the shortness of the exposures it was not necessary to give motion to the telescope.

It was now necessary to find an absorptive medium which would limit the light received by the plate to the portion of the spectrum from about G to H. There is a violet (pot) glass made, which practically does this. I had a number of pieces of this glass ground and polished on the surfaces. Three or four of these could be used together, castor-oil being placed between the pieces to diminish the reflection of light at their surfaces. Some inconvenience was found from small imperfections within the glass, and it would be desirable, in any future experiments, to have a larger supply of this glass, from which more perfect pieces might be selected.

In my later experiments I used a strong and newly-made solution of potassic permanganate, in a glass cell with carefully-polished sides. This may be considered as restricting the light to the desired range of wave-length, since light transmitted by this substance, in the less refrangible parts of the spectrum, does not affect the photographic plates.

Different times of exposure were given, from so short an exposure that the sun itself was rightly exposed, to much more prolonged exposures, in which not only the sun itself was photographically reversed, but also the part of the plates extending for a little distance from the sun's limb.

Gelatine plates were used, which were backed with a solution of asphaltum in benzole.

After some trials I satisfied myself that an appearance peculiarly coronal in its outline and character was to be seen in all the plates. I was, however, very desirous of trying some modifications of the method described, with the hope of obtaining a photographic image of the corona of greater distinctness, in consequence of being in more marked contrast with the atmospheric illumination.

Our climate is very unpropitious for such observations, as very few intervals, even of short duration, occur in which the atmospheric glare immediately about the sun is not very great. Under these circumstances I think it is advisable to describe the results I have obtained without further delay.

The investigation was commenced at the end of May of this year, and the photographs were obtained between June and September 28th.

The plates which were successful are 20 in number. In all these the coronal form appears to be present. This appearance does not consist simply of increased photographic action immediately about the sun, but of distinct coronal forms and rays admitting in the best plates of measurement and drawing from them. This agreement in plates taken on different days with different absorptive media interposed, and with the sun in different parts of the field, together with other necessary precautions observed, makes it evident that we have not to do with any instrumental effect.

The plates taken with very short exposures show the inner corona only, but its outline can be distinctly traced when the plates are examined under suitable illumination. When the exposure was increased, the inner corona was lost in the outer corona, which shows the distinctly curved rays and rifts peculiar to it.

In the plates which were exposed for a longer time, not only the sun, but the corona also, is photographically reversed, and in these plates, having the appearance of a positive, the white reversed portion of the corona is more readily distinguished and followed in its irregularly sinuous outline than is the case in those plates where the sun only is reversed, and the corona appears, as in a negative, dark.

Professor Stokes was kind enough to allow me to send the originals to Cambridge for his examination, and I have his permission to give the following words from a letter I received from him: "The appearance is certainly very corona-like, and I am disposed to think it probable that it is really due to the corona." Professor Stokes' opinion was founded on the appearances on the plates alone, without any knowledge of their orientation, and without the means of comparing them with the eclipse plates of May 17.

I have since been allowed, through the kindness of Captain Abney, to compare my plates with those taken of the corona in Egypt during the eclipse of May last. Though the corona is undergoing doubtless continual changes, there is reason to believe that the main features would not have suffered much alteration between May 17th and September 28th, when the last of my plates was taken. This comparison seems to leave no doubt that the object photographed on my plate is the corona. The more prominent features of the outer corona correspond in form and general orientation, and the inner corona, which is more uniform in height and definite in outline, is also very similar in my plates to its appearance in those taken during the eclipse.

Measures of the average height of the outer and of the inner corona, in relation to the diameter of the sun's image, are the same in the eclipse plates as they are in my plates taken here.

There remains little doubt that by the method described in this paper, under better conditions of climate, and especially at considerable elevations, the corona may be successfully photographed from day to day with a definiteness which would allow of the study of the changes which are doubtlessly always going on in it. By an adjustment of the times of exposure, the inner or the outer corona could be obtained as might be desired. It may be that by a somewhat greater restriction of the range of refrangibility of the light which is allowed to reach the plate, a still better result may be obtained.

Plates might be prepared sensitive to a limited range of light; but the rapid falling off of the coronal light about H would make it undesirable to endeavour to do without any absorptive screen. Lenses properly corrected might be employed, but my experience shows that excessive caution would have to be taken in respect of absolute cleanness of the surfaces and of some other points. There might be some advantage in intercepting the direct light of the sun itself by placing an opaque disc of the size of the sun's image upon the front surface of the absorptive screen. Though for the reasons I have already stated I did not attempt eye observations, there seems no reason why with suitable screens and under suitable atmospheric conditions, the corona should not be studied directly by the eye. There might be some advantages in supplementing the photographic records by direct eye observations. I regret that the very few occasions on which it has been possible to observe the sun has put it out of my power to make further experiments in these and some other obvious directions.

Postscript.—Received December 15, 1882.

I have Captain Abney's permission to add the following letter this day received from him:—"A careful examination of your series of sun-photographs, taken with absorbing media, convinces me that your claim to having secured photographs of the corona with an uneclipsed sun, is fully established. A comparison of your photographs with those obtained during the eclipse which took place in May last, shows not only that the general features are the same, but also that details, such as rifts and streamers, have the same position and form. If in your case the coronal appearances be due to instrumental causes, I take it that the eclipse photographs are equally untrustworthy, and that my lens and your reflector have the same optical defects. I think that evidence by means of photography of the existence of a corona at all is as clearly shown in the one case as in the other."—*Dec.* 15, 1882.

PLAGUES AND PESTILENCES.

At the meeting of the members of the Statistical Society, last week, Mr. Cornelius Walford, barrister-at-law, read a paper on the "Chronology of Plagues and Pestilences, as Affecting Human Animals and Vegetable Life." The causes, as collected from all sources, where specified, as judgments, abnormal condition of the air, arising from the introduction of extraneous matter or gases from space, such as meteorites, cosmic dust; dust and sulphurous gases ejected from active volcanoes, or released by earthquakes; noxious gases from decaying vegetable matter left after the subsidence of floods; effluvia from putrefying bodies uninterred during sieges and after battles; putrefying animal or other matter affecting the water supply, and exhalations from the soil. As predisposing causes were given want of food, change of climate in armies on the march, fatigue, fear, excessive luxury or debauchery, crowded and unhealthy dwellings, especially during wars; while as causes inducing famine, droughts, floods, and plagues of insects were specified. The view that plagues and pestilences are judgments dated from the earliest pagan times, and students of the classics will remember the plague supposed to have been caused in Attica by the gods as a punishment for the slaughter of a sacred bear; that in Thessaly by Apollo on account of disrespect shown; a plague at Sicyon caused by Apollo and Artemis for the same reason; and the plague in Samaria given in Josephus as the punishment of idolatry. In the "Iliad," Homer describes the plague which prostrated the Greek camp from the wrath of Apollo at an insult offered to Chryses, his high priest. A similar plague was inflicted by Apollo at Corina, on account of Hyppolatus killing his prophet. Delphi, we are told, suffered a plague and famine as punishment for the ill-treatment of Æsop. In Rome a dreadful plague raged, which the Sibylline books proved to have been caused by the incontinence of a vestal virgin, who strangled herself to avoid being buried alive. Scripture records recount five instances of plagues inflicted by God as direct punishment for discontent and murmurings amongst His chosen people. Coming to profane history, we learn, A.D. 665, over-population caused a dearth of food in Ireland, which prepared the people for a severe infliction of plague, which had broken out in England the year before. Rufini tells that us that the joy of the English at the victory of Cressy in 1347 and the surrender of Calais the year after induced such unbridled excess and debauchery that God, not permitting these disorders to go long unpunished, inflicted the plague, which, after traversing Asia and Europe, raged with such fury in London that 50,000 persons were buried in the churchyard of the Charterhouse alone. The belief in these direct judgments remained down to very modern times. That earthquakes are the more potent of the terrestrial causes of plagues and pestilences had the support of Scripture authority, notably in the 14th chapter of Zechariah and the 17th of St. Luke, verse 2. Thucydides mentions plague, associated with serious earthquakes, preventing the annual invasion of Attica, and the famous Black Death of 1348 was preceded by fearful earthquakes and fiery meteors of portentous aspect. A violent earthquake in Central Germany heralded the third appearance of the sweating sickness and epidemic encephalitis in 1517, and of that epidemic in Holland at the same time, which physicians now believe to have been diphtheria. The great eruption of Mount Hecla in 1783, when a river of lava twelve miles wide flowed in six weeks a distance of 60 miles into the sea, drying up twelve rivers and destroying twenty-one villages, was followed by diseases of a most peculiar and inveterate kind. In the same year there were most destructive earthquakes in Italy and Messina, and terrible pestilences prevailed in Central Europe, due, as is supposed, mainly to the vapours or exhalations. Great destruction of life has been attributed at different times to mephitic vapours, not due to earthquakes. In the year 140 B.C. the Roman army in Algeria are said to have fallen victims to mephitic vapours generated by themselves for the destruction of the inhabitants, and in A.D. 168 a plague at Rome, preceded by a still more destructive plague in Asia, was supposed to have had its origin in foul airs from a small box which a Roman soldier had opened at the capture of Selucia. Our own annals tell of a marvellous visitation of rain and thunder in 1223, by which the congregation of the church of Barnwell, near Cambridge, were sorely tried. "Such flashes of lightning entered the church that each man thought it had been set on fire; and such a filthie stench arose withal that manie of the company fell sick thereof and hardly escaped death." The plague of 1345-49, which is said to have begun in China, "from the vapours proceeding from a certain fiery body which fell from the atmosphere, or was eructated from the earth," caused awful mortality. In Florence, 100,000 people died; in London, 59,000 are said to have died in a single week; while 100,000 perished in Venice, 90,000 in Lubeck, and 200,000 in Spain. One of the modern theories ascribes pestilence to cosmic dust composed of iron, nickel, cobalt, and other substances. This receives some support from the Jewish writer Philo, who in A.D. 92 describes a "loimic" pestilence arising from clouds of dust, which produced severe and intractable ulceration of the skin both of men and animals. In A.D. 593, during a pestilence in Rome, the air was charged with a mist or cosmic dust which induced violent sneezing, which gave rise to the expression "*Dominus tecum*" to a sneezer, a practice not yet extinct. A haze or "dry fog" has been frequently noted as accompanying cholera visitations. Such a haze, which was of a pale blue shade, and possessed of peculiar drying properties, and of a marked and indescribable odour, was very prevalent in the year of convulsions just a century ago, and its dispersion in 1783 was attended with violent thunderstorms. It is thought that this haze may be associated with the powerful agents which seem to pervade the air after volcanic and earthquake eruptions, and on scientific grounds it seems clear that some diseases may be so occasioned. During plagues and pestilences popular superstition has frequently suggested poisoning the waters as the cause. Different sects were thus led to accuse each other, and this and other malpractices, and the mortality arising from disease was swelled by slaughter. At Mentz 12,000 Jews fell victims to the populace, on suspicion of having poisoned the wells of the city. In Milan, in 1630, when a severe visitation of plague occurred, there was a popular belief that the disease was propagated by people who anointed the walls of the houses with a poison fatal to all who touched it, and many unfortunates who were suspected lost their lives; while the house of a barber, named Mora, who was accused of preparing the poison, was pulled down, and a column, known as the "Column of Infamy," was erected on the site, where it remained until 1778. Drought, both in ancient and modern times, has been too intimately connected with diseases of unusual severity to leave much doubt of their being in some way connected. Pestilence has been caused not unfrequently by the decaying bodies of locusts and animals perishing during an epizootic visitation, as well as by decaying vegetable substances. Under all the other heads some very curious and interesting facts were collected and stated, and a complete enumeration was given of all the authenticated cases of plagues that have afflicted humanity, and of the legislative means taken for mitigating their effect; the author suggesting, at the conclusion of his paper, that there still remained to be treated, the "Periodicity of Plague Visitations," the "Spontaneous Origin of Disease," and "Pestilential Cyclones."

SCIENTIFIC SOCIETIES.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on the 20th inst., Mr. J. K. Laughton, M.A., F.R.A.S., President, in the chair.

The following papers were read:—1. "Popular Weather Prognostics," by the Hon. R. Abercomby, F.M.S., and Mr. W. Marriott, F.M.S. The authors explain over 100 prognostics by showing that they make their appearance in definite positions relative to the areas of high and low atmospheric pressure shown in synoptic charts. The method adopted not only explains many which have not hitherto been accounted for, but enables the failure, as well as the success, of any prognostic to be traced by following the history of the weather of the day on a synoptic chart. The forms discussed are:—Cyclones, anticyclones, wedge-shaped and straight isobars. The weather in the last two is now described for the first time. They also point out—(1) that prognostics will never be superseded for use at sea and other solitary situations; and (2) that prognostics can be usefully combined with charts in synoptic forecasting—especially in certain classes of showers and thunderstorms which do not affect the reading of the barometer. 2. "Report on the Phenological Observations for the year 1882," by the Rev. T. A. Preston, M.A., F.M.S. The most important feature of the phenological year was the mild winter. The effect of this upon vegetation was decidedly favourable; and had it not been for the gales—especially that of April 28th—the foliage would have been luxuriant, and, therefore, free from insect attacks; but the contrary effect has been produced on insect life, for the scarcity of insects, especially butterflies and moths, has been the general remark of entomologists.

THE electric resistance of 100 yards of No. 8 iron wire is roughly 1 ohm.

SCIENTIFIC NEWS.

REGARDING the British observations of the Transit of Venus, Mr. E. J. Stone says he awaits the result with perfect confidence, as they have been so complete that the method of contact will now have a fair trial. He is confident that the contact observations will fix the true distance of the Sun without any greater error than 300,000 miles.

The death is announced of Mr. C. V. Walker, F.R.S., President of the Society of Telegraph Engineers. The deceased gentleman was one of the pioneers in telegraphy, and was the inventor of the electrical train signalling arrangements on the South-Eastern Railway, a chronological exhibit of which was shown at the Crystal Palace during the early part of the year. Mr. Walker was in his 72nd year.

The death of Prof. Gustaf Svanberg, for many years director of the observatory at Upsala, is announced. The deceased was eighty years of age, and first became connected with the observatory in 1829. The buildings were completed under his direction in 1834. Prof. Svanberg had retired from active work for some years.

Mr. John Sadler, the curator of the Edinburgh Botanic Gardens, died the other day at the early age of forty-five. Mr. Sadler was a recognised authority in botany, and was president of the Fungus Club.

A great improvement has, it is said, been effected in accumulators by a combination of the Faure-Sellon-Volckmar patents. The Pullman train on the Brighton line, which formerly was lit by 18 incandescent lamps, supplied by 70 Faure accumulators, is now illuminated with 40 incandescent lamps, the current for which is supplied by 30 Faure-Sellon-Volckmar accumulators, the total weight of which is less than half those formerly employed.

According to Prof. Ayrton, the old accumulators weighed 130lb. in working order, and gave a current equivalent to one horse-power for three-quarters of an hour: whereas the new pattern weighs only about 75lb., and gives a horse-power for an hour. The flannel or felt is now dispensed with, and the plates are so arranged now that a defective or imperfect one can be easily removed.

It is stated that Mr. Brush has succeeded in greatly improving the accumulator. The data given by the reports are rather indefinite: but it seems the accumulator exhibited, which is 10ft. long by 18in. square, absorbs ten ampères and supports thirty Swan lamps for six hours. Its lighting efficiency is also said to be equal to twenty-nine candles per horse-power of steam.

The Union Club of Oxford have determined to adopt the Pilsen-Joel system for lighting up their premises. There will be six arc lights and 100 incandescent lamps.

With reference to some recent puffs in the newspapers it is pointed out that at the Severn tunnel works a 40-light Brush machine and a 60 incandescent lamp Siemens alternating current machine are kept running from 6 a.m. on Monday morning to 10 p.m. on Saturday night, with occasional stoppages of a few minutes to clean and oil up, there being only one machine of each kind.

The first practical application of the electric transmission of power in Scotland has been made at the works of the Railway and Electric Appliances Company, Polmadie, Glasgow, under the care of Mr. Rankin Kennedy, the engineer and electrician. From four to five horse-power is transmitted by means of two dynamos of Mr. Kennedy's design, one being placed in the turning shop, where it acts as the generator, and is driven by a belt from the shafting; the other being in the carpenter's shop some distance off, where it acts as the motor, running at 600 revolutions per minute, and driving the shafting by means of a belt.

M. Marcel Deprez explains that in his Miesbach experiments the 60 per cent. referred only to the electrical effect; the power actually transmitted for industrial purposes was 25 per cent. in the first, and 30 per cent. in the second experiment.

The eleventh annual soirée and exhibition of the Lambeth Field Club and Scientific Society will be held on Monday next at St. Philip's Schools, Kennington-road.

Mr. De Rance, of the Geological Survey, has discovered manganese and hematite in the old red sandstone of Derbyshire. Analysis shows that the manganese ore contains 45 per cent. of magnesium. Some of the deposits are 20ft. thick.

A fire-balloon has been made, in which the lower part is constructed of asbestos cloth, while the upper part is covered with a fireproof solution. A spirit-lamp is used to supply the hot-air for inflating it, and, being fireproof, there is no risk, as with ordinary hot-air balloons. The system is said to be specially valuable for war balloons, as a supply of spirit can be easily carried where it would be difficult to take the appliances for preparing gas.

Some interesting effects of lightning have been observed by M. Alluard at the summit of the Puy de Dôme, where, on a circular tower, is an iron mast about 20ft. high, supporting an anemometer of the Robinson type, with four copper cups. There is also a ladder and stand (both made largely of iron), to allow of access to the anemometer, for cleaning. Two metallic cables connect the system with copper-plates in the ground. Under these conditions, St. Elmo's fire often appears at the salient points of the mast, stand, &c., and a slight hissing is sometimes heard. All the cups of the anemometer show numerous signs of fusion by lightning, and only in their upper half; their connecting iron circle has also been fused in some places. Wherever such fusion has occurred the metal has been raised like a small volcanic cone in the centre of a crater. Some exterior attractive force seems to have raised the melted substance. M. Alluard proposes to study the phenomenon more closely.

In the course of other work, Herr J. Moritz lately had his attention drawn to the lowering of temperature obtainable from mixture of alcohol and snow; and this method, he considers, might in some cases be preferable to others. In one experiment he made, 75gr. snow and 77gr. absolute alcohol at + 4° C., gave, on mixture, a temperature of about − 30° C.; and, in other experiments, with 77gr. of each, temperatures of − 24·2°, and − 29·4° C. were reached. One advantage of the method is the absence of any salt or acid.

Moved by a desire to increase the reliability of German mill products, and to afford both the general public and the trade adequate protection against adulteration, either with organic or with inorganic matters, the Association of German Millers has recently offered a prize of about £50 for discovery of a method whereby wheat flour and rye flour may be readily and surely tested for admixtures of any kind. The competition is international. Papers must be written in German, French, or English, and must be sent in to Herr van der Wyngaert, 15, Bulow Strasse, Berlin, before 15th May, 1883.

Several animals, new to science, were described to the Paris Academy on the 11th inst. One is a strange fish brought up from a great depth off the Morocco coast; it is about a foot and a half long, and of deep black colour; but its most striking feature is its very large and capacious mouth with elastic membranes, much resembling a pelican's. Probably, food is partly digested in this cavity, The fish (which M. Vaillant calls *Eurypharynx pelecanoides*) has very little power of locomotion. M. Brongniart described a new fossil insect of the order of Orthoptera from the coal formation of Commentry (Allier). Insects are rare in the carboniferous strata; hitherto only 110 specimens have been obtained in the whole world. That now found is of remarkable size—about 10in. long, and the family of Phasmidæ, or "walking-stick insects," is that which comes nearest to it. M. Brongniart names it *Titanophasma Fayoli* (M. Fayol sent it). The upper part of the thorax not being preserved, it is impossible to say whether the insect was winged. Once more, M. de Merejkowsky described a new class of Infusoria, called Suctociliates, and forming a sort of connecting link between ciliates, which are characterised by small vibratory hairs, and Acinetians, which have no such hairs, but have *suckers*.

The construction of an electric railway from Geneva to St. Julien, on the French frontier, has recently been sanctioned.

It has been observed recently by M. Lailler, that linseed-meal from which the oil has been eliminated in such a way as not to affect the other principles present, retains all the therapeutic properties of the ordinary meal. With equal weight, it contains more mucilage, starch, albuminoid substances, &c. To prepare a poultice of suitable unctuousness and consistency, 25 per cent. less of the oilless meal is required than of the ordinary meal. The poultices prepared with the oilless meal are less heavy and remain longer warm than the others. The prepared meal, moreover, does not become rancid. After many experiments in eliminating the oil, M. Lailles finds sulphide of carbon the most suitable agent.

The glass globes hitherto used to moderate the intensity of the electric light diminish the light to a large extent, seldom less than 50 per cent. (according to *Sprechsaal*). A French paper has recommended the use of globes, &c., made of spun glass for the purpose. Experiments proved that such did not absorb more than 25 per cent. of the light.

Flexible mother-of-pearl patterns are produced on cloth stuffs, according to a recent German patent, as follows:—On a soft elastic base is placed thin caoutchouc as large as the pattern, and upon this a thin plate of copper, with the pattern cut through. Over the copper is placed the cloth on which the mother-of-pearl pattern is to be produced. A heater is now passed over the whole, with the result of melting the thin caoutchouc, and causing it to be pressed up against the cloth, in form of the pattern. The cloth is now removed with its adhesive pattern, and powdered mother-of-pearl is sprinkled on it; then a heater is passed over it, and any superfluous powder is removed with a soft brush. A fine crape-stuff, moistened with gum solution, is next laid on the mother-of-pearl pattern, and, after drying, adheres to it with protective effect, while the varying colour of the mother-of-pearl is but little affected.

Optical telegraphy is sometimes like a sort of advanced guard to the electric system, which it completes by penetrating into regions where lines would not be safe. This is the case, *e.g.*, in Algeria, where Capt. Chilly, with some other military officers, has been recently engaged on a mission of optic telegraphy. Each point of the extreme south is now connected with an electric telegraph station, so that a message sent in the evening from Negrine reaches Constantine next morning. Previously it took three days to convey a message to the nearest telegraph office. Between Negrine and El-Oued is about 93 miles, and the apparatus set up at Negrine throws the light (solar or electric) this great distance. The Arabs are astonished at the light, and are, of course, powerless to interrupt it. *L'Electricité* expresses a hope that ere long the Niger will be reached with the system in question, and St. Louis connected with Algiers.

Among other matters discussed at the Congress of Hygiene, which recently met at Geneva, was that of intemperance, which M. Roulet showed to be making rapid progress in Switzerland. He desired heavy duties on the sale of drink, especially distilled liquor, severe surveillance of it, and energetic repression of drunkenness. He insisted on the utility of temperance societies, and said, in closing, that the war against intemperance would not succeed till all alcohols except ethylic were removed from beverages. It is necessary to find a reagent enabling to determine accurately and quickly the quantityof those other alcohols in the drink. M. Alglave advocated monopoly of the sale of alcoholic liquors by Government. The Congress passed a resolution calling on all Governments to abolish legislative obstacles to the practice of cremation, and urging the advantages of this practice in the case of serious epidemics.

For cleaning glass vessels, Herr Muller condemns the use of quartz-sand, and (especially for vessels meant to hold drinks), lead shot, and recommends gypsum (without silicate) and marble, also bruised bones. Where it is desired to clean glass and porcelain vessels thoroughly of organic matter, a mixture of sulphuric acid and bichromate is best.

The synthesis of uric acid has been recently accomplished by Herr Horbaczewski. His method, described to the Berlin Chemical Society, was to mix powdered glycocoll with ten times as much of pure urea, obtained from cyanate of ammonia, and heat quickly to 200° or 300° C.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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VARIABLE STARS.

[20874.]—My attention has just been directed to a very interesting article on Variable Stars, by Prof. E. C. Pickering, in your number of the 1st inst. It contains an error which I take the liberty to point out, and which, if only for the sake of accuracy, you may deem it advisable to correct. The error is in the paragraph on temporary stars, where, in giving examples, one is stated to be "Tycho Brahe's star of 1755." Tycho first saw it early in November, 1572. It continued visible 16 months. After remaining a brilliant object for some months, its lustre gradually diminished till March, 1574, when it finally disappeared.

John Graham.

Prebend-row, Darlington, Dec. 19.

SUNSPOTTERY.

[20875.]—I had not intended taking further part in this controversy, my views coinciding with neither of the two parties engaged; but, against the assertion of "F.R.A.S." (letter 20847, p. 357) that he "can never too often reiterate that any effect produced by the sun must affect the whole world, and not different parts of it differently," I must enter my protest. In point of fact, I feel that it cannot be too often reiterated that the *only* way in which the sun can affect the meteorological conditions of our globe is by *intensifying* phenomena, and so rendering the different conditions which prevail in different parts of the world more widely different than aver. I must refer those who want to see the point discussed in detail to a little pamphlet on "The Doomed Comet," which I recently published. Here I can only mention one or two of the grounds of my opinion.

The examination of weather records has, I think, proved five things—namely, that in certain localities of the earth's surface, a connection between the state of solar activity and the weather (at least as regards temperature, rainfall, and atmospheric disturbance) is apparent; that in other localities a connection is apparent, but of a precisely *opposite* character; that in yet other localities no connection of any kind is traceable; that the connection is most obvious in tropical or sub-tropical latitudes; and that, as a consequence of the foregoing, combined records from all parts of the globe fail to exhibit the connection, the two opposite effects cancelling each other.

I need not enlarge upon the two first conclusions. They are pretty generally admitted, and the circumstance of opposite effects arising from the same cause has not a little puzzled some of the sunspotters. Several examples of it, however, are familiar to meteorologists. For instance, to quote Professor Archibald, "it is generally assumed that the same tropical heat which gives the primary impulse to the desiccating north-east trade wind of sub-tropical latitudes furnishes the energy which exhibits itself in the almost constant precipitation under the Equator. Any variation in the degree of this heat should consequently affect localities situated in the region of the Trades, and the Equatorial calm-belt in a diametrically opposite manner."

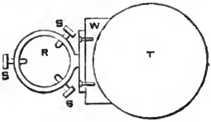
The fact of the weather in some localities failing to show any trace of a cycle is in no way remarkable. Local influences play a more important part in the production or modification of atmospheric phenomena than is generally recognised. Indeed, the distribution of meteorological conditions, or climate in other words, is determined almost entirely by local circumstances; and in the varying potency of these circumstances we have an explanation of the appearance of a cycle in one place and its absence from another. Where local influences are weak, there whatever effect may be due to a variation in the sun's activity is permitted to assert itself; where such influences are powerful or marked, there the solar effect is marked by more prominent local phenomena.

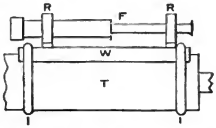
The last two conclusions I need hardly discuss either. The meteorological phenomena of tropical and sub-tropical regions are much less complicated than those of the temperate zones; whence it follows that it is easier to trace a cycle in the case of the former than in the latter. This is, doubtless, why such a degree of success has attended the investigation in India. The observations of Dr. Jelinck, referred to by "F.R.A.S.", bear me out in the last deduction. **J. A. Westwood Oliver.**

4, Bellevue-terrace, Springburn, Glasgow.

CHEAP FINDER FOR A SMALL TELESCOPE.

[20876.]—Perhaps the following description and sketches of a finder I have used for some years with perfect satisfaction may be useful to some of your astronomical readers who experience the worry of searching for celestial objects without some such adjunct to their telescopes. This plan has great advantages over that suggested by Proctor in his "Half-Hours with the Telescope." I utilised a pocket telescope, which opened to about 16in., and by removing one pair of the lenses not only turned it into an inverting telescope but reduced its length to 9in. Having ascertained the position of the focus, I fixed at that point a ring cut out of cardboard carrying the cross-wires. Such a little telescope as I adapted could be purchased second-hand for a few shillings; but, if preferred, a cardboard tube, as recommended by Proctor, might be employed. To secure the finder, F in sketch, I bought at an ironmonger's for about sixpence two brass rings, R R. They were intended, I think, for curtain fittings, and had feet attached to be screwed to anything. Their internal diameters were about ¼in. greater than those of the tubes of the finder, so as to allow play to the adjusting screws S S S placed in holes through the rings. I then procured a piece of wood W, 9in. long, 2in. broad, and 1in. thick, scooped one side hollow to fit the large telescope T, screwed to the wooden block the rings R R containing the finder F; then, by means of thick indiarubber rings, I I, tightly clasped the block (carrying the finder) to the large telescope, and all that remained was to adjust. This mode of attaching the finder requires more trouble at first than Proctor's, but it has the great advantage of permanence over the latter, and I can testify to its effectiveness. **More Light.**



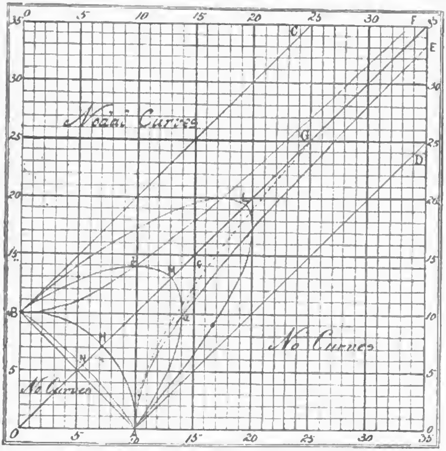


THE LINK-MOTION.

[20877.]—In my letter (20688, page 207), I invited the attention of engineers and others to a few curves described by the link-motion, in which the branches, for a considerable length, coincide with straight lines. I have been encouraged to pursue my inquiries into the general theory of this motion; and have arrived at some important results, which I feel assured will, when made widely known, lessen the difficulties that have been met with in its application to general purposes.

I have found that there is a certain zone of curves, within which each has its branches more or less coincident with the tangents. This length of coincidence can easily be computed; and my principal object has been to seek within this zone for those curves in which the length of contact is greatest.

I have endeavoured to embody the results of my investigation in what may be called a topographical chart, because the object of it is to show the relative places of curves having special useful properties. Every point in it—within certain limits—must be supposed to represent the place of a curve. The co-ordinates of this chart are the lengths of r and d, referred to at page 207; and the length l is assumed to be constant, and is represented by the number 10. Hence, for any three links—the two end links being equal—the middle link, divided into 20 equal parts, becomes a scale for r and d. If, then, values of r and d be taken according to this scale, only one curve can be described for each pair.



TOPOGRAPHICAL CHART FOR CURVES OF THE LINK MOTION.

Now, since every point on the chart can be represented by a pair of co-ordinates, and if r be assumed as the ordinate, and d as the abscissa of a point, the curve for that point will be fully known.

In the construction, our first object will be to lay down the limits within which it is possible for a curve to be described by the link-motion. Now,

FIG. 1.

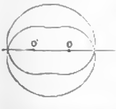


FIG. 2.

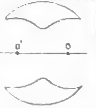


FIG 3

we cannot describe a curve if d be taken greater than $l + r$. Hence, for this limit $d = l + r$. This, then, is the equation in d, r, co-ordinates to the straight line A D, and no curves whatever can exist for points in the chart below A D.

Another limit is found from the consideration that no curve can be described if l is greater than $d + r$; therefore, we have the equation $d = l - r$, which is the equation to the straight line A B.

Again, the equation $d = r - l$ gives the line B C, which is a boundary separating the nodal curves from all others of the system. These curves have their places above the line B C, and in none of them do the branches pass through the origin. They occur in pairs, varying in form from a circle to imperfect ovals in cases where d is less than l, as in Fig. 1; but when d has values greater than l, they have forms resembling Fig. 2.

Moreover, any curve whose place is represented by a point on these limiting lines A D, A B, B C, has its branches at right angles to the axis at the origin. For, in the equation

$$\text{Tan. } \phi = \pm \frac{l^2 - r^2 - d^2}{\sqrt{4l^2d^2 - (l^2 + d^2 - r^2)^2}}$$

in which ϕ is the angle made by the curve with the axis. If we make $\phi = 90°$ we have the equation $4l^2d^2 = (l^2 + d^2 - r^2)^2$. This reduced, gives the three relations $d = l + r$, $d = l - r$, $d = r - l$. But these are the equations to the three lines A D, A B, B C respectively; hence, at these limits the curves have their branches at right angles to the axis. They differ, however, as to form, for near A D they resemble Fig. 3, and increase in dimensions as their places are more and more removed from A D; they have also their curvatures convex to the axis. On A B they, in some respects, resemble the curves on A D, and are also convex to the axis, but they are difficult to describe—Fig. 4 has been taken near this limit. On B C the curves are all concave to the axis, but in form they vary considerably according as they lie on opposite sides of the vertical line $d = l = 10$. On the right of this line they have the form of Fig. 5, and on the left they resemble Fig. 6.

The vertical line $d = l = 10$ is a remarkable line; it shows the places of a series of circles that can be described by the link motion. For if we make $r = nl$, where n may be either an integer or a fraction, the equation in the particular case of the curve, expressed in x, y, co-ordinates may be reduced to the form $(x^2 + y^2 - n^2l^2)\,[(x^2 + y^2)^2 - n^2l^2(x^2 - y^2) + 4l^2y^2] = O$. Now $x^2 + y^2 - n^2l^2 = O$ is the equation to a system of circles, and $(x^2 + y^2)^2 - n^2l^2(x^2 + y^2) + 4l^2y^2 = O$ is the equation to a system of lemniscates. As we proceed up this line $d = l = 10$ we find that both the circles and the lemniscates are generally incompletely formed; but when $n = 1$ or $r = l = 10$ both are complete as at Fig. 7, and we have the seeming paradox of a point describing a circle and passing twice through the centre before the circle is completed. Again, when $n = 2$ or $r = 2l = 20$ we have another singular result, for then the equation to the lemniscus, in x, y, co-ordinates becomes after reduction $[y^2 + (x - l)^2 - l^2]\,[y^2 + (x + l)^2 - l^2] = O$, the equations to two circles, so that at this point *three* circles are described, as at Fig. 8, the outer one having a radius $= 2l$ and the radii of the other two being each equal to l.

As the branches of the lemniscus alone pass through the centre—in the modifications that the curves undergo from the perfect circle and the perfect lemniscus—these branches alone can partially become straight lines. A very simple case occurs when we suppose the angle ϕ to become equal to O, for then both branches coincide with the common tangent, and consequently with each other. Thus: putting $\phi = O$ in the equation for the tangent, we have the condition $d^2 = l^2 - r^2$. Now, in $d\,r$ co-ordinates this is the equation to a circle of radius l. It is represented on the chart by the quadrantal arc A H B, the centre being at the origin of the same co-ordinates. The points of this quadrant give all the curves of the link motion that have their branches coincident when parallel to the axis of x. I have examined the points of this arc A H B, and the curves are all of the form given at Fig. 9. At points on each side of the line, however, there is an immediate variation in form: thus: for $r = 8{\cdot}6$, $d = 8{\cdot}6$, we have the curve Fig. 10, which is above the arc A H B and concave to the axis; but when $r = 6$, $d = 7$, we have the curve Fig. 11, which is below the arc A H B, and convex to the axis.

Although at the points of this arc the branches of the curves have an intimate contact with their tangents, and for short distances might be considered as straight lines; yet there would be a great practical difficulty in adjusting the links and the distances of the centres so as to exactly fulfil the required condition. For, if there was the least deviation on the one side or the other, the contact of the tangent and the curve would be an ordinary contact. It is not, therefore, in this part of the chart that the useful curves are to be found.

The zone, to which I have before referred, lies above the curve line A E, and the points below this line are places of curves, all of which are convex to the axis.

The line A E is an equilateral hyperbola, its equation in d, r, co-ordinates is $d^2 = r^2 + l^2$. For points on this line—like those for the points on the circular arc A H B—the curves have a close contact

FIG. 6.

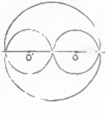
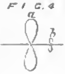
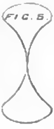
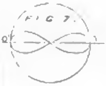
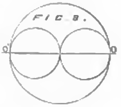


FIG. 4.









with their tangents, and for points above this line, the length of contact gradually increases until a certain limit is reached, which is marked in the chart by the curve line A G, which is another hyperbola. For every point in the zone between these two hyperbolas we can compute the length of contact from the equation $\rho^2 = \frac{r^4 - (d^2 - l^2)^2}{r^2}$ where ρ is the common radius vector of the tangent and the curve. This equation will apply to all the curves till a limit has been reached, when the curves begin to be concave to the axis. I have found the hyperbola A G, whose equation is $d^2 = l^2 + \frac{9}{7}r^2$, to be a safe approach to this boundary. Points may, however, be taken slightly over this line A G at which the formula given above would be available; but at a very little distance beyond, we come upon the curves that are concave to the axis. Even in these curves there is still a considerable length of contact of the curves with their tangents; but the equation for the *length* of contact will no longer be applicable.

For points on the hyperbola A G, the actual length of coincidence of the curves with their tangents may be found from the equation $\rho^2 = \frac{13}{49}r^2$. They have all forms resembling Fig. 12, more or less elongated.

The equation $\rho^2 = \frac{r^4 - (d^2 - l^2)^2}{r^2}$ has been obtained from the equation to the curve referred to polar co-ordinates ρ and θ, by supposing θ to be equal to ϕ, in which case the curve will coincide with the tangent for small variations of d. If within the zone we make d to vary with small increments, the variations of ρ are very considerable. For example, if we take any horizontal line, as $r = 10$, and mark where this line meets the curve A G, for this point $d = 13{\cdot}64$ and the curve has with the tangent a length of contact

$2\rho = 10{\cdot}2$
For $d = 13{\cdot}8$, $2\rho = 8{\cdot}52$
" $d = 14$, $2\rho = 5{\cdot}6$
" $d = 14{\cdot}14$, $2\rho = 0$

As another example, take the horizontal line $r = 15$, which meets the hyperbola where $d = 17{\cdot}12$, and the length of contact in the curve for this point when

$$d = 17{\cdot}12 \text{ is } 2\rho = 15{\cdot}3$$
$$\text{and for } d = 17{\cdot}5 \quad 2\rho = 12{\cdot}22$$
$$d = 17{\cdot}75 \quad 2\rho = 8{\cdot}8$$
$$d = 18{\cdot}03 \quad 2\rho = 0.$$

The angle made with the axis O, O' by the branches of the curves on A G may be found from the equation $\sin.\ \phi = \pm \frac{13r}{14d}$.

If, in the equation $\rho^2 = \frac{r^4 - (d^2 - l^2)^2}{r^2}$ we suppose ρ to become zero, we have the two equations $d^2 = l^2 + r^2$, $d^2 = l^2 - r^2$. These, as before stated, point out the hyperbola A E and the quadrantal arc A H B.

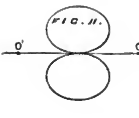


FIG. 11.

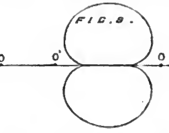


FIG. 9.

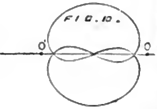


FIG. 10.

These equations also show the geometrical properties of the position of the links when a curve is described whose place is at any point on these lines. For suppose the links are placed, as in Fig. 13, so that the middle point C of the middle link A B is situated on the line joining the fixed centres O,O'. Then it is evident that if the angle C A O be a right angle, we have $d^2 = l^2 + r^2$. But if A O C be a right angle, we have $d^2 = l^2 - r^2$. Again, if we suppose the angle A C O to be a right angle, we have the equation $d^2 = r^2 - l^2$. This is the equation to another equilateral hyperbola, and is the line B F on the chart; it passes through the midst of curves that are concave to the axis, which I have not yet examined.

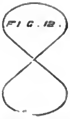
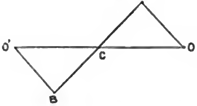


FIG. 12.

In the course of this investigation, I have found the following important property of the links placed as in Fig. 13. In all cases, the angle A O C $= 90° - \phi$ where ϕ is, as I have before defined, the angle which the branches of the curve makes with the line of centres. Hence, in the triangle A O C, we have the relation $d^2 \pm 2rd \sin.\ \phi + r^2 = l^2$.

FIG. 13.



If in this equation we give to ϕ any special value, we have the condition between d, l, and r for the places of all the curves whose branches are inclined to the axis at the given angle.

Thus, suppose we wish to know the situation of all curves whose branches are at right angles to each other, in this case $\phi = 45°$, and we have the two equations—

$$d^2 + dr\sqrt{2} + r^2 = l^2$$

and

$$d^2 - dr\sqrt{2} + r^2 = l^2.$$

These are the equations in $d\,r$ co-ordinates to two equal ellipses, the major axis of the one coinciding in direction with the minor axis of the other, the semi-axes are respectively 18·477 and 7·655.

They are represented on the chart by the two arcs A M B and A N B. Every point on these two elliptic arcs is the place of a curve, having its branches at right angles to one another.

In the same manner we can place upon the chart elliptical arcs showing the places of curves, having their branches inclined to the axis at any other given angle. Thus, for 60°, the equations to the two ellipses are—

$$d^2 + dr\sqrt{3} + r^2 = l^2$$

and

$$d^2 - dr\sqrt{3} + r^2 = l^2$$

Their semi-axes are 27·32 and 7·32. Only one of these ellipses is represented on the chart, by the arc A L B; the other would have to be drawn between the straight line A B and the elliptic arc A N B.

Similarly, curves whose branches make an angle of 30° with the axis, would be found on the two ellipses, whose equations are—

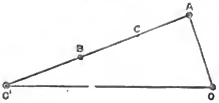
$$d^2 + dr + r^2 = l^2$$

and

$$d^2 - dr + r^2 = l^2$$

and whose semi-axes are 14·142 and 8·1637. These and other lines, showing special properties of the curves on them, have not been laid down upon the chart, to avoid the confusion that would arise in their explanation.

FIG. 14.



I may, however, mention here that the relation—

$$d^2 = l\,(l + r)$$

is the equation to a parabola whose latus rectum $= l$, and whose vertex is situated at a distance l below the zero of the chart on the vertical line passing through that point. A portion of this parabola passes through the zone before mentioned, entering it at the point a, whose co-ordinates are $r = 10$, $d = 11{\cdot}14$, and passing out of the zone near the point c, where $r = 14$, $d = 15{\cdot}492$.

The curves to which I have referred in the table given at p. 207, taken between $r = 10$ and $r = 14$, all lie within the zone.

The relation $d^2 = l\,(l + r)$ has reference to the position of the links when there is this geometrical property. Suppose the links are drawn out so as to have the position at Fig. 14; then if the angle A O O' be a right angle, all curves that can be described with links, and the distance O O' having this property will have their places on the parabola $d^2 = l\,(l + r)$.

If, however, the angle O A O' be a right angle, then all the curves that can be described with such a relation, between the links and the distance of the centres, will have their places on the hyperbola whose equation is—

$$d^2 = l^2 + lr + \frac{r^2}{2}$$

This line also passes obliquely through the zone.

Milverton.

JERKS IN RAILWAY TRAINS.

[20878.]—The question originally put by "S. J." may have had a satisfactory reply from Mr. Stretton, in "Nun. Dor.'s" opinion; but as questions of the sort are committed to print by the favour of our editor, it is evident the answers are not meant for the querists alone, but for all who like to read. That the answer was not satisfactory all round, is evident from the objections which Mr. Brown and myself raised, and surely we have the right to express our opinion without being abused by a qua incog.

"Nun. Dor." now claims to be perfectly familiar with the "elementary facts retailed by Mr. Brown and myself." To what facts does he refer? Does he admit that the mechanical effects we pointed at *do* obtain. If so, why all this fuss? Again, what does he mean by saying "I repeat that the jerk to which 'S. J.' refers will be felt while the passenger is sitting." Well, who ever said otherwise? He may repeat this a thousand and one times; but what has that to do with the matter in dispute? Afterwards he admits it will be less felt when sitting than when standing. This is just what I said at first, and to which "Nun. Dor." objected, and it is plain, to anyone open to reason, that the safest course—that is safest from the risks alluded to by "S. J." of being thrown on the platform—is to keep sitting till *after* the jerk. I really admire "Nun. Dor.'s" way of getting out of the hole Mr. Brown put him in, in his last communication. No. 3. "Nun. Dor." is not to be stopped in that way—he jumps over it. "Tram-cars," says he, "are out of the question." This is short and sweet. Nay "Nun. Dor.," not so fast: tram-cars are literally *in* the question. If you will refer to "S. J.'s" original query, you will find this statement: "The jerk above mentioned may be felt sometimes in a tram-car."

"Nun. Dor." says Mr. Brown misunderstood what he said about the buffer-springs, and I can only guess the error is his, for he leads us to infer *he meant* the draw-bar springs. He is all over the shop; anywhere to get out of the way.

I expected, when I saw "Meteor's" diagram, that we were to have an interesting demonstration of two different causes producing exactly the same effects; but after carefully noting that the angle A O A¹ ought not to be so large, the thing dropped.

What is the use of the diagram? To prove I was wrong in saying a passenger ought to keep his seat till the train stopped (a fact which any sensible person will allow) he presses his head against a rail. Who told him to do so? I'm sure I didn't, and I may say, with certain heads—soft ones—the experiment might be dangerous. Again, I did *not* say it was the inertia of the passenger which caused the jerk. "Meteor" can read: let him return to letter 20718.

We are favoured with experiments Nos. 1, 2, 3, and 4, and with a promise of No. 5. To what do they tend? What do they prove? There is no doubt but that much water could be spilt in that way, and much ink afterwards, in recording the experiment, but what for?

Swansea. **A. R. Molison.**

[20879.]—Some of our correspondents appear to be a little confused as to the jerk of the train that was the subject of the original letter, and the matter may perhaps be made clear if I state my own experience. I was, and had been for many years, a season-ticket holder on the South-Western loop line from Waterloo. Of late, since the introduction of more powerful engines, the trains had been jerked about in a most unpleasant manner; and the passengers had adopted the habit of waiting for the "back jerk" before leaving the carriage; this "back jerk" was a very common recurrence, and passengers had become accustomed to it. On one occasion, the carriage had passed the booking-office of the stopping station; I waited for the "back jerk," and, after this had passed, opened the door and stepped out, when I was rolled over and over towards the engine, my right arm broken short off above the elbow, and I sustained other minor injuries. On making inquiries afterwards, I found that one or two of my acquaintances had been thrown down in the same way, and several others had had narrow escapes. The railway manager said I "left the train whilst it was in motion," which was literally true, though there had been an invitation to alight. Can any reader explain the jerk from which I suffered? Of course, the great severity of the injury was owing to the circumstance that the jerk happened to catch me just at the most effective moment. **H. B. T. S.**

THE VOSS MACHINE.

[20880.]—As many amateurs will now probably construct the "Voss" induction machine, it may be of service to them to know that it is not necessary that the fixed back-plate should be in one piece; the machine will act equally well with this plate in two pieces, so long as the division is between the two paper shields. About a year ago, a "Voss" machine was commenced by H. Yeates, and finished by Cumine, the rotatory plate of which was 24in. in diameter. The effects produced by this machine, as stated to me by Cumine, exceeded those obtained from the multiple plate Holtz machine lately described in the "E. M." When using vacuum tubes with the "Voss" machine, it is desirable that the discharge passing between the outer coatings of the two small Leyden jars should be used, as this plan gives the most brilliant results for nearly all purposes, whilst in medical applications the strength of the discharge can be regulated with exactness. Permit me to thank Mr. Franks for a letter inclosing a piece of the metal-faced paper he had used in some experiments. I have been unable to write to Mr. Franks, as he did not give his address. **H. B. T. S.**

PHOTOGRAPHIC LENSES.

[20881.]—We have had from time to time a great deal of valuable information as to the construction of lenses for telescopes and microscopes, but scarcely anything as to the construction of photographic lenses. Now that the dry-plate process is so successful, I think that information as to the best lenses for photography would be of interest to a large number of readers, and the excellent results given by the cheap and simple apparatus advertised by Mr. Lancaster in the "E. M." lead me to think that the construction of photographic lenses is not beyond the skill of many amateurs if the proper formulæ were made known to them. **H. B. T. S.**

DRINKS.

[20882.]—Number 924 of the English Mechanic seems to show a widespread desire to know more on the subject of drinks and substitutes for alcoholic beverages. Dr. Edmunds has given a good idea of the subject, and I can only supplement it.

Water is not believed to be a food in the ordinary sense of the word—that is, physiologists do not believe that it is broken up in the system. We believe that it is simply a solvent, and that it is cast out of the system chemically the same as it went in. Its use is to dissolve substances and so allow them to be taken into the blood, and by this power of solution it also carries waste products out of the body. Our body consists of about 75 per cent. of water, and it enters into all our food; thus the cucumber and melon contain about 95 per cent. of water, whilst the pea contains only 6 or 7 per cent. Fruits contain a large percentage of water, and so do roots, whilst nuts and grain do not contain a great deal. The very air we breathe contains a variable quantity of water; in summer, the air being hotter requires more water to saturate it, hence we are more thirsty in summer than in winter, since the body then exhales more fluid. In winter the air, being colder, is more nearly saturated; hence we do not lose so much by our breath, and so retaining more in the system we require less drink; the skin also does not perspire so freely in cold weather. In some cases the system even absorbs moisture from the air, as seen in some persons gaining weight in the interval between meals.

Thirst is a sensation of dryness, referred to the back of the throat: it is really the system calling for fluid. The experiment has been made of cutting the gullet of an animal, kept without liquid for a long time, and inserting a piece of pipe in the gullet, so that when the animal drank all the fluid ran out of the pipe instead of going into the stomach. The result of this experiment was that the animal drank and drank and never got satisfied. The fluid did not enter the system, and so could not quench the thirst. But when it was allowed to enter the stomach, the poor animal was soon satisfied. Thirst may be produced by the heat of the weather, the scarcity of water, or by the food and condiments we take. Thus salt, sugar, pepper, spices, mustard, and alcohol all give rise to thirst. Persons fond of highly-salted or seasoned dishes are more liable to it than persons who take plain dishes. Tobacco smokers are more liable to thirst than those who abstain from it. Eaters of animal food, in the same way, are more thirsty souls than vegetarians, since flesh is broken up into uric acid, urea, and other compounds requiring expulsion. Wine, beer, or spirit drinkers are more thirsty than abstainers, since the alcohol in these beverages increases perspiration from the skin, and an increased renal flow.

A man can live from three to six days without food or drink, but if plenty of water be allowed, he may survive up to fourteen days or more. In cases of shipwreck at sea, immersing the body in sea-water, once or twice a day, helps to mitigate thirst, for we are of opinion that some water is absorbed. But to drink sea-water under such conditions means death. The best thing to quench thirst is water, the purer the better, and all our drinks are chiefly water, coloured, flavoured, or adulterated. If it be adulterated with much salt, sugar, or alcohol, then we are nearly as thirsty as before, since these fluids enter the blood just as they are, and instead of allowing waste matters to be removed they only increase them. In fevers we have great thirst; there is increased heat, which means a waste of tissue and a crying out of the system for water to carry off the waste products. Hence, in all cases of fever, be it small-pox, scarlet fever, measles, or any other feverish state, we cannot err in allowing the patient cold or acidulated water at regular intervals. Fluids are harmful at meal times, as they dilute the gastric juice and retard digestion. Drinks may be divided into—1, thirst-quenchers; 2, general stimulants; 3, nervine stimulants; 4, food stuffs; and 5, irritants.

Thirst-quenchers.—These are the pure waters, as distilled-water, rain-water, spring- and river-waters, if they do not contain much saline matter. Distilled-water is best, since it contains no salts at all, and being perfectly pure, it has more power of dissolving any waste products the system may want to get rid of. It tastes insipid at first; but use makes it agreeable, and then ordinary water tastes saltish. Salutaris-water is said to be distilled-water charged with carbonic acid gas. After these come the aërated-waters, as soda, potash, and gazogene waters. Then come the flavoured and coloured drinks, such as aqueous solutions of the syrups. These syrups are lemon, nectar, pineapple, raspberry, strawberry, vanilla, sarsaparilla, orgeat, cherry, ginger, apricot, orange, currant, and other syrups. We may also include here eau sucrée, oatmeal and water, toast-water, rice, and barley-water. Frank Wright's non-alcoholic wines can be taken neat, or mixed with water; they are not thirst-quenchers unless mixed with water. The summer light beers, such as pop, ginger-ale, treacle-beer, hop-beer, horehound, and other herb beers contain a small percentage of alcohol, about two or three per cent. With the exception of the waters, all these contain a little nourishment, which is due to the sugar they contain. Extracts of malt or maltine may be included here, so long as they are mixed with water.

General Stimulants.—These are the many hot drinks, such as hot-water, or the fruit syrups mixed with hot water, and the hot water in tea, coffee, cocoa, and the substitutes for these. Hot water is a very good general stimulant, and in cases of feeling faint or fatigued, gives more real relief than a glass of hot brandy or whisky-and-water. This reminds me that in heartburn, a glass of hot or cold water quickly gives relief. In fact, the action of brandy and water in this complaint is due to the water alone, as brandy will often produce it. We have many substitutes for tea not generally known: these are mint, sage, thyme, and marjoram teas, made from an infusion of these herbs. As a substitute for coffee, we have radical coffee—i.e., wheat roasted and ground, maize coffee, bean and pea coffee. To make these you roast, grind, and infuse the various grains, and so make a palatable drink. The great advantages of these substitutes are that they contain no theine, theo-bromine, or caffeine wherewith to ruin our nervous systems. We can take them as often as we like, and just before retiring to bed, and are not kept awake by them.

Nervine Stimulants.—These are tea, coffee, cocoa or chocolate, and Liebig's extract.

Tea is the worst, and is said to be the cause of much mischief; its active principle is called theine. If theine be injected under the skin of a frog, it paralyses its hind legs. To a person unused to it, it causes general trembling, loss of power over legs, and general wakefulness. In China, where tea is very much drunk, a vomiting of blood is said to be common, and is due to this habit. Tea often gives to its votaries a withered, dried up, leathery appearance. Tea and meat ought not to be taken at the same meal, as the tannin of the tea is said to form leather with the gelatin of meat. If tea be taken, it ought to be very weak. The only nourishment tea contains is the milk and sugar in it. The Russian way of drinking tea is very pleasant: a piece of lemon is put in the cup, and then tea is poured on it; it can be taken with or without sugar.

Coffee.—This also contains an active principle called caffeine, which is a nervine stimulant, but milder than theine. Many people take it to keep them awake: let me warn them of taking it or tea for such a purpose, since we are goading on the system to work when we should be at rest, and are using up our reserve of vital force. Strong black coffee gives rise to a griping pain in the stomach; hence, in France, where it is often taken, they drink a small glass of brandy after it, which paralyses the nerves, and so the pain is not felt. If coffee be mixed with chicory its flavour is improved, but the chicory is not good. In Germany, there are chicory-eaters who are subject to peculiar and special diseases.

Cocoa or Chocolate.—These are the mildest of the nervine stimulants; their active principle is called theo-bromine. They are very nice and pleasant drinks, and may be taken with advantage instead of tea or coffee. The best brand I know is Van Houten's.

Liebig's Extract.—This is not a food, as a great many believe, and does not nourish. It is a stimulant only, depending for its properties on osmazone, syntonin, and other extractives.

Food Stuffs.—The food drinks are milk, butter-milk, and whey. They help to quench thirst, and also are nutritive, but one likes nourishment solid; they come in most useful in sickness or debility.

Irritants.—The irritants are beer, porter, wine, spirits and liqueurs; they depend on alcohol for their irritating properties. They all exert a baneful influence on the system, inflaming the stomach, increasing the heart's action unnecessarily, and help to retain waste products in the system. Hence drinkers are more liable to gout, rheumatism, calculus, apoplexy, &c., than are teetotalers. In moderate doses they give rise to a feeling of warmth and of strength. The warmth is due to the blood being sent to the surface of the body, whilst the internal parts are cooled. The strength is due to increased heart's action, but is not real, as shown by experiment. To a fatigued person, alcoholic drink means ruin; it is like spurring a jaded horse—he goes faster, but life is shortened. For hard, mental, or bodily work, those get on best who leave them alone. Alcohol acts as an anæsthetic, paralysing the speech and voluntary motion, as seen in the thickened speech and staggering gait. In large doses they give rise to delirium and death. Allow me to conclude by stating that the wine of the ancient physicians was in reality a fruit syrup. They evaporated their wines, for medical purposes, until they formed a treacly mass, and kept these. When it was wanted it was mixed with water, and given to the patient as a cooling drink.

T. R. Allinson, L.R.C.P., &c.

2, Kingsland-road, E., Dec. 16.

MINNESOTA AND THE NORTH-WEST.

[20883.]—Another batch of letters lie before me inquiring as to the opportunities offered the writers in the North-west. The letter I wrote a fortnight ago will sufficiently answer many of them. To the clerk ("R. H.", of Shrewsbury), with a liking for mechanics: get a good practical knowledge of mechanics before coming out. To his friend, 17 years of age, who has a theoretical knowledge of farming, I would say that if he comes alone he will find it hard struggling. He might get work on a farm at 20 dollars a month and board and lodging, and the experience would be valuable to him, if he was not what is called out here a "tenderfoot." But there are so many young Englishmen whose education and bringing up render them unfit for competition in rough work with the Swedes and Norwegians that are here. To those about to emigrate, who think life in Minnesota is easy, that money is easily earned by anybody, and that young men with dainty hands and manners can become rich in a hurry, my advice is—Don't. If "R. H." really means to "rough it," and take all that the words imply, he will not make a mistake in coming here. Thousands have roughed it, and have done well at the business.

To "T. J. S." and all other carpenters and cabinet-makers, I would say that handy men and good workers can get plenty of work. With such a trade at your fingers' ends don't think for a moment of going into farming. Stick to your last. The demand for carpenters in this city, beginning with next March or April, will be far greater than the supply at anywhere from 10s. to 12s. a day. First-rate men can earn more. Your father, aged 69, is a shoemaker. There is abundance of work out here for such men, but I should never advise you to bring a man of that age out. Remember that the ways of the people are so entirely different to what they are in England, and it is a serious matter tearing an old man from his country. Under certain conditions it might answer. You must judge for yourself. I merely state that there is plenty of work for you and your father if you are good workers. In regard to your brother, there is plenty of work for teachers, but the supply is great also. A school teacher from abroad can scarcely expect to get work easily unless he or she has some special qualification. Yes, land is to be obtained on easy payments in Dakota and this State too. The new land is mostly prairie. Material for house large enough to accommodate six people would probably cost, at a low estimate, £100. This does not include furniture. The climate is exceedingly healthy for everybody—young and old—especially for people with a consumptive tendency. There is plenty of work for good dressmakers. Best time to come, spring. Bring all the clothes you can and your mechanics' tools, which are admitted free of duty, I believe.

"W. B.," of Dunscar, will have found answers to his queries in my previous letter. The only question I should have in his case would be whether he is not too advanced in life to make such a change. It is a great change—one which a young man with any taste for adventure relishes; but with those who have passed the meridian of life it may be different.

To "E. C.," a jeweller, I would say that there is a great deal of competition in his business here. Yes, the American watches are in greater demand than the Swiss. The latter are dearer than the American, after the duty is paid, and their quality is no better. Waltham and Elgin watches hold the market. No, indeed; French clocks and Birmingham jewellery cannot be profitably imported. There is a trade here for some fancy foreign clocks, but it is small, and the business cannot be profitably carried on unless you know the market. There might be a chance for you to do something in establishing a business here. Really, I cannot say. It all depends on yourself. Certainly this is a wonderful place for jewellery. Everybody wears it, and profits are large. Costs of the journey for two need not be more than £45—from Liverpool to Minneapolis. You can spend a day or two in

New York and Chicago out of this if you are careful.

I think, Mr. Editor, this is the last time I shall need to trespass on your space in this matter of the North-west—at least, for the present.

R. M. Tuttle.

P.O. box 206, Minneapolis, Minn., U.S.A.,
Nov. 27, 1882.

INDICATOR DIAGRAMS.

[20884.]—Many correspondents have sought through the medium of the English Mechanic for information respecting the fault, or faults, existing in their steam-engines, at the same time forwarding diagrams. Therefore it may not be out of place to offer a few remarks upon the indicator and its diagrams that may be of use to those desiring such information. It is not worth while to waste valuable space in describing Richards' indicator, but a few hints upon fixing and driving it may not be amiss. When attaching the indicator to a horizontal engine it is preferable to have the two holes drilled in the top of the cylinder; but in such cases that have a jacket surrounding the cylinder, or have the steam-chest upon the top, it is best to have the holes in the sides, as near the top as possible, taking care that their position is such that they are not covered by the piston at each end of the stroke. In pipe-connections elbows and tees should never be used, nor should the size of the pipe be less than ½in. It is also advisable that the connections are not too near the steam-port, and it is necessary that they must be perfectly rigid. When indicating a beam-engine it is usual to tie the cord upon the radius-bar in such a position that the stroke of the engine is reduced to the smaller stroke necessary for the diagram. But the apparatus for driving the indicator, when applied to the horizontal engine, is far more complicated, as, in the first place, a wooden radius-bar is required, which may be suspended from the roofing, where that is convenient; but I prefer an A frame, as shown in Fig. 1, made of flat iron, about 2 × ½in., having the feet turned up and drilled so as to fit upon the bolts or studs holding the guide down. When it is desired to have this in a central position between the guides, two pieces of flat iron may go across and the frame be bolted upon them. Between the two upper ends a piece of hard wood should be bolted as shown, to which the radius bar R may be attached by means of a stout coach screw, the bar being bushed to prevent wear. The bar R must be stiff, so as not to spring or buckle while in motion, and may be fitted with a sheet-iron fork at the lower end to embrace any convenient part of the cross-head, and its point of suspension must be perpendicular to the centre of the stroke of the engine. A point must now be found upon the radius bar to attach the cord, so that the indicator card traverses 4 or 4½in. This found, a grooved pulley must be fixed centrally between the two indicator cocks, and at the same height as the point of attachment on the radius bar. This will serve for both ends, and when done with, the frame, radius bar, and pulley may be stowed away till required again, and do not, when once made, take much trouble to fix.

FIG. 1.

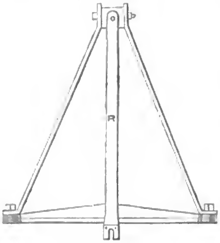


Fig. 2 represents the normal indicator diagram, which all diagrams taken from condensing engines should resemble, save where the point of cut-off differs. Should the pencil, however, describe the steam-line A B in the direction of the dotted line *a b*, it shows that the steam is late in its action, and that the engine has been carried over the centre by the momentum previously imparted to the flywheel. In other words, it is requisite that more lead be given to the slide-valve, or advancing the eccentric upon the shaft. The opposite defect is shown upon the card where the line is drawn in the direction *c d*. Having ascertained the point of cut-off, it should be noticed whether it bears the same ratio in both diagrams to the length of the stroke: then, if B C be too long, proportionately to A D, the slide-valve should be adjusted by the nuts, so that the rod is lengthened, and *vice versa* if B C be too short. When the line B C slopes in the direction of B *e*, it indicates wire-drawing from contracted passages, either ports or pipes. Fig. 3 represents a diagram taken from the front side of a horizontal condensing engine, 18in. cylinder, 26in. stroke, and 60 revolutions per minute. The defect in the exhaust and bad vacuum is easily seen, and a new valve was put in, cutting-off at half-stroke. This, of course, reduced the terminal pressure, and, as the dotted line shows, from a subsequent diagram, allowed the exhaust passage and pipe to carry the exhaust to the condenser easily, and to the considerable improvement of the vacuum. The diagrams in Fig. 4 were taken from a horizontal condensing engine, 20in. diameter of cylinder, 2½ft. stroke, and running 55 revolutions per minute. This exhibits somewhat of the faults of Fig. 3, save that the separate expansion-valve cuts off at half-stroke. But this engine had a long and tortuous exhaust-pipe, with five bends in it, and an ordinary jet condenser, the cubic contents of which was ·3,5 × the capacity of the cylinder. Also the covers were jacketed, and the ports arranged so that they could be filled with fresh steam at every stroke. The remedy was, of course, a larger condenser, more direct exhaust, and the jackets disconnected. Care should be taken at all times to exclude water from the cylinder of the engine, not so much from the fact that it distorts the diagram, but it is wasteful and injurious to the engine; many total wrecks are to be attributed to no other cause. When indicating with water in the cylinder, the line B C, Fig. 2, is lower, and the exhaust line A D shows considerably more back-pressure. This results from the fact that the water lowers the temperature of the entering steam, thus affecting its pressure, and becoming heated, and rapidly evaporating under the diminishing pressure within the cylinder, adds to the quantity to be exhausted, and consequently increases the back-pressure. A similar defect is apparent when the piston is leaky; but as that can be tested by means of the indicator cocks from time to time, it ought not to require a diagram to show it. Let the crank be just past the centre on either side, let the engine be loaded, and turn on enough steam to show pressure, but not to move the engine. If, now, the cock farthest from the piston be turned on, and it blows steam, there is enough to justify the removal of the cover. When that is off, move the engine round till the crank has turned the centre farthest from the broken joint. Load the engine, and turn on a little steam. If the piston is leaky, you will see where; and if it be the valve face, the steam will issue from the port. The diagram shown, Fig. 5, is a copy of one taken from a non-condensing horizontal engine, 16in. diameter, 2ft. stroke, and 50 revolutions. The loop and subsequent rise of pressure during exhaust were caused from the fact that the exhaust-pipe terminated in a series of stacks of 1in. steam-pipe, used as a dryer, and was evidently a great hindrance to the engine. The apparent wire-drawing in this case was caused by a steam-pipe leading out of the engine-pipe to a donkey-engine, used for feeding the boiler. It is evident that if a feed-pump of sufficient capacity were connected by means of an eccentric and rod to the crank-shaft of the engine, and the steam formerly used to drive the donkey-pump be applied *through another pipe* to the dryer, the result would be considerable economy in working compared with that shown by the diagram. I remember taking a card from a large engine, one side of which showed a late admission, or no lead; observation showed that the eccentric was in the right position, and the corresponding diagram was all that could be desired. Now, to have altered the length of the rod and equalised the lead, then advanced the eccentric until the lead was correct, would have been the remedy, had it not been for a mark made upon the crank-shaft opposite the eccentric at a time when a good card from each end was obtained. The valves were of an improved style of balanced slides, that are seldom met with, very simple, and proving themselves the best I ever saw; they had a rod connecting them, with an ordinary taper key driven into a slot to tighten the rod and valve together. This had become loose, and each time jumped up until stopped by the steam-chest cover, thus making the valve late in action both ways, while, of course, the other end was undisturbed.

FIG. 2.

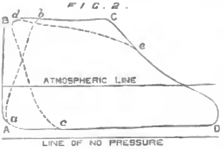


FIG. 3.

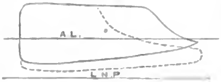


FIG. 4.

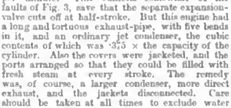
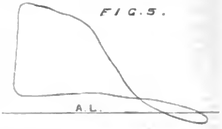


FIG. 5.



A good round corner at A, Fig. 2, shows a fair amount of cushioning; but should this commence to rise at *c*, it shows that there is too much lap on the exhaust sides of the slide-valve, closing the exhaust too soon. A fair amount of cushioning is necessary for an engine to run noiselessly, and to prevent undue strains; but it sometimes causes the very evils that it is designed to remedy, especially in cases where the engine is a long distance from the boilers, and the pipe is not well lagged with non-conducting material, resulting in the admission of water into the cylinder, which does not, like steam, obey Marriotte's law, therefore, offers a solid, and often serious obstruction. Sometimes the drain-cocks are opened a little way, which certainly relieves the strain and removes the noise, but increases the back-pressure by the admission of air—a considerable loss in a large condensing engine. Relief valves are sometimes added, keeping the existing drain-cocks for starting and stopping. The only objection to these valves is the noise they make in closing, making a stranger look about for a loose key or pin, and giving one a general idea of something being wrong.

Some engineers keep the exhaust open till quite close to the end of the stroke, and make the lead early enough to bring the piston to rest; this is evidently a waste—to use fresh steam, and let that which has done its work go free. This system is done by grooving the edge of the valve, so as to allow of a gradual admission of steam. This is shown in a diagram by the slight angular rise from a rather sharp corner of the line A B, Fig. 3.

Fred. Walker.

A NEW STOP-COCK.

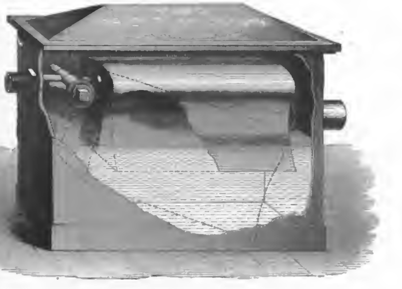
[20885.]—Allow me to lay before your readers a great novelty in the construction of steam, and other stop-cocks, which, I think, will prove a very useful and effectual improvement in what, at first sight, looks like the old-fashioned form of stop-cock.

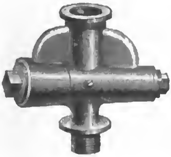
It occured to Mr. Dove, the inventor, that the ordinary cross-head of a steam-engine offered a suitable pattern for a stop-cock with a steady action and long bearing surfaces, and he has carried the idea into practice in a manner well deserving of notice.

The plug is hollow, longitudinally, and has three ports in it, two on one side, and one middle one on the other. The two outer ports open to similar ports in the "cross-head" portion of the cock, and into these ports the flow takes place, the two currents meeting at, and flowing out of the central port.

By this arrangement, there are very long contact surfaces of metal and metal, which prevents leakage, and the angle of rotation, instead of being 90°, may be made 180°; and this fact, coupled with another important feature, that the whole is equally expanded, when used with hot water or steam, commends it to my mind as one of the best forms ever produced, while its price is far below that of screw valve cocks, although equally reliable, and more speedy in action; taking but a second to shut off steam.

I send you a diagram of its application to the bell of a steam trap, which almost explains itself. The bell becomes lowered by the condensation of the steam inside it: this opens the tap, and lets out water (if any). When the water has escaped a whiff of steam lifts the bell and shuts off the further exit of steam. Its action is very prompt and efficient.





The other diagram shows the general form of tap used with the steam trap, but it is manufactured for all purposes by Messrs. John French and Co., of 71, Commercial-street, London.

Thomas Moy.

GRINDING AND POLISHING GLASS SPECULA.

[20886.]—I would first express my sincere thanks to "L. L. L.," (20755), W. S. Scott (20807), and to others who have communicated with me privately in answer to my last letter, whose information I hope to weave into my future letters, so that as much as possible may be given to our readers; I would only now pass a few remarks on "L. L. L.'s" and W. S. Scott's excellent letters, while I would still wait for others to add their mite, either through our columns or to me direct.

Referring to speculum metal, I may state by the way, that I have found common slate pencils cemented on to the tool and filed nearly half way into shape, then ground with a little emery to bring all up, then used aloes (with water of course), to answer well as a bed of hones as it is called, for smoothing the speculum metal previous to polishing. As to the speculum being thin enough to give to the shape of the polisher, this only shows me that the old workers had no real idea of the delicacy of the curve if it is to be true, and confirms me in the conviction that they did not make so good telescopes as we are apt to credit them with. Can any one tell us how many of all the specula that Herschel made he considered perfect? I think I have seen it stated somewhere that out of 400 that he made during his lifetime, he considered only one perfect, and that was a small one about 7in. diameter. I think the truth or otherwise of this would be interesting to know. Lord Rosse found that with his large 6in. thick speculum a strong pressure with the hand on the back utterly spoiled its definition. What if it had been thin enough to follow the tool, instead of the tool wearing it into shape!

It is interesting to notice that the Rev. Edwards, a hundred years ago, found that the tool ought to be about $\frac{1}{15}$ larger than the speculum, as I mentioned in my last letter the late A. Ross and Herschel also found. This is, of course, when the speculum is worked on the top of the tool.

The elliptic tool $\frac{1}{4}$th more one way than the other, with the shorter diameter the same as the diameter of the speculum, would only be equivalent to a tool about $\frac{1}{18}$th larger than the speculum, which is about Herschel's proportions.

I think with "L. L. L." that the central hole mentioned by Edwards, applies to the tool for the small mirror (and perhaps to the large one) of the Gregorian or Cassegrain, and not for the large mirror of the Newtonian.

As to the testing then used, as given by "L. L. L.," it only shows how rough it was, and that any local defects could not be detected, and therefore a good mirror was a matter of accident. We are much indebted to the Foucault test for the modern improvement of the reflecting telescope, as it reveals and makes intolerable defects that could not even be seen before, except in a general want of good definition, which they could not trace to its sources, and therefore could not directly address themselves to the correction of. They had to act upon the "hit or miss" system of experimenting till they accidentally got it better. Again many thanks to "L. L. L." and W. S. Scott for their valuable notes of the old mode of working.

We will now proceed with our subject of figuring, and take up now the other position of the polisher, viz., on the top of the speculum, and in this position two modes of figuring are used. We will consider and dispose of local polishing first: this is specially used for large mirrors, and even for small ones by some amateurs. It consists, as most know, of using a series of polishers differing in size but all smaller than the speculum. These have to be used according to the judgment of the amateur, as to how much the centre or a zone has to be sunk, and what part specially. Now as to this mode of figuring, I feel I cannot too strongly condemn it; because it is apt to lead to an error, that no testing can detect and distinguish from other causes of deficiency of definition, and which error nothing can remove but repolishing as a whole the entire surface. All this leaves us open to the "hit or miss" style of experimenting till we get it better. Now, I know it for a fact that some amateurs have been trying for months to get good definition by this mode of figuring, and utterly fail—as well they might when we see what local polishing is apt to do to a mirror. I always pity the case of an amateur who writes to me, asking my advice, and telling me that he has got his mirror to show the shadows pretty correctly—much better, he is pleased to tell me, than they were six months ago; but that there is still remaining a little elevation here (giving me a drawing of the shadows and face of the speculum), and a small falling-off there, and the edge is a little turned down—but not so much as it was, he is happy to tell me: so he thinks he is improving, and getting control over the figure; but it will not give such good definition as he could wish—not so good as a friend's of his who has a With or Calver's mirror. Now, he cannot exactly see why; for the shadows seem to come on pretty nearly the same as in his friend's, and he has been very much perplexed with this fact: and would be very much obliged if I could help him by telling him where his fault lies. He is confident he has followed out the instructions, meagre though they were, for the use of the local polishers as well as any one could. And then he has so sunk the centre that there is no outstanding spherical aberration when tested by zones on a star or planet—and this is what most puzzles him, for he had always thought, and been taught, that what is called spherical aberration was the cause of bad definition, since there is no chromatic aberration possible from a mirror; and when he got, with much labour, the foci of the zones on a star or planet to be at the one place, he thought he should be all right; but after all his trouble, he finds it is not so, and he is very much discouraged. Can I help him?—Well, who could resist such an appeal? I must try to answer him; but this necessitates an explanation of the fact that the so-called spherical aberration is not the only aberration the amateur has to contend with. Now, for the sake of distinguishing this so-called spherical aberration (for an ellipse has aberration) from the other aberration, which I shall have to explain, we will call the spherical aberration longitudinal aberration, because it is lengthways of the axis of the speculum; and the second aberration we will call lateral aberration, because it is sideways, or across the axis of the speculum, and this will need some explanation. It is illustrated in Fig. 1, where great exaggeration has to be used because the real deviation from a true figure is so small that, even with the Foucault's test, or the zonal test, it may be utterly impossible to distinguish it from the effects of longitudinal aberration; in fact, the definition may be utterly spoiled by an infinitesimal irregularity of surface that no measurement could detect, and may be caused by half an hour's local polishing, or figuring, as it is called. In the figure the plain line A B is the shape of the amateur's speculum, the dotted line the true figure. It will be seen that there is a depression at C, and an elevation at D, on the opposite side. Now, the light from the sloping sides of the depression C, and the elevation D, would be reflected, not to the true focus E on the axis E F of the speculum, although upon the same lateral line G H, and therefore at the same distance from the speculum, and would therefore need no alteration of the eyepiece; and so likewise with

FIG. 1.

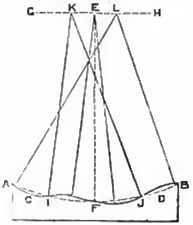
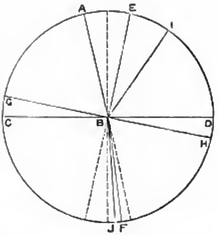


FIG. 2.



the rays I, J meeting at K. Now, the distance K L is the lateral aberration of the irregular curve the amateur has got by his months of local figuring; and it must be evident to all who think, how small an amount of local irregularity in the surface would cause that amount of lateral aberration that would destroy the definition of a line, say, when the image of that line is magnified with all its lateral aberration, by a high-power eyepiece, the sharpness of the edge of a line would be more destroyed by an inconceivably small deviation from symmetry of figure causing lateral aberration than would be caused by many times more longitudinal aberration. Now in this latter aberration (supposing symmetry of figure), since the images are all in the line of vision, the images formed by the various zones must be separated considerably more longitudinally than laterally, to cause the same amount of bad definition. In fact I find that a little under or over-correction of longitudinal aberration makes no perceptible difference in the definition; and it is the difficulty of avoiding getting the surface out of symmetry, and thus causing lateral aberration, that has led, I believe, to the notion that a little under-correction for longitudinal aberration is better than a littte over-correction; the fact really being, I believe, that those who use local figuring find they had better do with as little figuring, or I had better call it, *disfiguring*, as possible, and that the under correction had better be left, and attempt no more, if the figure is pretty good, than risk any more figuring, or disfiguring as it may turn out to be, by deteriorating from the former definition by causing lateral aberration, though the longitudinal aberration has not been overpast. The only remedy is to repolish, when lateral aberration has set in, with a tool the same size as the speculum, and begin afresh to locally figure (that is, if the amateur or the one in the trade knows no better way to figure), with the hope that better success will attend him this time. It is this aptitude, especially in the hands of amateurs, to get the surface out of symmetry by local polishing in the endeavour to remove the longitudinal aberration, that makes me utterly condemn it and recommend the amateur to have nothing at all to do with it: we will leave it to those in the trade who have more experience in the use of it, and who may now and then produce a perfect speculum by its means, while we will follow a more excellent way, because absolutely certain—a way that the trade ultimately will, I believe, have to adopt. "Prismatique" has frankly acknowledged that the trade has had to learn from amateurs before, and I hope we amateurs shall be able to help them again. At the same time, we will not upbraid them, for no doubt they are doing their best, even now, under the gentle pressure of us amateurs. It may be well for the amateur to read over again what I have said on lateral aberration when caused by flexure in two of my former letters, 19237, par. 4, and 19388, par. 4.

But some in the trade may say, "Some good object-glasses have been figured by local polishing, and it is acknowledged that the speculum is not quite equal to them on stars, though on planets it may be; therefore, local polishing does not deserve the denunciation you give to it." My answer is, The object-glass maker may get his surface much more out of symmetry than the speculum maker his speculum surface, and yet not show so much in the definition: for this reason, a defect in a refractive surface is not so detrimental in turning the refracted ray out of its proper course as the same defect in a reflecting surface would be in turning the reflected ray out of its proper course; in this way a small defect that would not matter in an object-glass may perceptibly injure the definition of a speculum. This will be easily understood from Fig. 2. Let A B be an incident ray on the glass surface C D, which being both refractive and reflective, will enable us to trace the ray as reflected and refracted. The ray will be reflected to E and refracted to F. Now suppose a defect in the surface at B, a depression in fact with one of its sloping sides in the line G H, (E B becoming the perpendicular), the reflected ray would now reach I and the refracted ray would reach J. Now the distance J F of the refracted ray caused by the defect is the lateral aberration, as we may call it. Now the much greater distance or lateral aberration E I of the reflected ray is caused by the same defect only. Thus we see how much more detrimental is the effect of a fault on a reflective surface as compared with the same fault on a refractive surface. In this particular the object-glass worker has the advantage over the speculum worker; but there is this great advantage in studying speculum working—it drives us to deviso means of producing a more perfectly symmetrical surface, which, when we are master of, we can apply to the working object-glasses, with the expectation of far greater perfection than if we rested only in the surface required to make a tolerable object-glass—all this I am keeping in view in my investigations for the benefit of the object-glass of the future, as well as the reflector of the future.

The substance of what I have just shown is that symmetry of surface in a speculum is of paramount importance—far more, in fact, than freedom from all longitudinal aberration; and if there be a defect let it be symmetrical, so as to throw all the rays from any zone to a common focus on the axis of the speculum, even though they do not exactly meet the foci of the other zones. In other words, a little under or over correction, as it is called, of spherical aberration, is nothing near so bad as a very little want of symmetry of figure causing lateral aberration. Now I hope to teach the amateur to absolutely do away with all the spherical aberration with the greatest ease and certainty, and produce a symmetrical speculum as well. As to the comparative ease for the amateur of object-glass working versus speculum-working, the consideration of this the amateur had better leave till he has fully before him the excellent letters of "Prismatique" on the object-glass working, in which the easiest way for the amateur will no doubt be given, and my letters on the speculum working, which, though more lengthy, are only so because I seek to explain the laws; but the actual working in practice is very simple, and the more so because the reason why of everything is known.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

A VIOLIN WITHOUT A SOUNDPOST.

[20887.]—In the effort to improve the violin, I have found the addition of a soundpost to be a delusion and a snare, and though this deception has lasted many years as a consequent ignorance of the law of vibration, yet Truth, my hobby-horse, cannot be driven to death, but is bound to win. Suppose I take a free reed, and, instead of moving it up and down, I vibrate it from side to side, would the result be good? "Capt. Cuttle" would, according to his reasoning, put four of these reeds on a sounding-box, and finding the sound perfectly muted, place a soundpost underneath—not, however, to produce equality, but to move the soundboard up and down by a reaction from the back, and contrary to the motion of the reeds. But who ever heard of soundposts applied to reeds with good effect, or any other vibrating medium being benefited thereby? Harps, pianos, organs, have discarded the soundpost, and, in the words of "Capt. Cuttle," have been allowed to die a natural death. So will the violin soundpost die in time. The Rev. H. R. Haweis says: "It took 200 years to convince people that the timbre lay with the wood, not the strings; nor could the old masters see that tone would only arrive with an extended study in the properties of wood, and a radical change of model." But I have made the discovery that strings and wood must move in the same direction to produce the best result. I must warn "Capt. C." not to call the soundpost a simple addition, which steps in unobtrusively: on the contrary, it is the greatest nuisance to entertain, for days and weeks may be spent on the adjustment of it. Its position exhausts the patience of the maker and repairer of violins, though I admit it is easy to apply to bass instruments, they being less affected thereby on account of their larger vibration. Now, actions speak louder than words, so I propose that "Capt. Cuttle" and myself should each make a violin, he with a soundpost, and according to the old form, and I without a soundpost, in accordance with my new violin. A rough model need not take more than a week to make; staining and varnishing can be left out. Fair-play is a jewel, and no doubt Mr. Schucht and Mr. Davies will see justice done. I do hope the Captain won't back out "because he is an amateur, or only a tinker," &c., for he writes so professionally, that he ought to be able to perform something equal to his pretensions to knowledge. A clever correspondent of *Musical Opinion* asks, "Will it pay to construct violins on this plan? (the old form). Good violins, with rare exceptions, are not the product of accident; and it is much less labour to construct by rule than to make a score of fiddles to obtain one tolerably good violin. Why should not an artist know how to make a violin by correct rules, as he knows how to make the flute or any other musical instrument? Again, if as good instruments can be made here as at Cremona, why not make them? You will not pay for them! Cremonas were not made for one or two pounds. An artist will pay from seven to fourteen pounds for a flute or cornet, and at the same time be looking for a thirty-shilling fiddle, when it costs more to make one good violin than both the other instruments, and at the same time requires the skill of the fine artist and the scientist." My hobby-horse and long bow are in good condition; but I will not comment on the above.

Fiddler.

EXTRAORDINARY VIOLINS.

[20888.]—Many thanks to "War" for the notice of violin invented by M. Chanot. I beg to suppliment it with the following. This invention relates to the improvements of the tone and expressive power of violins and other musical instruments of various kinds, by the introduction therein, or addition to, of what is called a bell harmonica. It consists of a flattened tube, or elliptical chamber of glass, placed in the interior of the body of the violin, the two ends of this glass piece being carried by two end blocks of wood. These blocks are supported from the ends of the instrument by means of a light pole or bar of wood fastened to the ends of the instrument, and passing along the interior of the glass shell. A bow-shaped, or semi-elliptically formed bar of lancewood is placed transversely across the body of the instrument above the glass shell to support a soundpost, the top of which carries the breast of the instrument. Finding, however, that the soundpost was non-efficient, Mr. Hy. Bell, used a rectangular plate of glass, curved transversely, supported at each end on blocks, and with a perforation for the soundpost to pass through from belly to back.

But as our readers do not like to take their violins to pieces, here is another invention that anyone can apply. It is the addition of a horn or trumpet, in such a manner that the latter shall open into the interior of the violin, by which means the vibrations of the latter are greatly increased, and its tones rendered much more powerful. The tube of the horn may be inserted at any point; but it is preferred, in order not to cut into the body of the violin, to insert the horn at the point where the neck of the violin is usually attached, a hole being opened for that purpose into the body of the violin. At the end of the neck a screw is attached to the horn. The fingerboard is also attached to the latter, the whole being so arranged that the size and shape of all the parts that come in contact with the hand of the player are the same as in the ordinary violin. By means of this modification tones are produced upon instruments of this description superior to anything attained before. This invention is very suggestive, if the tube of the horn could be fingered with the violin. I sincerely hope that "ours" will be on the *qui vive*, and give more illustrations of various violins. Will Mr. Schucht, "A.," of Liverpool, &c., oblige a—

Fiddler?

TUBERCLE BACILLUS.

[20889.]—As I have seen no reference to this subject in the pages of the "E.M.," I think a few remarks, while answering "E. W." (query 48839), may interest some of our readers.

The Bacillus tuberculosis is found in greatest abundance in the cheesy portions of phthisical sputa, in fact, in portions of expectorated tubercle, especially the non-reticulated form. Koch and Ehrlich have successfully demonstrated its existence by staining the organism and surrounding substance different colours, but as the results obtained by their methods are not always successful, and even when so are decidedly inferior to that recommended by Dr. Heneage Gibbes, I will confine myself to the solutions recommended by him, and his method of using them, while the plan I have myself adopted for mounting after staining will alone be given.

No. 1—

Magenta crystals....	2	grammes
Pure aniline	3	,,
Alcohol sp. gr. 830 ..	20	,,
Distilled water......	20	,,

Mix the aniline and spirit, reduce the magenta to a fine powder, add the spirit slowly while stirring till all the magenta is dissolved; add the distilled water in the same way, and place in a stoppered bottle without filtering.

No. 2—

Acid nitric, strong......	1	part
Distilled water	2	,,

No. 3—

Saturated alcoholic solution of methyline blue..	1	part
Distilled water..........	4	,,

The chemicals must be the purest obtainable, and distilled water alone used in their preparation and the subsequent washing. They can all be obtained ready made from F. E. Becker and Co.

The sputa, if possible containing some of the cheesy portions already mentioned, are placed on a glass plate and mixed with a small ivory spatula. A very minute portion is taken up with a clean camel's hair brush, and evenly painted over a cover-glass, care being taken not to go over the same place twice. The cover-glass is placed aside to dry in air. It will be found more convenient to prepare several cover-glasses in this way before proceeding with the following manipulations.

The cover-glasses, when dry, are passed three or four times rapidly through the flame of a spirit-lamp; this fixes the sputa, and they may be placed aside for an indefinite period before staining.

The cover-glass, sputum downwards, is floated on solution No. 1 for 20 minutes (the solution during the time being kept at a temperature of about 104° Fahr.), and then placed on solution No. 2 for 10 or 12 minutes; this latter operation removes the stain from everything except the tubercle bacillus.

The cover-glass is next washed in distilled water, with frequent changes, for half an hour, floated on solution No. 3 for one hour, at the ordinary temperature; again washed in distilled water, and (the excess of water being previously removed with blotting-paper) placed aside to dry. When dry, the cover-glass is again passed through the spirit-lamp, and on cooling, mounted on a thin glass slip without the addition of any medium.

The best way to fasten the cover-glass to the slip is to pass a brush charged with some thick cement round its edge before placing it on the slip.

By this method, the tubercle bacillus may be detected with a good 1in., while any ordinary dry quarter will show it distinctly as a small red worm on a blue ground.

Sections of lung may be treated in the same manner, and mounted in—

Glycerine	1 part
Solution of gum	5 ,,

The solution of gum should be of the same consistency as the glycerine, and a lump of camphor should be placed in the bottle in which it is kept. I do not recommend chrysoidine for a second stain, as it renders photography impossible.

These organisms measure from $\frac{1}{4000}$in. to $\frac{1}{12000}$in. in length. The observer should be extremely careful not to mistake the coloured bands produced by minute markings and an inferior object-glass for B. tuberculosis.

If the sputum is not fresh, almost the entire blue ground will be found to consist of B. termo, spirilla, torulæ, &c., while B. tuberculosis is alone stained with magenta.

A. Cowley Malley.

LEGAL REPLIES.

[20890.]—Glasshouse (48952).—As the proposed glasshouse will not in any way interfere with the neighbour's light, I can see no objection to its being built; nor can I give any rule as to the height allowed above the party-wall. But there are by-laws relating to buildings in many towns and places, and these may have to be considered. The querist must also look at his lease, if he has one, or at any deed of covenant that may relate to the property, as the erection of such additional buildings may be thereby forbidden.

Factory Act: Coachbuilders (48954). — The Factory and Workshop Act, 1878, applies to every workshop where manual labour is used for trade purposes, and where children, young persons, or women are employed. A "young person" in the Act means one who is over 14 and under 18 years of age. If the apprentices employed at the coachbuilder's are under 18, his workshop will come within the provisions of the statute.

Local Board—Electric Lighting License (48954). — A local board wishing to establish a system of electric lighting must apply for and obtain a license to do so from the Board of Trade, and not the Local Government Board, and must comply with all the rules and conditions laid down in the Electric Lighting Act, 1882 (45 and 46 Vict., c. 56), passed last year, and now in operation, which the querist had better get and consult.

Sale — Agreement (48969). — Although the querist may deem the verbal agreement as binding as the written, it is generally not so in law, because the rule is that parol evidence to vary or contradict the contents of a written document cannot, in general, be received. He would have acted more wisely if he had had *all* the terms of the contract in writing. As matters now stand, the querist has given a written order for goods which have been delivered to him. *Primâ facie* there has been a sale, and he can only get rid of his liability by proving fraud or breach of faith on the part of the vendors, in which he may or may not succeed, according to the evidence heard at the trial. As to the paint he has clearly acted as if he had bought it by paying for part, and he will have to pay for the remainder. He had better settle both cases, and be more careful for the future. He will only lose more by going to law.

Unhappy Marriage (48980).—This is one of those cases in which lawyers are practically helpless: though we are often asked and expected to do wonders. A suit in the Divorce Court for the restitution of conjugal rights would cost quite £50, and would not attain the desired object. You can bring an action for damages against anyone who harbours your wife after you have given him notice not to do so, and also against anyone who has persuaded her to leave your house, and so has deprived you of her services. But these actions are rare, and though maintainable, I have never known one of recent years. Still, such an action could be brought, but only in the High Court, I think. You had better consult a solicitor on the whole case.

Spirits—Duty (48985).—The Customs and Inland Revenue Act, 1881, imposed a duty of 10s. 4d. a gallon upon spirits, and includes "Methylic alcohol purified so as to be potable." I presume this means drinkable, and so I should think that disguising methylated spirit in a scent would not make the user liable to pay the full duty as if he used pure spirit; but I am not certain, this being a special point of Excise law.

Master and Servant—Notice to Leave (48990).—This is a very confused question, and the main point, whether or not the principal consented to the querist's leaving without notice, is not stated. Presuming there was no consent and no notice, then the querist is liable to pay damages for his breach of contract in leaving without notice, and if he sued for the fees due to him for tuition, the principal could bring in a set-off or counterclaim for these damages, which is what his solicitor suggests and intends. Probably a quarter's notice would be necessary; but this would depend upon scholastic custom. I cannot recommend a solicitor.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

CARBONATES — CAUSTIC SODA AND CARBONATE OF SODA — ANALYSIS OF ELECTRO-PLATING SOLUTIONS—CARNAUBA WAX—ANALYSIS OF BINOXIDE OF MANGANESE—COLZALINE OIL—STUDYING ANALYTICAL CHEMISTRY.

[20891.]—"Carbonates" (query 48608, p. 280) are practically insoluble in ordinary methylated spirit. The specific gravity of methylated spirit varies with the alcoholic strength, and if by this term the querist understands the "purity," the specific gravity is a satisfactory indication. It must be remembered, however, that a special license is required for the sale of methylated spirit, and those vendors who are not licensed are compelled to add one ounce of shellac to each gallon of the spirit, thus modifying the density and rendering the liquid pretty nearly useless for anything but making varnish. The shellac can be recognised by the fact that the "finish" leaves a resinous residue when allowed to evaporate, and produces a milky precipitate when poured into water.

"Caustic soda and carbonate of soda" (query 48776, p. 305) can be separated by treating the mixture with alcohol. The alcohol must not be methylated, and should be re-distilled from some caustic and carbonate of sodium. I do not say this method is the best, but the ordinary do not appear to satisfy the querist. Still, I do not see why he should not obtain very fair results.

"Analysis" (query 48682, p. 282) of a silver-plating solution for the amount of free cyanide of potassium may be effected by at once titrating the liquid with decinormal solution of silver nitrate until a permanent white turbidity is produced. Each 1cc. of silver solution (containing 17·0 grammes of $AgNO_3$ per litre) used represents 0·01302 gramme of free potassium cyanide. The process is very simple, and the end of the reaction easy to observe.

"Carnauba Wax" (query 48804, page 306) is a troublesome substance to estimate in soap, as "Perplexed" appears to have discovered. I think the querist will find the best plan is to dissolve 20grm. of the soap in spirit, and boil down the liquid with about 50grm. of clean sand, stirring all the while. The product is then thoroughly dried in the water-oven, and next extracted with redistilled petroleum-spirit in a Xoxbeth's tube, in the manner described on p. 127 of the book mentioned by "Perplexed." The petroleum-spirit should then be shaken with warm water to dissolve out any soap which it may contain, and may then be separated from the aqueous liquid and evaporated to dryness, when the alcohols derived from the saponification of the waxes will remain as a residue. I shall be glad to learn how the querist succeeds by this method, and shall be happy to give him any further assistance in my power.

"Analysis of Binoxide of Manganese" (query 48926, page 347), for the amount of iron present, may be effected by dissolving a known weight of the sample in strong hydrochloric acid, reducing the solution with zinc, and titrating with standard bichromate solution. The method is simple and accurate. I know no simpler plan of obtaining even approximate results.

"Colzaline Oil" (query 48446, page 214), I should suppose, from its name, to be a mineral oil intended for use as a substitute for colza or rape oil. Mineral oils are incapable of saponification, and may thereby be distinguished from fixed oils of vegetable or animal origin. The method of procedure consists in boiling the oil with alcoholic potash till the spirit has evaporated, then adding water, and shaking the solution of the resultant soap with ether. This is separated from the aqueous liquid, and on evaportion leaves any mineral oil or rosin oil which may have been contained in the original sample. "Oilman" will find a full description of the method in Vol. II. of my "Commercial Organic Analysis."

The querist who desires to qualify himself for the post of "Analytical Chemist" to a chemical manufacturer (query 48642, p. 260), may proceed in several ways. He may study at a recognised college for some years, but should be careful as to his choice. The School of Mines is about the very last for this purpose, as there is only nine months attention given to chemistry out of a three years' course of study, and the knowledge of chemistry which students there acquire is by no means of a practical character. They generally have to learn all but the bare rudiments afterwards. Another course the querist can adopt is to study, not necessarily as an articled pupil, with a consulting chemist, having a practice which includes the examination of the commercial products of such works as the querist aspires to a position in. In London chemists usually see special classes of practice, some being almost exclusively engaged in agricultural analysis, some in examining food or water, while others are metallurgical chemists, and so on. In a provincial laboratory the querist would see a greater *variety* of practice than in London, though the work here lies much in particular grooves, and choice must be made accordingly. It is not possible to give other than general advice in these columns; but I shall be glad to reply to the querist if he likes to write to me privately.

Alfred. H. Allen.

1, Surrey-street, Sheffield.

SPECTROSCOPE EXPERIMENT.

[20892.]—I made an interesting experiment lately with a miniature spectroscope, which, perhaps, some of your readers may like to repeat. I placed a small piece of sodium, about the size of a pea, on the top of a glowing coal-fire free of flame; then turning my spectroscope upon it, I waited until, in a few seconds, it melted and burst into flame. At first, I saw the usual yellow line, D; but in one or two seconds, so dense a vapour of sodium surrounded the burning metal that the D-line was reversed, and I saw it *black* in the midst of a glow of yellow. I saw also a bright green line in a position which the micrometer scale gave as 33, the D-line of the sodium being 23 on the same scale. The wave-length of this green line I calculated to be 5,530; and as the "lower magnesium line" is 5,527, it seems possible that it might have been caused by magnesium. I do not know if magnesium is often found in the ordinary sodium one buys, but I have no reason to suppose that my specimen was unusually pure. I repeated the experiment four times that day, and twice another day, each time with the same result.

The following list of scale constants, given in a letter from Mr. C. A. Young to the *Observatory*, December, 1880, may be useful to owners of small spectroscopes:—

Lower edge of lower band, Bunsen flame	λ = 5,635
,, ,, middle ,, ,,	,, = 5,165
,, ,, upper ,, ,,	,, = 4,740
D_1 middle of pair	,, = 5,892
Lower magnesium line	,, = 5,527
b_1 magnesium line	,, = 5,183
F_1 hydrogen β	,, = 4,861

R.

"MAKE YOUR OWN GAS."

[20893.]—The apparatus offered as made by me and described by your correspondent (letter 20872, p. 362), is certainly *not* mine, although the generator most probably was purchased from me; this being the smallest and least important part.

As the insertion of such an advertisement leads to unpleasant correspondence, and possible deception, I supplement it with a disclaimer.

Thomas Fletcher.

DOMESTIC RECIPES.

Beefsteak Pudding.—Sift a teaspoonful of baking-powder with two cupfuls of flour, add half a pound of beef-suet or butter, chopped very fine, and one cupful of water. Mix and roll out, line a well-buttered pan with this pastry, cut two and a half pounds of round-steak in neat scallops, and mince a small onion fine; place a layer of meat on the paste, season with the onion, and with salt, pepper, thyme, and parsley; then another layer, and season, and so on till the steak is all used; fill up with cold water, cover it with paste; place a buttered paper over, set in a saucepan with boiling-water to reach two-thirds up the outside of the mould: steam this two and a half hours, turn carefully on a dish, and serve with any kind of meat-gravy.

Robin's Soup.—One quart of split peas, two ounces of flour, two onions, one ounce of butter (or it is excellent without the butter), and a little mint; one gallon of water. Boil well together, and season with pepper and salt. Cost of materials, 7d. per gallon.

Robin's Plum-Pudding.—Half a pound of currants, quarter of a pound of raisins, one ounce of candied peel, two ounces of sugar, one egg, one pound of flour. Boil from two to three hours. Cost of materials, 10d. Cost of soup, pudding, and bread for eight persons, 1s. 8d.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47602.]—**Cleaning Plate.**—Surely a mop or brush can be made to reach the parts. If so, try hyposulphite of soda in saturated solution; but if you cannot reach the parts with anything in the shape of a rubber, I am afraid you will have to pickle in cyanide solution.—T. P.

[48092.]—**North-London Engines.**—I append some of the dimensions of these engines:—cylinders, 17in. by 24in.; wheels (6-coupled), 4ft. 4in.; height of chimney from rail, 13ft.; centre of leading wheels to centre of smokebox, 4ft.; centre of smokebox back of front to buffer beam, 2ft. 3in.; centre of driving to centre of leading-wheels, 5ft. 6in.; centre of driving to centre of trailing, 5ft. 8in.; centre of trailing to back of trailing buffer-beam, 6ft. 6in.; total length of frame, 24ft. 1in.; length over buffers, 27ft. 10½in.; centre of cylinders to centre of driving-wheel axle, 9ft. 8in.; breadth of buffer-beam, 1ft. 3in.; length of tanks, 10ft. 11in.; diam. boiler (outside), 4ft. 2in.; height of frame from rail, 4ft. ½in.; centres of buffers from rail, 3ft. 4in.; firebox extends above trailing axle, 6in.; centre of boiler from rail, 6ft. 6in.; height of coal-bunker, 3ft. 6in.; length of coal-bunker, 1ft. 10in.; capacity of coal-bunker, 25cwt.; pressure on safety-valve, 160lb.; capacity of tank, 879 gallons. The engine is powerful; the tractive force being 133·38lb. for every pound of effective pressure on the pistons. The driving and trailing-wheels are fitted with wooden brake-blocks, and have their springs fitted with compensating beams. The counterweights on the wheels are very large, and made in one piece with the spokes. They take up about one-third of each wheel, and there are no spokes; but it is solid on the counterweight side. I will send a sketch if necessary.—E. W.

[48237.]—**Equatorial Circles.**—I was hoping that some one practically connected with this matter would reply to you, as I should very much like to see it thoroughly described in these pages. If you will refer to pp. 190 and 363, my hints there will give you some idea how to set about it; but as regards the R.A. circle, I must tell you that my reply on p. 363 is intended more to convey the principle of the vernier-reading than the practical application. I would certainly advise you to adopt the rotating hour-circle (see page 380, Vol. XXVIII.; also page 296, Vol. XXXII., for description of new equatorial stand), as the advantages are so great (see also p. 134 present volume), and to obtain good results with the minimum of work, I would recommend the following plan from practical experience:—If you live near London, you could go to Smith's, a dealer in brass tube, &c., in Clerkenwell, and obtain two bands of tube about 9in. diam., so that one can rotate on the other without shake; otherwise you must make your own from brass bands in one piece, so as to have only one joint in each circle. The smaller circle must have the joint (butted, not lapped) made and strengthened inside. This is to fit on a turned disc of wood about 1½in. thick; the other must fit this as truly as you can make it, but the "butted" joint must be strengthened outside. The division-marks can be made right across the width of the outer band; but the lines of the vernier must be on the upper edge, so that the two sets of divisions may be contiguous. The disc carries the telescope in any convenient way that will allow the latter to be moved in declination. Now the outer circle has to be divided into 24 hour-spaces, and I think you would manage it best in this way: get a strip of thin glazed paper, without folds or creases, make a fine ink-dot on the lower edge of band; when dry, put the paper strip carefully and closely round the band, and clip to the proper length till the ends just meet; take the half of this strip, and measure round the band, first one way from the ink-dot and then the other, being careful to check off your measurements always before proceeding to the next division. Three bi-sections will give you eight divisions on the band, and now each of these wants dividing into three spaces. You must not punch figures or hammer the band, or you will distort it; you must also bear in mind that as the vernier will read at the lower edge of the band, the divisions want marking there with all the accuracy you can command, or your labour will be in vain. If the inner circle fastened round the wood disc be 1in. broad, the outer one can be about half the breadth, and so placed that the vernier shall keep the outer ring a ¼in. up from the bottom of the inner one, assisted by a similar vernier placed 12 hours distant from the first, or by three metal studs fixed to the stand. The vernier may be made from a piece of stout sheet brass, top edge straight, but curved to the inner circle, so as to fit close to prevent the outside (hour) circle slipping down between. You must allow 1in. or more in the length of the vernier beyond that required for one hour's space, to fix it to the stand with a flat-headed screw, one on each side of the divisions, with the holes slotted about ½in. to allow a little to and fro adjustment. The middle portion of the vernier is to have a space marked off exactly equal to one hour's space on the circle, and this space is to be divided into 30 divisions, or some other number that will divide 60 minutes without leaving any remainder. Suppose you divide it into 30, then, as the vernier is fixed and the hour-divisions move with the telescope, each mark will in turn pass along the vernier, and as each division on this will equal two minutes, and if each fifth division mark be numbered 10, 20, 30, 40, 50 minutes, it will be easy with a little practice to read the hour and minutes almost at sight. If you cannot divide the hour-space on the vernier into 30, a mathematical instrument-maker, such as Mr. Stanley, would do it for you at a small cost. If this be not clear to you, or you want more information, write again.—J. C. L.

[48290.]—**R.A. and Declination Circles and Verniers.**—I should like to correct a few errata in my reply on page 363. In first column, line 22, "C D is the reading length of vernier," the engraver has omitted to put a line at C close to the figure 4, similar to the line at D. In the diagram, Fig. 2, the figure 109 should be read as 9 and 10. Fifth line from bottom, *simple* should be *single*. Second column, 25th line from top, before "say" insert "a circle of."—J. C. L.

[48405.]—**Interference of Light.**—I just remark that I passed this question (as I do all others similar) because addressed to another by name; and I think querists often defeat their own object by such limitation. It asks why interference colours of a thin film disappear, and the film appears white as the latter gets thicker; and it is to be regretted that most text-books really do little to explain the matter. I am not sure I can without a diagram make it clear, but will try. The querist knows that no colour in the film is pure, but is a residual of what are left after one or more colours are cut out, destroyed by the clashing phases of the waves. Let him also remember that, although the longest visible waves are nearly double the length of the shortest, the ratio of the longest conspicuous red waves is to the shortest conspicuous violet only about 3 : 2. A film of the one-wave thickness of 2 would, therefore (I omit the half-wave dislocation of phase from the second surface for the sake of clearness—it does not affect the reasoning at all), bring the red waves of length 3 into half-wave phase, or destroy them, and the other waves give vivid complementary colour. But let the film equal 6 in thickness, or *two* "red" waves—this is now equal also to *three* blue waves; both *ends* of the spectrum, therefore, come fairly together, and the colour must be different and less marked, there being more correspondences. The greater the thickness, the *more* are the wave-lengths which come together, and if a slice of the reflected light be analysed, the more and the narrower will be both the strips of light from coincident waves, and the dark fringes from interference-bands. At first there are one or two broad bands, but they get more and narrower with the greater number of wave-lengths that will multiply "even" into the thickness of the film. But a lot of narrow bands through the spectrum give "white light," as any simple experiment will show. The querist can trace it all out by splitting a very thin film of mica, and examining with a prism or direct-vision spectroscope a slit placed in the reflected light from it. He will find the spectrum filled with narrow black bands, varying from 6 to 60, or more, according to the thickness: they soon become so numerous and thin as to be invisible to the naked eye. But lastly, the querist will see for himself that the ray from second surface is separated laterally from the ray reflected from the first; and he will readily see, on further reflection, that with a certain thickness this lateral separation of the two sets of waves attains such a magnitude as to exceed the limit of vibration of the ether-particles; and when this is so, the two sets of waves can no longer "interfere" with or act upon each other at all. I shall be glad to know if the querist has followed my attempt at explanation.—Lewis Wright.

[48476.]—**Metropolitan Ry. Engines.**—On reading the above I referred to my note-book, and find the following Metropolitan engines, 19 to 33, and 39 to 44, with coal bunkers 2ft. 6in. wide, weigh 42tons 12cwt. (not 42tons 2cwt.) full, and 35tons 14cwt. 5qr. empty. The class numbered 1 to 18, with coal bunkers 18in. wide, weigh (full) 42tons 3cwt., and (empty) 35tons 8cwt. 3qr. I find, moreover, that on adding the figures given by "Guide Yoke," they come to 43tons 1cwt. 3qr., and not 42tons 2cwt. The correct weights, I believe, should be—Bogie, 10tons 5cwt.; drivers, 16tons 11cwt. 3qr.; trailing-wheels, 15tons 15cwt. 1qr.; total, 42tons 10cwt. 45 to 49 class have coal bunkers 2ft. wide, and consequently are heavier than 18 class, and not so heavy as 19 class. But perhaps "Guide Yoke" will kindly explain.—George H. Fullerton, Edinburgh.

[48502.]—**Eyepieces.**—As I have not yet seen an answer to this query, here is a description of a Kellner that I have. Power of 55 on 78in. focus; the field-lens is a crossed one, 1¾in. diam., 2¼in. focus, flattest side to the eye. The eye-lens is a meniscus, $\frac{7}{16}$in. diam., very deep convex, and very shallow concave; concave toward the eye, and 1½in. focus, mounted 1¾in. apart, and no diaphragm. It gives a very large and brilliant field, but not flat, but flatter than a Ramsden. If "X. Y. Z." is near me, he can see and try it. Of the construction of an aplanatic I am ignorant, and should much like a description of it.—J. Hildersley, 76, Fortess-road, N.W.

[48509.]—**Harmonium Reeds.**—New sets of reeds can be obtained of any of the dealers, at about 11s. for the best; but so far, I do not see what "T. B." wants with a new set. He says that, with a high pressure of wind most of the notes flatten in pitch, but, whether he means temporarily or permanently he does not say. All the bass notes of harmoniums are slightly flattened when using extreme force on the bellows; but, if the reeds are made of decent metal, they ought not to be injured by the hardest possible blowing. If they have become permanently flat they are inferior, and it might be worth while having a new set; but you will need to have them the same scale. American reeds are not suitable for such work, being on altogether too small a scale. If you bend the free ends of the reeds you must also reset to obtain promptness in speech. If the reeds are made of good metal you can blow as hard as you like without fear of hurting them.—Henri Etienne.

[48533.]—**Angles of Pyramids.**—"M. I. C. E." cannot surely have read my replies to this query with the slightest degree of care. In the example in my last, the altitude is plainly given as 8ft., side of base 12ft.; how then can he say $\frac{6}{10}$ is arrived at by dividing the altitude of the right-angled triangle by its base, when its altitude is 8 and base 6? The fraction is arrived at by dividing the base (of triangle) by the hypothenuse, which (the hypot.) is the distance from apex to *middle of any side of base*, not, as he makes me say, to the middle of base, by which, I take it, he means to middle of its area. And in his example where the height is lowered to nought, the angle at apex will be 180°, as the sides of pyramid now lie in a straight line—in fact, it is no pyramid (of course, "M. I. C. E." understands it is the angle any side makes with the side opposite, that is their planes, I have been speaking of all the time). Now, half-side of base, which is 6, divided by distance from apex to middle of any side, which is now also 6, gives 1, as sine of half-angle, which is sine of 90°, which, multiplied by 2, gives 180° angle at apex. Will no other correspondents quash either one or other of us, and so end this matter? For instance, would any one work out in their own way the angle the plane of any side makes with the plane of side opposite in the pyramid mentioned above?—4 equal sides, vertical height 8ft., side of base 12ft.—Scotch Working Mechanic.

[48604.]—**Brick-Making.**—If this querist cannot refer to back numbers, he should procure Dobson's book on "Bricks, &c." published by Lockwood and Co.—E. G. M.

[48619.]—**Polishing Stag-Horn.**—Use pumice-powder and water, with a brush, and finish with rottenstone and oil. If you want portions of the creamy inner substance to show, rasp off and grind smooth, or scrape with a bit of glass.—T. P.

[48622.]—**Making Ports in Cylinders.**—If not cast in, bore down from the flange to the boss on which the valve is to work, and then plug upper end; but they are usually cast in (see several illustrations in back volumes). As to size, it is a safe rule to make as large as possible.—J. B.

[48624.]—**Electricity and the Organ.**—The recent developments in electricity have been mainly in connection with generating machines, lamps, &c. There is nothing in them likely to affect the apparatus used with the electric organ, though possibly some of those who have recently invented the ingenious telephone exchange switch-boards and bell indicators might introduce improvements. The question is, Is it worth while? as the pneumatic system answers admirably, except when the key-board is too far removed from the pipes.—C. P. O.

[48629.]—**Thermostatic Bar.**—The best metals for a thermostatic bar are, I believe, steel and brass—two rods being screwed together, which bend owing to unequal expansion. Mercury in a tube can also be used; but, I believe, the electrical method is now usually preferred. In that you have a balanced thermometer, or a thermometer with platinum wires inserted through the stem into the mercury. When the latter rises and makes contact a circuit is completed, and an electro-magnet acts on the regulating tap. I think you could find many devices of the kind by looking through the back volumes of this paper.—Nun. Dor.

[48632.]—**Braiding Machine.**—There are several designs for covering wire in back volumes, but I do not remember a braiding machine. I suppose, however, the machine by which rope is braided might be made to answer, and as that is a very old device, it will no doubt be found in any dictionary of such appliances—such as Ure's, for instance.—T. P.

[48634.]—**Wood Screw-Cutting.**—What is the querist's difficulty? Wood screws are usually cut with a die, if wooden screws are meant; but if screws used for holding wood, they are made by machine, and I doubt whether any one would waste time by cutting them in a lathe.—S. M.

[48641.]—**Cleaning Medallions.**—Presumably, they are plaster of Paris. If so, you will not succeed in cleaning them.—A. B.

[48642.]—**Analytical Chemist.**—I do not think there is any examination for this branch; but the fact that you have served under an analyst or taken the associateship of the School of Mines would be equivalent to a certificate of competency.—R. K. L.

[48650.]—**Electric Gas-Lighter.**—This question has been answered very recently. The lighter you saw is apparently the one described in specifications 2229, 1880; 245, 1881; and in an improved form in 985, 1882. The battery is made by spreading chloride of silver ¼in. thick on muslin blotting-paper, and laying a thin foil of silver on that. Submit the layers to pressure, and when the chloride is solidified, roll round a core of ebonite with the silver foil inside, and secure with a few turns of thread. Place that in a cylinder of zinc having an inside diameter about ½in. larger. The exciting fluid is a solution of sodic, potassic, or ammonic sulphate. A small induction coil is required with a trigger-push to make contact sufficiently long to send a spark through the platinum terminals, or to render the platinum coil incandescent. The wires are carried along inside the tube—one running straight up, and the other coiled around the inside. The contacts are made by springs brought together when the parts are in position and screwed home. If you obtain the specification 985, 1882, price 6d., you will have all the information needed; but there is nothing very novel, except the special arrangements.—S. C. T.

[48727.]—**Rancid Butter.**—I do not think there is occasion for complete despair, butyric acid being soluble in water; wash the butter by rubbing and working it thoroughly down under your hand in a tub through which the water is freely flowing; this will practically dissolve out the acid, which may be ascertained by tasting as the washing proceeds. The flavour of the small quantity of acid remaining will be concealed by the salt; therefore, salt well, and you may add carefully a little anotta to colour it; then press it tightly into some vessel and keep it in a cool place for a day or two, when the butter will become firm and useful for cooking purposes at least. If the process be efficiently carried out the butter will not have depreciated more than a few pence from its original value. I should not think that sour milk is to be recommended, on account of the lactic acid present; but new or skim milk might have a dissolving effect on the butyric acid, the presence of which is the cause of rancidity; but the milk would have to be washed out in water, and, unless it answers better, entails more handling of the butter without adequate advantage in the end.—W. A. Cairns.

[48732.]—**Indicator Diagrams.**—When I first read "F. W.'s" query on above I inferred that his engine is either a winding engine or drives a rolling-mill. Consequently I explained the diagram to the best of my ability. I do not quite follow Mr. F. Walker's reply on page 325, No. 924, as he speaks of "having a more modern slide-valve," &c. As the querist says his engine has Cornish valves, I rather think putting in a slide-valve would come in expensive, to say nothing of the loss of steam in the passages when working. Cornish valves, as generally applied to an engine cylinder, work with next to no friction, and as the passages are very short, there is very little loss of steam in them. Can the same be said of a slide-valve? Not as generally applied, at any rate. There is another part in Mr. Walker's reply I should be glad to have explained; that is, a description of the Cornish valve-gear which "operates the steam at one end and exhaust at the other by the same movement." The Cornish valve-gears of my acquaintance all have separate cams or tappets for steam and exhaust valves, and are driven by mitre gearing from the crank-shaft. When Cornish valves are applied to a reversing engine they are usually fixed two at each end of cyl., and at opposite sides. If a horizontal, then a second-motion shaft carrying the eccentrics is driven by mitre gearing from crank-shaft. A rocking shaft is fixed across the cyl., carrying suitable "wings," or levers, for opening the steam and exhaust valves alternately. The link is worked in the usual way. Another way of working Cornish valves is by eccentrics on the crank-shaft driving the rocking-shaft direct. Whilst writing, I would like to supplement "Ducrow's" remarks on query No. 48780 by saying that if he will cut a groove diagonally, as it were, across his crank-shaft brasses, that the beating be now speaks of will most likely disappear. I would also recommend the use of powder-blacklead and oil for a time, as the blacklead will fill all hollows in the brass.—Labor Omnia Vincit.

[48759.]—**Substitute for Hops.**—Since replying to 48155, I have tried a small experiment as to substituting camomiles for hops. Undoubtedly, wort can be made bitter by the addition of camomiles, but what kind of a bitter? A very unsatisfactory one. It is not exactly bitterness that the brewers aim at in producing a high-class bitter ale. There is flavour to be considered as well. "Home Brewer" says the leading brewers have written to the *Times* disclaiming the use of hop substitutes. Remember, the leading brewers (Bass, Allsopp, &c.) have a reputation to keep up, which is worth more to them than the difference in price between hops and substitutes for them. Who uses the substitutes? I really cannot say. I have never used any. In brewing pale bitter ale, we even rejected foreign hops because of their rank flavour. In reply to 48155, "Nigel" seems surprised to find an honest brewer. He need not be: there are a great many. "Johnstone" is very much mistaken as to the use of cocculus indicus. I have read the book, but I have not got it now, or I would go through it again. Might I suggest to "Home Brewer" to try the difference between camomiles and hops as follows:—Take a camomile and chew it in the mouth, spit it out, and rinse the mouth with water, and then try the hop. I should be glad if "C. T. B. W." would publish in "ours" his recipe for camomile ale.—W. L.

[48783.]—**Graphic Methods.**—I know of no book attempting a general description of these. Such would have to go into a variety of highly technical minutiæ, and I should think "J. C." would do better to look into books treating separately the particular branches of science he is interested in. In general and very rough explanation, perhaps, I might say that a graphic diagram may be looked upon as a plan of facts. Time usually replacing length, and, therefore, running horizontally; amount vertically, beginning at zero. Thus in an indicator diagram our quantity is pressure of steam, in a diagram of launching velocities we have speed, in a rainfall diagram inches of rain, and similarly for wind-stresses, and so forth. Of course in an ordinary building-plan we have to represent something which has definite shape, but in plotting the velocity of a Palliser shot or the retarding influence of a Westinghouse brake, we are dealing with things which can hardly be conceived as possessing form, and there is consequently scope for great variety in methods of representation. Time, and, of course, other dimensions may be represented vertically; in other cases may be denoted by a circle, and the like. It is hardly necessary, too, to say that we do not always deal specifically with time, or rather, perhaps, our whole diagram is taken to include events occurring at one particular point of time. Thus, in plotting persons killed per train-mile on various railways, if one year's average or result only is taken, there would be no scale or divisions of time apparent on the face of the diagram. If "J. C." would say as to what particular points he wishes for information I shall be most happy to attempt further detail.—Horatio.

[48789.]—**Scented Soap.**—If "Cock Robin" will obtain a bar of best pale soap, and make it into shavings by rubbing it along a jack-plane, turned upside down, he will then be able to melt them by means of a water-bath—either a good large glue-pot or an earthenware jar in a saucepan. When the soap is thoroughly melted, take out and stir until it begins to cool; then add any of the following essential oils or ottos:—For honey, use citronella or lemon-grass; for old brown Windsor, use carraway, cassia, or cloves, colouring it with caramel (burnt sugar, if preferred dark). For so-called glycerine, use a little myrbane or nitro-benzol, colouring with either gamboge or raw palm oil. If "Cock Robin" makes his own soap, by all means confine its use to household purposes; it is quite unfit for personal use. Ordinary scents are useless, and too expensive for scenting soap; but if he does not care for the trouble of melting and messing, he will find a few drops of scent in the washing water quite as useful. The essential oils or ottos are too rank for use without dilution and mixing. Fuller particulars if required.—London Stone.

[48807.]—**Neuralgia.**—"W. S. W.," in his reply to query on p. 326, says:—"I can assure him that a proper application of galvanism would remove the complaint." If "W. S. W." could be persuaded to give his brother-readers some of his experience in this matter, he would confer a great favour on a multitude of sufferers from this distressing malady. A paper, or series of papers, on Medical Galvanism would be of great service to those who, at this season, in our humid climate, are martyrs to tic, rheumatism, neuralgia, &c., which horrible torments the inhabitants of more favoured climes escape.—X + Y.

[48818.]—**The Weather.**—May I be permitted to add a brief note to supplement and explain my query? I desired to institute an inquiry among your scientific readers as to the causes of our changeable, damp, sunless climate? Such causes, as I apprehend, might be found in the action of the Gulf-stream, polar-air and ice and magnetic currents, our large number of rivers, clearing of woods and foliage, smoky furnaces, &c.? Our simply "insular" position affords, to my mind, little or no clue to the strange nature of our climate in England differing, even in some respects, from that of Ireland and Scotland. Surely a careful investigation of all such causes would be useful as well as interesting?—E. R. Colby.

[48830.]—**Wood-Bending.**—If near a steam-boiler, a pipe leading to a wooden box, with one end open, put planks in, and stop other end with shavings, jammed tight; leave planks of ½in. thick in box for half an hour, take out and bend round shape until cool. If not near a steam-boiler, a simple method sometimes used by boat-builders would answer; get a common pot of large size, fit a wooden cover into it, make a square hole in centre, and make a timber pipe with shoulder to fit into cover of pot, and also into box or stove; also another hole about an inch round to put water in when boiling too long. Oak, ash, elm, or any hard wood will bend well; must be fair-grained, and free from knots.—Wanting Steam.

[48835.]—**Fusible Plugs.**—Will Mr. F. Walker kindly explain why these plugs should be 3½in. above the tube? If it is to provide against cases where the water assumes a "spheroidal condition" would not the heat that was sufficient to produce this condition be sufficient to melt the plug? Will "Labor Omnia Vincit" say why he replaces the plugs every six months? If properly made at first, should they not last a long time?—Manufacturer.

[48862.]—**Chilblains.**—From childhood I have always had cold feet in the winter season, and have been a great sufferer with chilblains, but never had a broken one, and having tried all sorts of remedies with but little relief, I was one evening, some four or five years ago, bathing my "poor feet" in hot water, when the thought struck me that if I put them in cold water after the hot the sudden change would drive out the chilled blood from my poor inflamed toes, and perhaps cure. It was cold and frosty weather at the time, so I got a kettle of boiling water and a vessel with some ice-cold water (there was ice in it) by my side. I bathed my feet in the hot, adding more hot from time to time, for about half an hour, when I suddenly plunged them in the cold and let them remain for five minutes or more until they seemed quite cold, then rubbed them dry with a course towel, and in a few minutes they began to glow with much warmth. I got into bed, but had no cold feet that night. The next morning the swelling had gone down, the inflammation had disappeared and the toes felt stiff and looked shrivelled, but am glad to say this treatment had the desired effect, for I have not been troubled with "toe-blains" until last week, when I was reading Dr. Edmunds' reply. They were undergoing the same mode of treatment at the same time, and with the same good result. I have recommended others to try it, but they all say they should be afraid. I would much like to hear what Dr. Edmunds has to say of this kind of treatment, and, if others try it, with what result.—Jimbo.

[48886.]—**Cant of Rails.**—Rails are slightly canted towards the inside of the road to give the two wheels, which are fastened in pairs upon the axles, a tendency to run towards one another instead of separating. The effect of the conical shape is to counteract any tendency to roll off the rails; for if a pair of wheels were shifted a little to one side the parts of the tires rolling upon the rails being then of unequal circumference, would cause the wheels to roll towards the other side. The conical shape produces this kind of adjustment so well, that the flanges do not in general touch the rails.—Tyro.

[48886.]—**Cant of Rails.**—The rails are canted so that their vertical axis may be at right angles to the conical surface of the wheels, which are made cone-shaped, so that when passing over curves, the wheels of the train being thrown outwards by centrifugal force, the outer wheels will run on their greater diameter, and the inner ones on their smaller diameter. It is supposed this arrangement prevents the wheels sliding on curves, which, of course they would tend to do, by reason of the wheels being fixed to the axle, and the outer wheel having to traverse a greater distance than the inner one. I doubt, however, if the desired object is obtained. The cant is generally 1 in 24.—Sefton.

[48887.]—**Cracked Condenser.**—The crack in the surface-condenser of which you speak is probably due to the over-heating of the condenser through break-down of the circulating pump, or insufficiency of pumping power; for, if it became very hot, the cold bed-plate and bolts at the bottom would prevent its free expansion, while it would give very easily at the top; indeed, the cylinders in their own expansion would rather aid the top of the condenser to expand. As the condensers are usually made of very thin metal, they give way, when over-heated and not allowed to expand freely, much sooner than the bed-plate or holding-down pumps. This shows the necessity of having enough available pumping power for the circulating water, and also of carefully guarding the condenser from getting hot.—H. B. G.

[48888.]—**Loco. Bridge.**—A brick arch is employed in the fire-box of locomotive engines to prevent the contact of the flames with the crown-plates of the furnace. This bridge, however, is not often used now.—H. B. G.

[48901.]—**Ebonising.**—Peartree and sycamore are the best woods for black, but mahogany is very good. Birch, beech, or alder comes out very well. You can polish with heelball. But for best work you must French polish bright and rub down with powdered pumice-stone and soft flannel.—J. HILDERSLEY.

[48903.]—**L. and S. W. R. Engines.**—The principal dimensions of the new 10-wheel tanks, recently built by Beyer, Peacock, and Co., are as follows:—Cylinders, 17½in. by 24in.; diam. of coupled-wheels, 5ft. 7in.; diam. of bogie and trailing-wheel base, 3ft.; bogie centres, 7ft.; bogie-pin to driver, 10ft.; coupled base, 8ft. 6in.; trailing driving-wheel to radial-box, 7ft. 6in.; total length over frames, 35ft. 8in.; total width over frames, 8ft.; capacity for water, 1,000 gallons; capacity for coal, three tons; weight (empty), 54tons, 13cwt. The boilers are supplied by two Gresham's injectors. The engine is fitted with Webb's patent radial axle-box to trailing-wheels, single slide-bar, Gresham's automatic vacuum brake apparatus; also steam-brake to engine. The numbers are at present, I believe, from 415 to 424, inclusive. More of the same class are coming from Stephenson and Co., Newcastle. I will send sketch if desired.—CLYDE.

[48912.]—**Hardening Lathe Centre.**—After you have turned up your centre and smoothed up with emery-cloth in the lathe, put it in the fire and keep it there until purplish yellow. Now, take it out and plunge it in cold water, which hardens it very completely. It now wants letting down, and for this purpose heat it again until the colour only reaches a pale straw-yellow, which will give you about the right degree of hardness for a lathe centre. I cannot understand how one so treated can be twisted out of truth during the process; but I think I can give the reason why you think it is twisted. Probably, the hole into which your centre fits is not quite true with the centre line of the lathe, and if you turn the centre up in one position, it will not run truly if you put it in in any other position. So, when you have turned it up, before you take it out you should put a couple of marks with the centre-punch, so that you may know the right way to put it in again after it has been hardened. I think, if you do this, you will not be troubled with any more twisting.—H. B. G.

[48925.]—**Boiler.**—The cost of heating apparatus depends entirely on the difficulties you have to contend with, such as swampy soil, &c., which add to the cost considerably for boilerage, which is the most essential part of the work in heating. To heat billiard-room you must have your connections under floor, which may be polished, stained, or tiled. If so, you will require coils and cases, which are expensive, and, perhaps, no easy means of getting under floor, which will also add. It is easy enough to give a price for straightforward work; but, without seeing, or plans, it is impossible to give a definite price; but if "Boiler" will advertise his address, I shall be pleased to assist him.—H. L. H.

[48930.]—**Rendering Wood Fireproof.**—Try sulphate of ammonia dissolved in water—about 5lb. in a gallon, or stronger, as it is cheap, and say how it succeeds.—N. H.

[48937.]—**Star Magnitudes.**—If "Anxious" will refer to Vol. XXXV., p. 126, letter 19914, he will find a long and interesting letter by Mr. Espin, explaining how he and Mr. Read set about determining the magnitudes of stars with an opera-glass. The letter is remarkably clever, and seems to satisfy the querist's wants exactly.—A YOUNG ASTRONOMER.

[48946.]—**Froude on the Resistance of Fluids.**—"R. C. L." appears to be studying the laws governing the motion of solids in fluids. Mr. W. John, the managing director at the Barrow Shipbuilding Company, has been reported in *Iron*, 8th Dec., to have stated, in a lecture on the 20th Nov., Mr. Froude showed that a body of any form, deeply immersed in a boundless fluid with no friction, could move uniformly, if once set going, without any addition of force, and that when it came to a medium like water, which has some friction, friction was the only thing which caused resistance, &c. Penguins, cormorants, and other birds, preying upon fish, swim very fast under water, I should say, four times as fast as they can above. I have been picturing to myself submerged despatch boats, carrying one on their back. The canoe and outrigger of the future may be something similar. Perhaps "R. C. L." will kindly give us his opinion in working the matter out. Spars do not tow so highly as they as they ought to by this theory. Perhaps they are not submerged sufficiently.—J. D. C., Captain, R.N.

[48936.]—**Specification of Organ at Temple Church.**—

GREAT ORGAN. (1)

1.	Double diapason (closed)	16ft.
2.	Large open diapason	8ft.
3.	Small open diapason	8ft.
4.	Stopt diapason	8ft.
5.	Hohl flute	8ft.
6.	Viol de Gamba	8ft.
7.	Principal	4ft.
8.	Octave	4ft.
9.	Nason flute	4ft.
10.	Twelfth	2⅔ft.
11.	Fifteenth	2ft.
12.	Full mixture	3 ranks.
13.	Sharp mixture	3 ranks.
14.	Large trumpet	8ft.
15.	Small trumpet	8ft.
16.	Clarion	4ft.

SWELL ORGAN. (2)

17.	Bourdon	16ft.
18.	Open diapason	8ft.
19.	Rohr Gedackt	8ft.
20.	Salcional	8ft.
21.	Vox Celeste	8ft.
22.	Principal	4ft.
23.	Röhr flute	4ft.
24.	Twelfth	2⅔ft.
25.	Fifteenth	2ft.
26.	Mixture	5 ranks.
27.	Double bassoon	16ft.
28.	Horn	8ft.
29.	Oboe	8ft.
30.	Vox humana	8ft.
31.	Clarion	4ft.
32.	Spare slide	—

CHOIR ORGAN. (3)

33.	Lieblich Bourdon	16ft.
34.	Violon diapason	8ft.
35.	Lieblich Gedackt	8ft.
36.	Spitz flute	8ft.
37.	Dulciana	8ft.
38.	Flaute Traverso	8ft.
39.	Gemshorn	4ft.
40.	Violin	4ft.
41.	Lieblich flute	4ft.
42.	Mixture	3 ranks.
43.	Basset horn	8ft.

SOLO ORGAN. (4)

44.	Flute harmonic	8ft.
45.	Flute Octaviante	8ft.
46.	Piccolo harmonic	8ft.
47.	Tuba	8ft.
48.	Clarinet	8ft.
49.	Orchestral oboe	4ft.

PEDAL ORGAN. (5)

50.	Sub-bass	32ft.
51.	Major-bass	16ft.
52.	Open-bass	16ft.
53.	Viola	16ft.
54.	Stopped-bass	16ft.
55.	Quint	10⅔ft.
56.	Violoncello	8ft.
57.	Principal	8ft.
58.	Twelfth	5⅓ft.
59.	Fifteenth	4ft.
60.	Trombone	16ft.

COUPLERS. (6)

1. Swell to Great.
2. Swell to choir.
3. Choir sub-octave to great.
4. Solo to great.
5. Great to pedals.
6. Swell to pedals.
7. Choir to pedals.
8. Solo to pedals.
9. Pedal octave.
10. Tremulant to swell.

Compass (manuals) CC to G^3.
Compass (pedals) CCC to F.

Reconstructed by Foster and Andrews, of Hull, in 1878.—DIA-PANTOS.

[48941.]—**White Background for Photos.**—Vignetting will not give a sharp edge, so you must "block out" the background. This is done by making the part you wish to appear white opaque on the negative. This is done usually by pasting opaque paper over the required part.—C. J. R., Ventnor.

[48948.]—**Diffraction Rings in Astro. Telescope.**—In Webb's "Celestial Objects" you will find the following:—"Herschel II. speaks of nights of extraordinary distinctness, in which 'the rings are but traces of rings, all their light being absorbed into the discs.' I have entered, 1852, April 1, 'an exceedingly fine night at first, with scarcely a trace of rings or appendages.' See also the star 70 Ophiuchi, in the following catalogue."—C. J. R., Ventnor.

[48948.]—**Diffraction Rings in Astro-Telescopes.**—These are a necessary result of the undulatory theory of light, though they appear to be somewhat affected by the state of the atmosphere. Herschel II. speaks of nights when the rings were but traces of light, as does also Webb ("Celestial Objects," page 3). On the other hand, the latter mentions nights when the rings were very troublesome, and the former says this was always the case with 70 Ophiuchi.—A YOUNG ASTRONOMER.

[48960.]—**Terra-Cotta Statuettes.**—A friend of mine had one or two plaster busts whose appearance he wished to render similar to terra-cotta. To effect this, he took some of this last-named substance to the oilman's, procured a pot of paint of the exact colour, added a quantity of turpentine, and "stumped" the busts with the mixture. It is now all but impossible to distinguish between the imitation and the real. Do you think this hint would be of any use to you?—A YOUNG ASTRONOMER.

[48984.]—**Street-Coil.**—An electro-magnet is placed vertically; a small brass flywheel is placed so as to revolve just above its poles; the wheel carries a soft-iron armature, to suit the poles of the magnet; by means of a cam on the spindle of the wheel, the current is established and disestablished so as to propel the brass wheel. The axis also carries an eccentric, which oscillates a fork lever. Have a hammer at the other end, which plays between two bells. It is usual to have a separate circuit for it, actuated by a switch.—ELECTRA.

[48993.]—**Yellow and Red Timber.**—These are identical. The Swedish and Russian shippers call it redwood; but in this country it is more generally known as yellow deal.—TIMBER MERCHANT.

[48995.]—**Curvature of Earth.**—Tables of this quantity are usually to be found in mathematical books; but as "Glatton" does not appear to possess such a table, I append the following half-dozen quantities:—

Distance in miles.	Curvature in feet.
1	·67
5	16·67
10	66·70
15	150·08
20	266·80
25	416·88

Here the "distance" is measured on the circumference, but on a circle having a radius equal to the earth's. The arc sub-tending a chord of two miles would be itself not sensibly different from two miles. For an arc of this length the versed sine would be 2·67ft.—A YOUNG ASTRONOMER.

[48995.]—**Curvature of Earth.**—I think what "Glatton" wants to know is the difference between the radius and a line drawn from centre of circle to middle of chord, which is found by ordinary solution of a right-angled triangle, thus mean radius of earth being 3956·5 miles, $3956{\cdot}5 - \sqrt{3956{\cdot}5^2 - 1^2} = 8{\cdot}046720$ inches. This is the difference above mentioned, but is not the versed sine of the angle subtended by the arc of which two miles is the chord, but is the versed sine of half that angle.—SCOTCH WORKING MECHANIC.

[49010.]—**Hardening Plaster Casts.**—This can be done by boiling the cast for about half an hour in a strong solution of potash alum. Another way is to dry the plaster, and soak it repeatedly in weak shellac varnish until it will absorb no more—allowing it to dry between each soaking. This can be done with a camel-hair brush quite as well as by dipping the cast in the varnish.—THOS. FLETCHER, Museum-street, Warrington.

[49012.]—**Cements for China or Glass.**—To resist heat I think you will find that this recipe for the above is very good. It is made of a little Stourbridge clay mixed with a little tow, or asbestos is usually added to increase its coherence. It should be well beaten before application; the glass or china should be first rubbed over with a little of the cement mixed with a little water, taking care to press the two edges of the glass or china together. This cement will bear a very strong heat.—G. L. G.

Incombustible Paper.—The *Chemiker Zeitung* gives the following modes of preparing incombustible writing and printing paper, which appear worth attention. The best asbestos is treated with a preparation of permanganate of potash and then with sulphuric acid. Ninety-five per cent. of this asbestos is mixed with five per cent. of wood-pulp in water containing borax and glue. A fireproof writing-ink is made by mixing Indian ink and gum with chloride of platinum and oil of lavender; for printing-ink lampblack and varnish are to be substituted.

THE diameter of a wire in mm., whose sp. gr. is S, and weight W grammes per metre, may be found by multiplying the square root of W / S, by 1·12865.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

48276. Experimental Physics, p. 169.
48302. Induction Coil, 170.
48306. Dynamo Gearing, 170.
48307. Bits, Moits, &c., 170.
48317. Watch Enamel, 170.
48319. Brig, 170.
48324. American Bicycle Head, 170.
48327. Gower Bell Transmitter, 170.
48331. Tempering Trusses, 171.
48335. Electric Bell Relay, 171.
48347. Welsh Locos., 171.
48351. Model Boiler, 171.
48353. Electric Bell, 171.
48356. Brush to Dynamo-Machine, 171.

48597. Boot Heel, p. 259.
48606. Pressure on Pedals in Bicycle and Tricycle, 260.
48607. Combination of Levers, 260.
48609. Electro-Plating, 260.
48610. Watchwork, 260.
48611. Organic Analysis Table, 260.
48615. Electrical, 260.
48616. Steel Castings, 260.
48625. Fingering, 260.
48635. Concrete, 260.
48637. Insurance Companies, 260.
48638. Gauge-glasses, 260.

QUERIES.

[49013.]—**To Mr. Wetherfield.**—Will you kindly inform me if, when taking a new house not quite finished, and nothing being mentioned at the time, the tenant should be at the expense of laying on the water, as charged by the company for taking up the road, and for which I thank you in anticipation?—Iota.

[49014.]—**Telephone Signals.**—Over our building is stretched a number of telephone wires. At intervals there is a kind of buzzing musical sound. They tell me it is the telephone signalling. Is it so? If so, how is it produced, as I should like to have the same on my line?—F. G.

[49015.]—**Engine Side-Rods.**—In a locomotive engine the piston makes a stop at each half-turn of the wheel; do the connecting-rod and side-rod make a similar stop? Perhaps some reader of this paper will be able to explain this to me. I am under the impression that it does stop, although I am not able to distinguish it when the engine is travelling.—Engine Cleaner.

[49016.]—**Gilding upon Silk.**—I am about to paint a design in water-colours on white silk, and one part will have to be gilt with gold-leaf. Will some reader kindly tell me how to prepare the silk for gilding, and what materials besides gold leaf, and what tools will be required, and the probable cost of same? Any information will greatly oblige.—J. Coxon.

[49017.]—**Weight of Brighton Engines.**—Will any correspondent kindly say what are the distributed weights of London and Brighton engines, Richmond and Hastings?—George H. Fullerton.

[49018.]—**Manufacture of Cork Carpet.**—Can any of your readers describe as much in detail as possible, the process of manufacturing cork carpet, corticine, or linoleum, and the machinery employed?—L. D.

[49019.]—**Scented Soap.**—Would Mr. Richmond, or other readers, inform me what is the colouring matter in those cheap scented soaps known as rose, brown Windsor, honey, almond, and glycerine, and what scent is used in the three latter?—Aston.

[49020.]—**Writing on Glass.**—Will any reader kindly inform me the nature of the dense black pigment used for writing on glass for outside shop tablets—i.e., black letters on white ground?—Black japan is too thick and transparent.—Ballarat.

[49021.]—**Exposure.**—Will one of our readers oblige me with a simple scientific method of ascertaining practically and exactly the proper exposure to be given to a negative with a lens?—Thanks.

[49022.]—**Bottle-Jack.**—I have a bottle-jack that I cannot get into working order. I have well cleaned and oiled it; also moved escape-wheel a trifle nearer pallet, as the teeth are a little worn. Would a new and stronger spring remedy it? If so, how is it put in?—Anxious Amateur.

[49023.]—**Transit of Venus.**—Has the aperture of the telescope used, or its magnifying power, anything to say to the black drop? In the late transit, with 2·18 inch aperture, and power 80, I saw external and internal contact. There was no black drop; but there was a shaded appearance between the sun's limb and Venus, which lasted one minute.—R. O'H.

[49024.]—**Stains or Dyes for Wood.**—Can anyone tell me of a stain (light brown) for deal that will not wash off when varnished?—I have seen work stained and not varnished that no amount of scrubbing will affect, and I have heard that logwood and alum are employed. All the ordinary so-called stains (except aniline, which are fugitive and expensive) are simply water-colour paints, and not true stains at all.—Dandie Dinmont.

[49025.]—**Luminous Paint.**—Will any reader who has tried experiments in making luminous paint, kindly give me answers to the following questions?—(1) What are the best substances to use? (2) Probable formula of the luminous substance? (3) Does the amount of luminosity depend upon length of time of heating, or upon the temperature?—Bologna.

[49026.]—**Geological Query.**—A paper was read in this neighbourhood last week, by a local geologist of repute, in which he offered evidence in proof of the proposition that those parts of the earth which have undergone considerable denudation have risen, whilst those upon which the débris has been thrown have sunk in consequence. Being desirous of knowing the true cause of those gradual depressions and elevations of the land, which have been taking place during all geological time, and which are continuing in various parts of the earth at the present moment, I shall be glad to learn if the theory above mentioned can be considered tenable—in fact, does the silting cause the depression, or the depressions the silting?—H. T. W., Birkenhead.

[49027.]—**Boracic Acid.**—To Mr. Allen or Others.—How can boracic acid be estimated in a sample of impure borax?—Geo. E. R.

[49028.]—**Intrinsic Equation.**—The following problem occurred to me when looking from a window across a large open square, but it does not appear to be amenable to ordinary treatment by co-ordinates, either rectilinear or polar. Can the method of intrinsic equations be applied in this case? A man is walking along the opposite side of the square at, say, 3 miles an hour; when he comes exactly opposite me, his dog, which happens to be on my side of the square and close to me, runs across the square to meet his master at the rate of 6 miles an hour; the dog always runs directly towards his master at every point of the journey, thus describing a curve; given the width of the square, required an equation to the curve. It will be seen that a line joining the dog and man at any point of the curve will be a tangent to that curve, and the length of the curve up to any point will be twice the distance traversed by the man during the time taken by the dog to reach that point.—M.I.C.E.

[49029.]—**To Mr. Lewis Wright or Mr. Lancaster.**—Would either of the gentlemen named kindly help me in a little optical difficulty—viz., to get a parallel beam from a lantern? From Prof. Tyndall's and Mr. Lewis Wright's books on light, it is inferred that the parallel beam is got from the condenser alone, the objective being removed; but they do not describe the modus operandi. I can only produce a blurred image of the three wicks of my lamp, seen through a narrow slit, instead of a fine sharp line of light. What I want are the relative positions of slit, condensers, and source of lights.—C. R. T.

[49030.]—**Locomotives.**—Can any reader give the average coal consumption per mile of the express pass. engines on the leading lines? A short account of this, the class of loco., and the work done, would doubtless interest others besides—McK.

[49031.]—**Specific Gravity.**—I want to know the rule for calculating the quantity of water that must be added to a liquid of low gravity, such as alcohol and liquor ammonia, to produce a solution of a fixed higher gravity. Will some of the readers of the "E.M." assist me?—Gravity.

[49032.]—**Bags Lined with Paper.**—Could any brother reader oblige by helping me to fix paper on to twilled jute sacking cloth? I make the cloth and have got an order for 75,000 bags; the idea of the paper being fixed to the cloth is to preserve the aroma, flavour, &c., or some such-like commodity in transit. The paper seems to be common brown paper with a film of some black, pitchy (not pitch) looking material, joining it to the cloth; it is very adhesive, burns (the black film) like pitch, but no smell, into an ash; neither the cloth nor the paper is discoloured in any way; very large quantities are used of this cloth. Any brother reader will confer a very great favour by giving me a help (practically) to enable me to succeed.—Delta, Dundee.

[49033.]—**Electro-Motor.**—In a back number some one asks for an article from some correspondent on electro-motors for railway or tramway use; none have appeared as yet. Will some kind correspondent say if the motors used on the new electric railway in Ireland, running from Portrush to the Giants' Causeway, are the same as that on Ayrton and Perry's electric tricycle, described on p. 290, and describe either motor thoroughly, so that one might make a model; and how many pint bichromate cells would drive it, say, for an hour at a time? I am sure that there are a great many readers interested in this.—Electro-Motor.

[49034.]—**Electrophorus.**—Will some correspondent kindly give me the composition of an electrophorus? Books on electricity say it is a cake of resin; hot melted resin poured into a tin dish, cracks when cold. I added shellac and Venice turpentine with improved results, but still it cracked; would it do to toughen it with tallow? Query—Why don't books on electricity give exact composition?—Electro.

[49035.]—**Colouring Toilet Soap.**—Will W. Henley or some other obliging reader instruct me how to colour toilet soap? I have some pulp for the purpose; it does not mix in the grease, but settles to the bottom. I make my soap by the "cold process."—Citronella.

[49036.]—**Reflector or Refractor.**—Many anxious for larger aperture are following Mr. Jobson's advisers with interest, and would like to hear from some one accustomed to use a refractor of over 3in. aperture. Would not the amateur who has no observatory find advantage in its prompt readiness when in our wretched climate an hour's clear sky offers? No time need be lost in adjusting speculum or diagonal, waiting for tube to cool or air-currents to settle. As regards ease of position, has the reflector much advantage? If it be an equatoreal, is not the eyepiece apt to be in most difficult positions, only to be met by reversing the telescope (often necessitating readjustment)? Must not the observer see at most times as through a glass darkly, for it is only when the silver is fresh that it nearly equals an o.g.—R. K. P.

[49037.]—**Kaleidoscope.**—I wish to make one of 6in. aperture, diminishing to 2in. at the eye end, but of short length, about 12in. Will the reflecting surfaces inside act as well with this short length, or will the images be distorted?—J. C. L.

[49038.]—**Tin-pot Battery.**—I have lately fitted up one of these, but so far can get no result. I want it to ring a 4in. bell. The tin can is 7in. by 5in., and contains clean cast-iron borings packed round a 6in. by 2in. porous cell, which contains caustic potash solution. A zinc rod is suspended in this, with a tinned copper-wire on the end. A piece of copper-wire is soldered to top edge of tin can. I cannot refer to those numbers of "ours" which contain a description of this battery, so must ask some kind friend to tell me where I am wrong. I tested one some time since which worked very well, and have made mine, as near as I can remember, like it.—Labor Omnia Vincit.

[49039.]—**Incombustible Paper.**—Can any one tell me how to make paper incombustible, and at the same time adhesive when rolled up into the form of a tube?—Constant Reader.

[49040.]—**Ormolu.**—Will some one give me the mixture and the mode of finishing ormolu ornaments, so that I can cast and finish same?—Country Brass Founder.

[49041.]—**Electric Clocks.**—Would Mr. E. M. Nelson kindly add to his interesting letter on the above subject the following information?—How are the contacts made—platinum or mercury? Practically, the difficulties in making electric contacts to act properly are these—First: If the contact hesitates it may propel the dial it is working twice instead of once. Secondly: If platinum is used, considerable pressure must be brought upon it, or, after a time, contact will fail. Thirdly: Mercury evaporates and burns up quickly. Would Mr. Nelson say if he has tried mercury covered with creosote, and if it has answered? With all due respect to Sir Edmund Beckett, I find that the magnetic attraction is better than gravity to drive the dial. Of course, a mechanical arrangement must exist to prevent the suddenness of the keeper throwing the movement 2, 3, or 4 minutes instead of one. When this is properly made you can put on a very strong battery without having anything to consider but your contact points being burnt up. I need not add that if you have to balance your work with battery power, the attempt must prove an utter failure.—F. E. T.

[49042.]—**Gravitation.**—To "F. R. A. S."—Would you please to explain how it is that gravity decreases as the square of the distance increases inversely? The two forces, the centrifugal and centripetal, must balance each other. According to the orthodox, the gravitating power reckoned at Mercury as 1 will be at Neptune 6,300 times less. The velocities of the planets accordingly ought to have a corresponding balance, but they have not. According to the velocities, it ought to be a force for Mercury 1 and 9 on Neptune, and instead of the orthodox squares of the distance the velocities show the square root of the distance. Will you also kindly say whether Newton's force of gravitation is assumed or proved: if the latter, where may it be found?—Ed. Wilding.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 27, and unacknowledged elsewhere:—

J. Clarke.—H. Luyton.—J. Larmor.—Rev. E. J. Warmington.—J. Peirce.—C. Motter.—Scott and Co.—Senor Don J. Fleming.—T. McNally.—Thurso Mechanics' Inst.—J. M. S.—Rampart.—G. Greenwood.—F. Stelfox.—Hamlet.—W. D.—J. D. L.—Geo. W. Ten.—Carmel.—J. C.—Apprentice.—Pax.—R. E. Crickitt.—Engineman.—Gerett Adml.—J. Sutcliffe.—C. E. Stretton.—A Fellow of the Royal Astronomical Society.—Faber.—A. B. M.—S. Jackson.—W. T. Bayne.—J. Hargreaves.—J. P. N.—W. B. P.—Dr. Edmunds.—Edward M. Nelson.—Philip Braham.—Fioni Almoni.—Fred. Carre.—E. P. R.—J. T.—Jas. Gorman.—J. W. D.—Nicholson.—Fitter.—W. H. J.—G. Schntze.—Auld Reekie.—An Anxious Father.—Parallel.—Sigma.—T. Roberts.—Ego Alpha.—Chemist.—J. C.—C. Slagg.—Medical Coil.—Shipwright.—Tom.

Bonoist. (See the indices for the motor, and make the one that suits best. As to electro-magnets, you will find a table on p. 336, No. 872. For one to lift ½cwt., the diameter of core should be ⅝in., and length of poles, measuring from bend, 3½in. Use No. 20 wire over four-fifths of the length, and put on enough to make the diameter 2in.)—W. R. Mowbray, Port Elizabeth. (We are afraid we have not space for your theory, which we imagine is quite original, unless you may find something akin to it on p. 12 of this volume.)—Engine Cleaner. (All have been fully described in back numbers. Suppose a vacuum created in a flexible vessel, it will collapse by the pressure of the atmosphere. If, then, you attach a rod to one of its sides or ends the rod will move a lever, and so on. Similarly with the steam brake, a piston or two pistons are connected by rods to levers, and in the Westinghouse a pressure of air is used instead of making a partial vacuum for external pressure to act.)—Postage Stamp. (The office named is kept by Mr. Hancock, who makes the stamps referred to.)—D. M. (The low-water safety-valve. See recent numbers.)—J. F. (You must make it hot and stir in a little white wax in shreds.)—J. P. (Cannot be done to any advantage. They are differently constructed.)—Pyrotechnist. (Any dealer in chemicals will answer both questions; but we suspect you will find it much too expensive for your purpose. A dark violet fire is made of alum and carbonate of potash 6 parts each, sulphur 8, and chlorate of potash 30 parts.)—Amazon. (We believe it is done by hand, by means of a gauge.)—A Constant Reader. (Nickel-plating described many times. See p. 33, No. 898.)—F. C. (You will find the B. W. G. up to No. 36 on p. 14, last volume. 2. Such a table up to ½in. is given in Mr. Sprague's book. See a table in No. 325, p. 297, and the formulæ in his articles.)—William. (They are simply collodion positives on iron plates. You will find instructions in back volumes. See pp. 490, 513, Vol. XXXII.)—D. H. (There are no particular rules. Strain them fairly tight, as low down as convenient. Ordinary bell-wire. 2. There is no possibility of fixing even an approximate price. Some people would give as many guineas as others would shillings.)—Romany. (Many recipes in back volumes, but they are mostly pastes. Melt 2oz. of black rosin in a pipkin, and add 3oz. of beeswax. When thoroughly mixed, remove from the fire and add half-ounce of fine lampblack and a quarter-ounce of Prussian blue. Stir and add turpentine to make a paste. Apply with a piece of rag and polish with a soft brush. Your conditions are rather too onerous.)—V. M. N. (Heel-ball is made in various proportions of the following:—Try beeswax 1lb, suet 4oz. Melt and stir in 4oz. ivory black, 3oz. lampblack, and 2oz. each of sugar-candy and gum-arabic—all in very fine powder. Mix thoroughly, and pour into moulds. If too hard, you could increase the suet.)—Country Brass Founder. (Calamine is carbonate of zinc. 2. Copper 8, zinc 3½, nickel 3; or tin 85½, antimony 14.5. 3. You must say what governor you mean; but you will find many described in back numbers.)—Tauton. (Any of the usual purgatives, and an enema of salt and water to wash out the lower bowel.)—Jas. Smith. (We cannot help you. Try *Notes and Queries*.)—Unfortunate. (You have probably outgrown your strength. Temperance, regular living, and patience will put all right in a year or two.)—Alethe. (If—doubtless, after personal examination—your own medical men are doubtful, how could Dr. Edmunds, even if he were willing, which we know he would not be, give any opinion or advice worth following, and that, too, in the absence of any particulars as to your age or condition! If we had a wife or sister suffering from the malady you suppose yourself to suffer under, we should place her under the care of Mr. Spencer Wells, Dr. Bantock, or some other surgeon of similar experience, and patiently and faithfully follow his instructions, and not risk life and health in the hands of people who "disperse by medicine and ointments.")—Practicus. (If "A." considers himself "morally bound to pay the extra pound," he has no right to waste our space and Mr. Wetherfield's time to find out whether "B." can legally claim it.)—Nettlefold. (If the slate roof is in the country, you might use the rain-water, but if in town, ordinary cistern water, in either case of about the same temperature as the skin. There is no danger to be apprehended from the paraffin.)—Aural. (Better get examined by a competent surgeon used to ear diseases; meanwhile, the use of the oil will probably do no harm.)—A. Z., Bradford. ("F.R.A.S." has adopted all the means you suggest except the "Parliamentary inquiry," and that is not so easily managed as you seem to think. We rather grudge the space the subject occupies from time to time; but we never refused insertion to a reply from any advocate of the party "F.R.A.S." assails, which was, in any sense or shape, a *reply*, and not merely abuse; and we have not inserted a tenth of the letters which have reached us endorsing our correspondent's views, and agreeing with his strictures.)—Bona Fide. (No medical examination is necessary. 2. We are compelled to decline inserting problems copied from textbooks.)—Englishman. (No; if the property is personal, the wife takes one-third, and the rest is divided equally among the children.)

International Railway Safety Exhibition.—A provisional committee, with Mr. Charles Boysset, vice-president of the French Chamber, as president, has been formed for organising an international exhibition of appliances, calculated to insure the safety of railway passengers, to be held in the Palais de l'Industrie, Paris, in 1883. The three classes of objects to be admitted are:—Systems of coupling, arrangements of signals, and various brakes.

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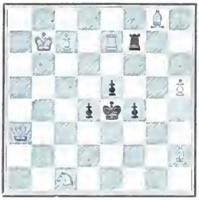
◆◆◆

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCXI.—By T. B. Rowland.

Black.

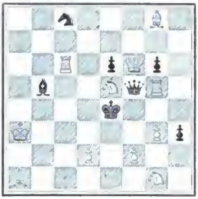


White. [8+5

White to play and mate in two moves.

PROBLEM DCCCXII.—By the Chess Editor of the *Matlock Register.*

Black.



White. [11+7

White to play and mate in two moves.

Solution to 807.

White.	*Black.*
1. Kt to B 6	1. Anything
2. Mates	

Solution to 808.

White.	*Black.*
1. B to K 2	1. B to Kt 7 (a)
2. B to B 4 (ch)	2. Kt takes B
3. Q takes B mate	
	(a) 1. R to B 6 (b)
2. Q to R 4 (ch)	2. Moves
3. B or Q mates	
	(b) 1. B to K 3 (c)
2. Q to R 2 (ch)	2. Kt covers
3. Q mates	
	(c) 1. P to K 4 (d)
2. Kt to Kt 6 (ch)	2. K moves
3. Q mates	
	(d) 1. P to R 4
2. R takes P (ch)	2. P covers
3. Kt mates	

Game played at Brighton between Messrs. W. Mead and A. Smith:—

(Danish Gambit.)

White (W. Mead).	*Black* (A. Smith).
1. P-K 4	1. P-K 4
2. P-Q 4	2. P takes P
3. P-Q B 3	3. P takes P
4. B-Q B 4	4. Kt-Q B 3 (a)
5. Kt takes P	5. B-Kt 5
6. K Kt-K 2	6. K Kt-K 2
7. Castles	7. P-K R 3
8. Kt-Kt 3	8. Kt-K 4
9. B-Kt 3	9. P-Q 3
10. P-B 4	10. Kt-Kt 5
11. P-B 5 (b)	11. B-B 4 (ch)
12. K-R sq	12. Kt-B 7 (ch)
13. R takes Kt	13. B takes R
14. Kt-R 5	14. R-K Kt sq
15. B takes R P (c)	15. P takes B
16. Kt-B 6 (ch)	16. K-B sq
17. Q-R 5	17. R-Kt 2
18. Q takes R P	18. B-Q 5
19. Q Kt-Q 5	19. B takes Kt (d)
20. Kt takes B	20. P-Q 4
21. Kt-R 5	21. Kt takes P
22. P takes Kt	22. Q-Kt 4
23. Q takes R (ch)	23. Q takes Q
24. Kt takes Q	24. K takes Kt
25. B takes P	25. B takes P

Drawn Game.

NOTES.

(a) Kt to K B 3 is the usual move; 4. P takes P is given by the books as leading to a lost game; but it brings about some interesting positions.

(b) Purposely giving up the exchange, relying on 14. Kt to R 5 to force the game.

(c) P to B 6 seems to be the right move, winning easily.

(d) Why not Kt to Kt sq?

NOTICES TO CORRESPONDENTS.

Correct Solutions to 807 and 808 by H. Planck and J. B., of Bexford; to 807 by W. T. Bayne; to 808 by D. Mackay.

D. Mackay.—The obligation is ours. We shall be glad to hear from you again.

J. P. Taylor and H. F. L. Meyer are thanked for the problems.

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Wanted, Tricycle. Will give 3in. back gear 2ft. Bench Lathe, with treadle, all from V steel, what offers?—Basse, Queen street, Colchester.

Spinal Instruments. 2, cost £7. Exchange for Conjuring Apparatus or Lantern Slides, other offers requested.—"Ino," 39, Methley-road, Kennington, London.

Photographs.—About 50 abbeys and cathedrals, 7in by 4in size, will take 4d. each, or what offers? Books.—Address, Paute, 182, Trongate, Glasgow.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 5, 1883.

THE PROGRESS OF ASTRONOMY IN 1882.

AT the close of another year the astronomer is able to look back with satisfaction upon no inconsiderable amount of discovery and work achieved in connection with the physical constitution, structure, and movements of the bodies which spangle the celestial vault. Much of this of necessity does not appeal very strongly to popular imagination; and yet there is enough left to excite the wonder and interest of a large proportion of those outside of the comparatively narrow circle whose business or pleasure it is to watch the face of the sky.

Chief among objects which appeal to the non-scientific public, we may reckon comets, of which three have been discovered during the year 1882. In fact, it would be more rigidly correct to say that four have been seen; but as the solitary view of the fourth was merely obtained in Egypt during the short period of totality of the Eclipse of May 17th, mention of this may be deferred until we come to speak of that phenomenon. The first comet, discovered during the present year (and known technically as comet *a*, 1882) was found in America by Wells on March 18th, and was subsequently extensively observed in this country. The chief point of interest in connection with it was that its spectrum showed strongly the well-known line of sodium (the metallic base of common salt). So brilliant was this that it was stated at the time (June 8) that "the comet might almost be said to shine by monochromatic light." This is very notable, inasmuch as the type of spectrum yielded by compounds of hydrocarbon has hitherto been one common to all the comets which have appeared since spectrum analysis has been applied to these bodies; and it is thus obvious that the chemical constitution of this comet must have differed wholly from that of the series which have appeared since 1864. *The* comet, however, par excellence, of the year, was of course the glorious object which seems first to have been seen by Mr. Finlay at the Cape of Good Hope on the morning of September 7. The first news of its discovery, however, reached this country in a telegram from M. Cruls, of Rio Janeiro, by whom it was independently discovered on September 11th. On September 17th Mr. Common, of Ealing, watched it within less than half the Sun's diameter of his limb; while on the same day, at the Cape, Mr. Finlay and Dr. Elkin observed it right up to apparent contact with the Sun: only losing sight of it when it actually passed on to his face. So closely did it approach to him, that it must have passed through the Corona! What a superb spectacle it subsequently presented in the early morning sky during October and November, hundreds who will read these lines must remember. In fact it is but very recently that it has practically disappeared from these latitudes; still, however, to be watched from more southern ones until it fades into that abyss whence it will not return for many generations. It is needless to occupy space here by the recapitulation of the story of the scare which was created when the Astronomer Royal for Scotland announced (on the authority of Professor Lewis Boss) that this comet was describing a spiral which must speedily bring it right into the Sun; with the implied result of a general mundane conflagration. Malgré the Great Pyramid, the world will last for Professor Piazzi Smyth's time. It is worthy of remark that the spectrum of this Comet (*b*), like that of Comet *a*, showed the sodium line very brilliantly, in combination, however, with three bands seemingly belonging to some hydrocarbon. The third Comet (*c*) was discovered by Barnard in America on September 10th. It presented no special feature of interest.

The total eclipse of the Sun on May 17th was most successfully observed in Egypt by MM. Thollon, Trépied, Ranyard, and A. Puiseux. Indications of a lunar atmosphere were obtained by the aid of the spectroscope; and the exact place of the bright line in the coronal spectrum, identified with 1474 of Kirchhoff's scale, was determined. The corona, of the sunspot maximum type, was magnificent, Mr. Ranyard describing it as full of delicate lines of light curving hither and thither, and arranged in great groups. This gentleman obtained a series of most successful photographs, which, in addition to the peculiar structure of the corona, exhibited images of a bright Comet (to which we have alluded above) about half a degree from the Moon's limb. This, with its scimetar-shaped tail, was a striking object during totality, causing no small consternation among the native Egyptians. Nothing was ever subsequently seen of it, though. The expedition which achieved these and other equally valuable results was dispatched through the munificence of M. Bischoffsheim. Two gentlemen, dubbing themselves a "British Government Expedition," obtained £350 from the Donation Fund of the Royal Society on the recommendation of a body at South Kensington, called the Committee on Solar Physics. They effected nothing whatever, which was not as well, if not better done, by the skilled observers of whom we have just spoken.

Sunspots of enormous dimensions have appeared on more than one occasion during the past year. A splendid one made its first appearance in the Sun's southern hemisphere on April 13th. Coincidently with this, magnetic storms occurred on April 19th. That well-known observer, the Rev. F. Howlett, measured the superficial area of this stupendous disturbance, and found it to be not less than 2,050,000,000 square miles. It was successfully photographed by Mr. Henry Pratt, of Brighton. Another even larger one was visible during November. As stated by a correspondent in the columns of our contemporary, the *Echo*, it covered a space of 2,356,846,000 square miles! Auroræ and violent magnetic disturbances occurred concurrently with its apparition.

For the last thirty or forty years, the interval between the two bright rings surrounding Saturn has been termed in all astronomical works, "Ball's division," on the supposed ground that it was discovered in 1665 by a certain Mr. William Ball, at Minehead (or Mamhead). It has, however, been recently shown independently by Mr. W. T. Lynn and Mr. C. L. Prince, that Ball never really saw it at all; and that it was first observed by Cassini in 1675. For the future, then, it can only be legitimately known as Cassini's division.

The fourth in point of size, among the giant refracting telescopes now in use, has recently been erected in the Halsted Observatory, Princetown, U.S. The diameter of the object-glass is 23in., and its focal length 30ft. 1in. It is furnished with every appliance for celestial observations of all descriptions. Some idea of the massive character of its mounting may be given by the mention of the fact that its weight, including that of the telescope, is about seven tons. This splendid specimen of the skill of Messrs. Alvan Clark and Sons has been provided wholly by private munificence; two subscribers alone, Messrs. R. Bonner and R. S. Stuart having respectively contributed 10,000 and 6,000 dollars towards the cost of its construction. We may add, that the great Vienna refractor by Grubb, of Dublin, which has an aperture of 27in., has also just been finally adjusted in the observatory for which it was constructed. Report speaks very highly of its performance; but it is scarcely in actual work at the time we write.

In celestial photometry, Professor Pickering, at Harvard College, U.S., and Professor Pritchard, at Oxford, continue their valuable labours. The close correspondence between the results which they obtain, by different means, affords cogent evidence of the value and correctness of the principles on which they are independently working. We may now look forward to something like a scientific classification of star magnitudes—an indispensable prelude to the study of the curious subject of the variability of stars, and its cause or causes.

By very far the most important astronomical event of the year has been the Transit of Venus over the Sun's disc, which occurred on the 6th of Dec., 1882. The recent appearance of articles in these columns, dealing in a popular manner with this phenomenon, absolves us from the necessity of entering into much detail concerning it here. It may suffice, then, to say that the British expeditions have been, with one most unfortunate exception, entirely successful; and that observations have been obtained, by the combination of which good results may be anticipated. The exception to which we refer is that of the party sent out to Brisbane in Queensland, which wholly failed to see anything whatever of the Transit. In the British Islands, comparatively few people appear to have observed the entire sequence of phenomena; the majority seemingly having missed the most important phase (that of contact) altogether. At Greenwich nothing was seen; at Oxford the Sun was only visible for about five seconds! In the West of England, however, observers were very much more fortunate, the sky having apparently been cloudless over a large area. Mr. Webb, at Hardwicke, observed both external and internal contact, but does not seem to have noted the times. Oddly enough, considering the usual climate, two at least of the Irish observatories succeeded perfectly with their observations: Doberck at Markree, and Dreyer at Armagh, having obtained excellent determinations of the times of contact both external and internal. An observer in Sussex, Mr. C. L. Prince, also appears to have got a good time determination of internal contact. The Americans seem to have been very successful in various localities, and notably to have obtained many series of admirable photographs. We regret to learn that the Belgian expedition to South America failed to observe the Transit. As we have said above, though, a sufficient number of observations have been obtained in various parts of the world to enable as accurate a deduction of the Sun's distance to be made as the method admits of. After all, though, it is chiefly useful as a check or control upon other modes of obtaining the solar parallax; one, at least, of them of superior accuracy to it.

In astronomical literature, excluding contributions to the Proceedings of learned societies, there is not much to note. Among the most important works we may mention Vol. II. of the really wonderful "Bibliographie Générale de l'Astronomie," of MM. Houzeau and Lancaster, completed during the present year. In 2,225 (!) double columns this contains a catalogue of every astronomical paper and essay that has appeared in the Proceedings of the learned societies, as well as those in reviews, magazines, and journals, since the beginning of the 17th century. As a work of reference, it is invaluable. "Les Etoiles," by that indefatigable writer Flammarion, is a popular but exhaustive description of the entire celestial vault. Mr. Ledger, the Gresham Professor, has reproduced a series of his Lectures under the title of "The Sun: its Planets and their Satellites," which is worthy of notice as a readable popular exposition of planetary astronomy. Professor Young's excellent work on "The Sun," in the International Scientific Series, will be read by every one interested in the subject on which he is so eminently qualified to speak, and on which he treats so lucidly and agreeably. Finally, we may commend the popular treatise on the Transit Instrument, by Mr. Latimer Clark, to all churchwardens and owners of turret and stable clocks; in fact, to every one whose duty or interest it is to see that time is correctly kept, and trains are not missed or appointments broken, through the erroneous indications of dials set up in public view.

We learn that Dr. Huggins has just succeeded in photographing the corona of the uneclipsed Sun. His method is of the very simplest possible character, consisting, as it does, in merely interposing a plate of violet glass between the object-glass of the telescope and the photographic plate. In this way an over-exposed image of the Sun itself is obtained, with the structure of the corona distinctly traceable round it. There is a certain fitness in the invention of this method by the man who was the first to point out the mode of viewing solar prominences under ordinary conditions (*R.A.S. Monthly Notices*, Vol. XXVIII., p. 88), afterwards successfully adopted by M. Janssen and Mr. Lockyer.

Death has, happily, not been very busy among astronomers during the year 1882. The first one of eminence who was taken from us was Dr. Robinson, who died full of years and honours on February 28th. He retained his faculties to the last, and his brilliant intellect shone almost undimmed when he had attained the great age of 90. He was appointed Astronomer Royal in Ireland as far back as 1815. Another painstaking and conscientious head of an Observatory passed away, too, on the 3rd ultimo, in the person of the Rev. James Challis, the Plumian Professor at Cambridge. His knowledge of practical astronomy was sound and extensive, and he did useful educational work in teaching the theory and use of instruments to such undergraduates of the University as manifested the disposition and capacity to profit by his instructions. By the death of Dr. Henry Draper, at New York, at the untimely age of 45, astronomical science sustains a severe loss. As a celestial photographer Dr. Draper was unsurpassed; in fact he constructed a reflecting telescope of 15½in. in aperture with his own hands for the express purpose of photographing celestial objects. His wonderful reproductions of the great Nebula in Orion and of its spectrum must be fresh in the memory of many of our readers. Dr. Draper will, however, probably be best remembered by his discovery of the existence of oxygen (and possibly of nitrogen) in the sun. As this discovery was not made at South Kensington, and moreover was opposed to particular dogmas of that establishment, it was virulently attacked by certain persons in this country. It is, however, now accepted by everyone qualified to form an opinion upon the question.

Such are a few of the more salient features in the astronomy of 1882. If they show us that work, and good work, has been done, they may also serve to remind us how very much more remains to be accomplished.

CAPACITY AND DIELECTRICS.

By JOHN T. SPRAGUE.

MUCH of the accepted teaching on the subject of electric static capacity is illusory, because the terms devised to fit the early ideas of the nature of "charge" are still used, and their artificial nature is seldom set forth. The many new applications of electricity will certainly render this of great importance before long, and necessitate a clear understanding of it, and I propose to trace out its leading features.

All mathematical electricians teach that the "capacity of a sphere is as its radius," and here begins the delusion. As a fact, a sphere has no capacity at all, *considered by itself*; and, therefore, the expression is often qualified by the statement, "provided it is at a considerable distance from surrounding surfaces"; but this form of statement hides away the fact that the capacity exists, not in the sphere, but in the surrounding space itself, and that the dimension of the sphere affects the capacity only because it forms a connection to the space and the medium occupying it. Any statement as to capacity of *a surface* should, therefore, be considered as referring to conditions in which the inductive resistance is large.

Capacity is measured by the quautity of electricity which is necessary to raise the charge to unit potential.

(*a*) *Spheres.* A sphere of one centimetre radius is taken as the unit of capacity in the centimetre gramme second system of measurement.

Capacity of spheres varies as their radii.

A charge on a sphere acts externally as though it were located at the centre of the sphere.

(*b*) *Concentric Spheres* have a capacity dependent on the relative radii r, measured by the formula $\frac{r \times r^1}{r^1 - r}$ in which r^1 is the outer sphere. The rationale of this formula is that it represents the capacity due to the product of the two radii, and inversely to the thickness of the dielectric, which is the difference of the radii. Now, if the inner sphere is a small ball, while the outer is represented by distant surfaces, a moderate increase of the radius of the ball does not much affect the thickness, or distance, so that the capacity varies nearly as the radius of the ball as in case (*a*); if the two spheres are very close, their radii only affect the formulæ by the corresponding surfaces, and the principal element is the thickness of the dielectric, and the result is the same as in (*c*) and (*e*).

The actual capacity in any given case is ascertained by multiplying the result by the specific inductive capacity of the dielectric enclosed between the two spheres.

(*c*) *Concentric cylinders*, such as Leyden jars, or submarine cables, have a capacity dependent upon their length and their diameters; that is to say, really upon the efficient thickness of the inclosed dielectric, and also upon the sp. ind. cap. The formula is $K = \frac{k\ l}{\log. \frac{D}{d}}$ in which K is the indnctive capacity; k the sp. ind. cap. of the dielectric; l, the length; D the outer diameter, and d the inner. The same formula furnishes the current-giving power of cylindrical batteries, because the logarithmic ratio of the cylinders governs the internal resistance.

(*d*) *A circular disc* has a capacity $K = \frac{2r}{\pi}$ which is $\frac{d}{\pi}$, that is, according to the diameter divided by the ratio of the air-circumference 3·14159, which is expressed in all formulæ by π.

(*e*) For *a pair of circular discs* the formula is $K = k\frac{r^2}{4t}$ in which t is the thickness of dielectric.

(*f*) For *pairs of plates* of any form the formula is $K = k\frac{S}{4\pi t}$. It will be instructive to comprehend the part played here by 4π. In the case of a sphere the constant ratio of the force to the surface density is 4π, and this is connected to the relation of the surface of a sphere to its radius, which is $4\pi \times r^2$; that is four times the circumference ratio, multiplied by the square of the radius. Now flat plates may be considered as parts of the surfaces of very large spheres, and the formula is derived from this artificial representation, combined with the treating the two charges as acting from the centre of the imaginary sphere.

(*g*) The formula can, therefore, be simplified by passing from abstract mathematical conceptions to practical conditions, by using unit dimensions and values. If we take one square foot as unit of surface, and one mil as unit of thickness, using the sp. in cap. of plates of those dimensions, the formula becomes $K = k\frac{S}{t}$, and furnishes the capacity in micro-farads. In this case t, the thickness of the dielectric, represents the infinitesimal difference between the two imaginary radii, and therefore the charge is inversely as the thickness, although the forces to which it is attributed vary as the squares of the distances, *reckoned from this ideal centre.*

94. DIELECTRICS.—All substances possess two properties in relation to electricity; all conduct electricity, but with very different facility: all offer a degree of resistance to transmission, and undergo a certain molecular stress: resistance and this susceptibility to stress are not identical, nor even proportionate, yet they have some relation to each other; substances which undergo *stress* and retain the strained condition when the generating force is withdrawn are called *dielectrics*, and the faculty of receiving this stress is called *inductive capacity*. An approximate distinction may be drawn between conductors and dielectrics, thus:—

Conductors are metals (also carbon in some forms) or substances of which metals, including hydrogen as a metal, form one of the molecular binary subdivisions or *ions*.

Dielectrics are substances not containing metals (except hydrogen, which in them does not replace a metal, or form a separate constituent), and whose molecular constitution is complex and not binary; gases also are dielectrics.

(*a*) *Inductive Capacity* or electro-static capacity is measured in "micro-farads," and *specific inductive capacity* is the degree of this property possessed by specified or unit dimensions of each particular substance. Inductive capacity varies with temperature, and is generally reduced by heating.

(*b*) *Resistance of dielectrics* follows the same laws as in conductors; it is measured in meg-ohms. (million of ohms.) on account of its magnitude, as compared with that of conductors; it varies as the thickness and inversely as the area; each substance has its own specific resistance, but in dielectrics it varies inversely as temperature.

Guttapercha is usually measured at 75° Fahr. as unity, and its specific resistance may become (according to Willoughby Smith) 23·6 at 32°, and be lowered to ·2233 at 100°; but other values are also given, and no doubt much depends upon its purity.

Indiarubber varies in the same manner, but to only about one-tenth the amount; and the resistance of both increases with pressure.

(*c*) The product of the resistance in meg-ohms, and the capacity in micro-farads, of any dielectric, is a constant value at the same temperature, irrespective of dimensions or form.

(*d*) Dielectrics have each their proper *breaking strain*, or power of endurance; when the "stress" exceeds this, the dielectric breaks downs, and discharge occurs. Even thick glass may be pierced when a powerful charge is concentrated upon a small area by means of pointed conductors; such breaks assume a zigzag line, following the points which offer least resistance, or which have least capacity for stress, and the discharge may break off into several lines.

(*e*) The act of charge alters the dimensions of the dielectric. If a glass-tube is filled with water, and a spark led into it by conductors, the water acts momentarily as a dielectric, and the act of discharge shatters the glass to pieces. The expansions and contractions which occur in a condenser are such as to enable audible sounds to be produced as in a telephone. When a transparent dielectric receives a charge it is found that the arrangement of its molecules is altered, so that it acts differently with polarised light, just as is the case when the magnetic field is formed in a transparent substance, and the degree of change produced is proportional to the square of the electric force.

(*f*) When a current is passed into a dielectric, there is at first a sudden rush, and then a slow, continuous flow, due to two causes.

1. *Leakage*, as it may be called, which is the true current, due to the actual conducting power of the substance, or to any accidental defects, such as cracks in the guttapercha covering a wire.

2. *Soakage.*—The dielectric appears to continually absorb the electricity, as though the condition of stress were at first produced in only the nearest and most yielding portions, and then it appears to be gradually developed throughout the mass. Hence, the inductive capacity of any dielectric will be found to be different, according to whether it is taken for a merely momentary charge, the value of the first rush, or after a prolonged electrification. For most purposes, it is the first of these which is of most importance.

(*g*) When a condenser is discharged, a corresponding current is produced; first a rush, then a slow, continuous current, which is the "soakage" coming out.

(*h*) It is possible even to send in successive reversed charges, which will follow each other into the mass of the dielectric, and will return as currents of alternate direction. This, also, occurs in long cables, into which successive + and − impulses may follow each other, and appear as signals at the distant end.

(*i*) *Residual charge* is a result of this action. On discharging a jar or condenser, the principal portion of the charge—that which is due to the first rush in charging—is instantaneously given up; that which would maintain the small current gradually distributes itself over the mass of the substance, and after a time a fresh discharge can be obtained, or several successive ones, each fainter than the preceding one. This residual charge affords evidence of the state of stress existing in the substance: if it is allowed to escape as a very small current through large resistance and a reflecting galvanometer, the spot of light traverses the scale slowly; but if the Leyden jar be tapped, it flashes across, owing to the sudden discharge. This action is exactly what occurs with a strained bar or spring.

(*k*) For use in condensers, the most useful dielectric is one possessing high resistance and high capacity. For telegraph cables, high resistance and low capacity are desirable, because the stored charges effected at each passage of current are the cause of "retardation," and limit the working power or rate of signalling.

(*l*) *Retardation.*—When a conductor and a dielectric constitute derived circuits to each other, the ordinary laws of conduction are modified by a principle which distributes electricity on all the paths open to it; if the two poles of a battery are connected to the faces of a condenser having a resistance of many meg-ohms, and also to a closed wire circuit of only a few ohms resistance, the current will only flow in the latter in the same proportion as the condenser is charged, and the discharge of the condenser at a break of circuit acts a counter E.M.F., resisting current on fresh make of circuit. When the condenser is charged, it no longer affects the wire circuit. This is what happens in a cable; the charge of the dielectric must precede the arrival of the current at the distant end, and this, instead of rising to full rate at once, increases gradually as the E.M.F. becomes freed by the dielectric charge being completed; as a consequence, the full power needed to affect instruments is only gradually reached.

SPECIFIC INDUCTIVE CAPACITY.—This is the relative capacity of each substance compared to that of air in the same dimensions, dry air being taken for the standard, as water is taken for the standard of specific gravity. Faraday took up the subject in his practical way, using a condenser composed of one sphere inclosed in another, and with a tube-stem provided with a stop-cock by which the dielectric could be exchanged. He employed two such pairs of spheres of the same size, one containing air and the other the dielectric to be compared, and charging both from the same source, and at the same time, he measured the "quantity" absorbed by each, which, of course, gives the relative capacity; this was also accomplished by an indirect method—by charging one, then dividing its charge with the other, and ascertaining the reduction of potential resulting from the division of the charge. Other experimenters have used flat plates of measured distance, and availed themselves of the delicate modern electrometers; but the real values are even yet very uncertain. A full account of the determinations as yet published will be found in Gordon's "Treatise on Electricity and Magnetism." Specific inductive capacity is frequently expressed as that of a cube, but for practical comprehension, the most convenient form is thin plates as given in the following table, in which I have collected the most reliable and useful particulars. The value *k* can be calculated for any value by simply multiplying that of air 0·0323 by the sp. ind. cap. of the substance.

Dielectric.	Faraday.	*k*. Capacity of plate, 1ft. sq., 1 mil (·001in.) thick.	Later determinations.	
			Boltzmann.	Gordon.
		Micro-farads.		
Dry air	1·	0·0323	—	—
Resin	1·77	0·0572	2·55	—
Pitch	1·80	0·0581	—	—
Bees-wax	1·86	0·0601	—	—
Glass	1·90	0·0614	—	—
Sulphur	1·93	0·0623	3·84	2·58
Shellac	1·95	0·0630	—	2·74
Caoutchouc	2·8	0·0904	—	2·220
Guttapercha	4·2	0·1357	—	2·462
Mica	5·	0·1620	—	—
Paraffin	—	—	2·32	1·994
Ebonite	—	—	3·15	2·284
Glass: flint	—	—	—	3·064
" crown	—	—	—	3·243
			Silow.	
Bisulphide of carbon	—	—	—	1·81
Oil of turpentine	—	—	2·153	—
Petroleum	—	—	2·061	—

OBJECT-GLASS WORKING.—III.

By "PRISMATIQUE."

THE thickness of o.g.'s of the construction described in No. II. of these papers, needs a little more comment. Results from comparing the thickness of various o.g.'s, by various makers, go to prove that rule of thumb has prevailed—o.g.'s of 6in. diameter, whose thickness has not exceeded ¾in., when both lenses have been measured on the edge together, and o.g.'s 3in. diameter, of the same, or even greater, thickness not being uncommonly sent out by the same maker, in each case very perfect in performance. This goes to prove that flexure is not as effective in distorting a refracted image as a reflected one, and perfectly agrees with theory. This will remove all doubt from the amateur's mind on that subject, which I will dismiss with this remark: The less glass we have, consistent with safety in working, the better.

Having determined upon the form—and our good friend Mr. Bradbury is getting together a grand selection for the experimentalist—the next step, especially for the beginner, is to know what he is working for practically. He must remember that perfect achromatism has never been attained, and that the nearest approach leaves a residue of colour, technically called the secondary spectrum. To those who have not seen through an o.g. this may seem a formidable affair: it is not so in fact, the secondary colour merely acting as a transparent haze, if I may use such a paradoxical expression, and this remark was made by the late Thomas Cooke, of York, to our respected correspondent, Mr. Wenham: "If you could sweep it away with a brush, the definition of the object would not be improved." Still the elimination entirely of the secondary spectrum is a desirable end, and the aim of all concerning themselves with o.g. work, professional and amateur alike. To grasp the mode of testing as generally practised by the trade, it is necessary, in the first place, to consider the action of a simple convex lens in producing an image of a single luminous point. The spherical bulb of a thermometer tube is used for this purpose, so placed as to reflect a reduced image of the sun. Now, in examining the image produced by a single lens of crown glass with an eyepiece, there is a mass of colour produced, visible at its most distinct position, spread about as it were; but if we push the eyepiece in nearer to the crown o.g. the luminous point spreads into rings with a blue centre, and violet as we approach nearer. This proves the fact that a single lens of convex spherical form gives the blue or violet rays a shorter focus than the red; the latter will be found surrounding the penumbra we are examining, also proving that we are going inside the focus for red rays. Now we bring our eyepiece away from the o.g., we find outside the focus a very little way, that the centre is red, and that the penumbra, instead of well-formed rings, is a diffused mass of blue and violet. If we think a little we can account for this: the blue and violet rays coming to a focus under the visual focus are correspondingly spread out beyond it, as the rays form two cones, the apex of each at the visual focus, the bases opposed. Thus the proofs of chromatic under-correction and aberration are faithfully delineated to our eyes. It must also be remembered that if there were no colour at all produced by the lens, the focus of each zone of the lens decreases from the centre outwards, measuring on the axial line. This gives us proof of positive spherical aberration. This can also be found in the fact that as we push the eyepiece towards the o.g. we pick up as it were the foci of the zones, each in turn spreading out into a ring as we reach the focus of the next. In the future testings of the o.g. in course of construction, any approach to these appearances will prove to us that our o.g. has either one or the other or both of those faults. Practically, with the curves generally used, corrections for achromatism and spherical aberration work hand in hand to within a very little of completion; generally a little spherical under-correction remaining, which must be corrected by the final figuring of the surfaces. This is more especially the case with apertures exceeding 4in.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—LVI.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 331.)

I TOLD you that by reason of the vacuum 30 or 33ft. of water had risen in the suction-pipe. Now settle that it was 30ft., and that every foot in height is equal to ½lb. in weight on a square inch; it follows therefore that 30ft. will equal 15lb.; this the atmospheric pressure is, with the 30ft. column truly balanced, and the consequence is that no higher can the water be forced up within the suction-pipe of a pump by simple external or atmospheric pressure. It should be borne in mind that the further the pump is fixed vertically from the surface of the water, the more sluggishly will the air press the water up the suction-pipe, consequently it is best to fix the barrel within 15 or 18ft. of the water. I rarely exceed 19ft. I had better here remark that horizontal distances are not taken into consideration with atmospheric pressures, or with the action of the atmospheric pump, or with vertical height of the suction-pipe of a pump, as this kind of pump may be made to draw miles horizontally, provided that the barrel does not exceed the limited distance of 30ft.

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The Lift Pump—Action of.

We now know the action of the atmospheric pump; let us proceed to examine the lift-pump. For this purpose let us again refer to Fig. 293. Suppose the barrel to be quite full of water up to the valve V, let this valve be perfectly closed, push up the handle O, this will cause the bucket to descend and the valve J K to open. Now pull the handle down, and the valve J K closes, and you find that the whole thing will not move. It is as rigid as a post. Why? Simply because the cup-leather fits truly, the bucket valve tight, and that there is no outlet above. It is no use trying to compress water; in fact, you may say that with this kind of tool it is one of the impossibilities to compress water. Some idea of this may be gathered when I inform my readers that under the common atmospheric pressure of 15lb. to the square inch, water has been diminished in bulk only to about 45 parts in one million, and that under the enormous pressure of fifteen thousand pounds to the square inch, it was only compressed by about 1/[illegible] of its volume. This experiment was tried in a bronze solid cast and bored [illegible]in. tube, 8in. thick, and was rent in halves by this enormous pressure.

This being the case, we must provide an outlet before we can work the handle of the pump, Fig. 293. Open the valve V and the cock U the pump being worked, the water will flow up, and out of the cock U, which now close, also close the rising main T with a stopcock, the water will now rise in the air-chamber according as it is compressed within the chamber, and as shown in the table.

Of course, by continuing the action of pumping, great pressure will be accumulated in the air-chamber, and, in fact, it would burst if proceeded with. But now open the stopcock on the rising main, and the pressure of air on the surface of the water will cause the water to ascend in precisely the same way as the air does when pressing upon the surface of the water in a well, and when the air is relieved in the suction-pipe of a pump.

You have seen one of the important uses of the air-chamber. There is another great reason for its use. It is most essential in all fire-engines: without it we should not get that regularity in the jet, in fact, the jet would be a continuation of jumps; but by the use of the air-chamber there is a constant pressure maintained, and this gives the desired effect of a continuous stream.

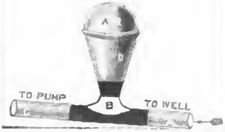
Pump-Work.

Fig. 294 illustrates two different air-chambers, which are generally made of copper. A B C is a section, D an elevation, F G is an elevation of one generally used for fire-engines on board ship. A is the inlet, B a pipe coming to within a few inches of the bottom, C the outlet. But, as a matter of course, it is not necessary that the pipe B should pass through the top of the chamber, but may come off as at A; nor is it at all necessary that the outlet should be in connection with the air-chamber. For a further explanation of the air-chamber, see suction-pipes and mains. My having shown and illustrated the theoretical and practical working of the pump, you will now be in a position to follow me step by step through the remaining portion of pump-work, which will require your particular study, inasmuch as it is my intention to explain thoroughly all the principal parts of the different pumps used for the various classes of work which I have met with during the last quarter of a century; after which, you will be able to select pumps and fittings suitable for any class of work which may be required—a great desideratum to the plumber.

Tree and Lead Pumps.

Sometimes it happens that the tree pump is only used in places where it is exposed to very rough weather, or where the lead pump is likely to get stolen. In this case the top-tree or barrel of the pump is made as usual, and let down into the earth, say, 3 or 4ft. to keep it steady. Then a leaden pipe is flanged to the side or otherwise, and taken a short way in a horizontal direction, and through the crown of the well and down to the water (or in some cases the lead pipe is only used for the horizontal part of the work); but take care to have the pipe laid with a good fall towards the well, so that it will empty itself when required. If otherwise left, the confined air lying within the pipes, and the trap known as a pocket, will be difficult to remove. In such cases fix a retaining or tail-valve on the suction-pipe in the well. When tree and lead pipe pump work have to be done, take care to make the flange large enough for nailing, so that it may be perfectly air-tight to the tree, if the horizontal distance or depth be great, a considerable concussion will take place; then use a suction or vacuum air-chamber fixed as shown at Fig. 295, and as near as possible to the tree or barrel of the pump.

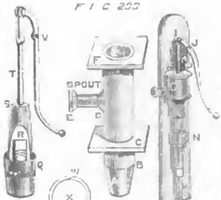
FIG. 295.



Lead Jack-Pump.

In many country shops, plumbers have to make up their own lead pumps from a straight length of pump barrel as follows:—take a length of, say, 3in. or 4in. pump barrel, then saw off about 2ft. 6in., and with a dresser beat the cone-shaped sucker-box end to the shape shown at A, Fig. 296. The cone is generally made from the shoulder to the end 4in. to 5in. long, but for this see size of suction-pipes further on, as this will have something to do with the length of the cone, so that you may make it nearer to the angle of repose. Next prepare the nozzle; this is made as follows:—Take a piece of 1½in. or 2in. pipe according to the size of the suction-pipe (or better still if one size larger pipe be used), and wipe it into the barrel as shown at D, and at about 9in. from the top. The flange E is wiped on, or a bead turned over, as you choose; next wipe on the fixing flanges C and F, Fig. 296.

FIG. 296.

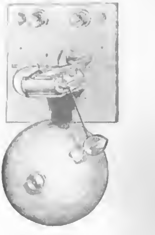


Next is the fixing; but before proceeding with this, let us see what other kind of jack-pumps are to be made. For this refer to Fig. 297. This is the kind of pump used about the suburbs of London. It has a cast-barrel nozzle, and a compensating or regulating head as shown at L, and which causes the flow of water to be more continuous than when the nozzle is branched direct into the barrel, as shown at D, Fig. 296.

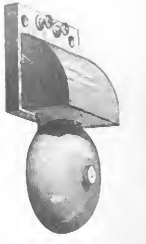
(To be continued.)

GENT'S IMPROVED ELECTRIC BELL.

IN the annexed engravings we illustrate an improved form of electric bell recently patented by Messrs. Gent and Co., of Leicester. The main feature in which it differs from electric bells of ordinary construction is the substituting for the armature usually moving against the face of the ends of a magnet, an armature suspended over its projecting poles.



As seen in the engraving, they are inclined so as to present a large magnetic surface; while, by this mode of suspension, the armature rests with its face at equal distances from the face of the projecting poles at all points,—the peculiar form of spring allowing the armature carrying the hammer to approach at a uniform angle. The power exerted upon the armature is said to be greater than in the ordinary form with a smaller quantity of wire in the coils, sufficient power being obtained to powerfully ring a 4in. or 5in. bell, with a magnet whose core is only a quarter of an inch in diameter, and wound with about three ounces of fine wire.



The whole is mounted on a metal frame, which is itself attached to a small wooden back, the magnet being inclosed and shielded from dust by a quadri-circular cover. As we understand that the cost of the improved bell is, especially in the larger sizes, less than the ordinary forms, it will no doubt meet with the favour it deserves.

HALL'S NEW TYPE-WRITER.

WE give in this number illustrations of a new invention, the object of which is to produce a type-writing machine that has but few parts, is substantially constructed, and not liable to get out of order; while it is simple to learn, and easy to use producing handsome, clear, and rapid printing. It is also small, very portable, and can be furnished at a low price. The whole machine is contained in a case 15 by 7½ by 3in., and weighs 5¾lb.

The printing mechanism is attached to a plate A, which moves step by step in printing from left to right, being guided by the round bar R. This bar is full of circular grooves, resembling the teeth in a rack upon a lathe or planer. The teeth of a small gear upon the plate engage those upon the bar, so that a coiled spring within the gear propels the printing mechanism towards the right, as each impression is given. When the line has been printed, the thumb-latch E, at the right of the plate, is pressed, disengaging the spacing mechanism from the teeth in the bar, and the machine is moved to the left side of the paper to commence a new line. The operation of printing is to take the handle P in the right hand, and place the pointer into one of the holes in the index-plate *l*—shown in Fig. 2—which will bring the corresponding type at F (see Figs. 2 and 3), by means of the projecting portion of type-frame I, to which the handle is attached opposite to the post J, and over a small opening in the bottom plate B; so that a slight pressure carries down the whole plate A, swinging on hinges 25, 25, and the post J presses the type to be used through the opening, and on to the paper, which rests on the flat-topped bar *g*, while all the rest of the type come in contact with an inked pad on the bottom plate B. As the different characters are used, the types are continually changing their position on the pad, and the ink is continually distributed and equalised. Two spring-arms, Q, raise the plate A, and type-form with it, from the paper and ink pad when the pressure is removed.

FIG. 1.

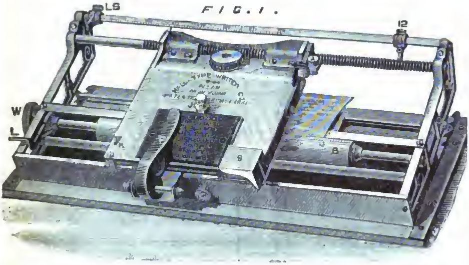


FIG. 2.

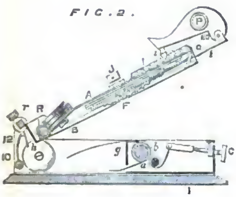
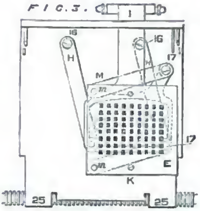


FIG. 3.



Form F (see Fig. 3), containing the type and other characters, of which there are 72 in all, is made of an elastic material, especially prepared for that purpose.

This form is attached by screws to the form-plate. Each individual type and character in the form to be printed is brought under the screw J, and in front of a hole through the inking-plate by a very ingenious piece of mechanism. The printing stud J can be adjusted to regulate the pressure upon the type to the greatest nicety, the plate A going down to a stop.

The mechanism above mentioned may be understood by an inspection of Fig. 3, where the under side of the plate A is shown. The form F is pivoted to the ends of two arms or links at *m*, *m*. These links in turn are pivoted at 17, 17, to the frame K, having a curved slot to admit the post J. This frame is pivoted to one end of the links H H, while the other ends are pivoted to the plate A at 16 16.

From this it will be seen that a pantagraph movement is thus secured which keeps the form precisely square at all times while allowing it to move freely in all directions. When a word has been completed, a space is made by depressing the key S with the little finger without letting go of the handle.

The frame of the machine in which the rod R is secured, and which has the mechanism for holding the paper or card to be printed upon, consists of two skeleton frames, B (see Figs 1 and 2), connected together by bars and plates. Near the centre of this frame is a metal roller, having a rubber face. This roller is designed to hold and move the paper to be printed upon, as shown at *a*. The paper is placed around the roll as shown, and is held in contact with the roll by the clip *b*, which has a spring attached to create a uniform pressure. This clip may be released to place the paper or remove it by lifting the screw at C. The plate *g* has a flat surface at the top upon which the paper rests while receiving the impression. The clip is graduated the same as the gauge bar *r* at the top of the apparatus. The rubber-faced roller has a small lever (L) at the extreme left to rotate the roll by a ratchet motion. At each stroke or movement of the lever the paper is moved up one line, and after it has been printed the paper is advanced another line by again moving the lever, and so on, until the sheet of paper has been filled.

The length of a line can be controlled by setting the two slides upon the gauge-bar *r* to the required width. An index in the bar corresponds with an index on the clip, so that corrections or alterations can be easily made. When the carriage reaches the right end of the line, a small arm, 12, upon the carriage raises the hammer, 10, Fig. 2, and strikes the bell *h*, which notifies the operator that a new line must be started.

The left-hand stop can be set to commence the lines uniformly at any point.

For rapid printing, the operator can readily learn the positions of the holes, enabling him to find them without paying any attention to the letters upon the card at the bottom. Fig. 2 shows the position of the carriage when raised to inspect the work in progress, by simply raising the hand without letting go of the handle P. Type forms containing any desired style of letters are furnished with this type writer very cheaply, and can be changed in a moment.

The apparatus is easily and quickly operated, and is without complication of parts. It is made by the Hall Type Writer Company, 853, Broadway, New York. The inventor, Mr. Thomas Hall, is at present in England, and can be seen or addressed care of the Wanzer Sewing Machine Co., 4, Great Portland-street, London, W.

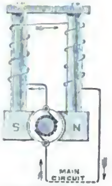
DYNAMO-ELECTRIC MACHINERY.—I.*

By Prof. S. P. Thompson, B.A., D.Sc.

THE brief reports of the lectures recently delivered by Prof. S. P. Thompson, before the Society of Arts, have necessarily been quite inadequate, and sometimes incorrect. The following extracts will, however, be read with interest and instruction.

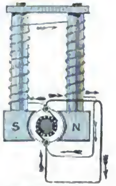
The name dynamo-electric machine appears to have been first employed by Dr. Werner Siemens, in his communication of January 17th, 1867, to the Berlin Academy, in which he described a machine for generating electric currents by the application of mechanical power, the currents being induced in the coils of a rotating armature by the action of electro-magnets, which were themselves excited by the currents so generated. The machine was, in fact, a self-exciting dynamo, with the field-magnets and armature united "in series" to the external circuit, or what we now call a "series-dynamo," a diagramatic representation of which is given in Fig. 1. But the term dynamo-electric machine, then introduced into electric technology, has not remained thus restrained to its narrowest meaning. It was next applied to machines of kindred nature, in which, though self-excited, only a portion of the entire current generated by the rotating armature was applied to excite the field-magnets (see Fig. 2).

FIG. 1



The Series Dynamo.

FIG. 2.



The Shunt Dynamo.

This principle of working (now known as that of the "shunt-dynamo"), first introduced by Wheatstone, is but a variation of the former arrangement in detail, and no violence is done to the original term to apply it to both cases. In fact, the name was welcomed as being convenient in practice for distinguishing such machines from those which were not self-excited—those in which either steel magnets or separately-excited electro-magnets were used to produce the magnetic field.

But since the great development of electric lighting took place, it has been found convenient to use generating machines in certain combinations, in which the self-exciting principle is abandoned. Some systems of electric lights require alternating currents, produced in machines which cannot excite their own magnets with a continuous magnetisation; and there are other systems where continuous currents are employed, in which also practice has shown that the currents are better regulated when the magnets of the dynamos are separately excited by currents derived from an external source. There is, then, a third class of dynamo-electric machine, the "separately-excited dynamo" (Fig. 3), which was indeed earlier than either of the preceding, having been brought out by Wilde in 1866. A dynamo is a dynamo, in fact, whether its magnets be excited by the whole of its own current, or by a part of its own current, or by a current from an independent source. The source of the magnetising power is indifferent, provided a magnetic "field" of sufficient intensity be produced wherein the generating coils can be rotated. Now, as it does not matter where the magnetising power comes from, it is clear that we must include amongst possible sources the power of permanent steel magnets. In short, the arbitrary distinction between so-called magneto-electric machines (see Fig. 4) and dynamo-electric machines fails when examined carefully. In all these machines a magnet, whether permanently excited, independently excited, or self-excited, is employed to provide a field of magnetic force. And in all of them dynamical power is employed to do the work of rotating the coils of the armature, in order to generate the electric currents.

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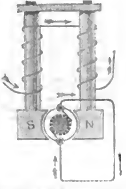
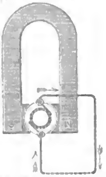
* Extracted from the Cantor Lectures, delivered before the Society of Arts.

FIG. 3



THE SEPARATELY-EXCITED DYNAMO.

FIG. 4



THE MAGNETO DYNAMO.

The true and comprehensive definition of a dynamo-electric machine is, then, the following:—A dynamo-electric machine is a machine for converting energy in the form of dynamical power into energy in the form of electric currents, by the operation of setting conductors (usually in the form of coils of copper wire) to rotate in a magnetic field.

Inasmuch, however, as every dynamo-electric machine, in the most general sense of the term as now laid down, will work as a motor, and becomes a source of mechanical power when supplied with electric currents, it is possible to discuss dynamo-electric machinery from the opposite points of view in serving the two converse functions; in short, to treat the dynamo on the one hand as a generator, on the other hand as a motor.

It is as a generator only that the action of the dynamo will be considered in the first two of these lectures, reserving considerations respecting its functions as a motor for the third lecture of the present course.

The Dynamo in Theory.

To treat exhaustively the theory of dynamo-electric machines would require not one lecture, but many. It would be necessary, moreover, to enter upon lengthy mathematical and geometrical discussions, which would be out of place in the present course, which is expected to deal with subjects from an industrial, rather than from a purely scientific, aspect. The mathematical theory of the dynamo is, indeed, very complex, and takes different forms for its expression in the four classes of machine now included under the one name of "dynamo." For every different variety in each of these classes, there is a fresh variety of mathematical symbols. The theory of alternate current machines is entirely different from that of machines which are to furnish continuous and constant currents. Every form of armature and coils requires its own specific treatment in symbols; and the simple consideration of putting iron cores into the coils, when treated mathematically, introduces such complex expressions as to yield no hopes of a satisfactory general solution.

Physical Theory of Dynamo-Electric Machines.

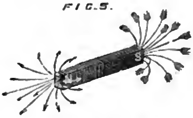
All dynamos are based upon the discovery, made by Faraday in 1831, that electric currents are generated in conductors by moving them in a magnetic field. Faraday's principle may be enunciated as follows:—When a conductor is moved in a field of magnetic force in any way so as to cut the lines of force, there is an electromotive force produced in the conductor, in a direction at right-angles to the direction of the motion, and at right-angles also to the direction of the lines of force, and to the right of the lines of force, as viewed from the point from which the motion originates.

This induced electromotive force is, as Faraday showed, proportional to the number of lines of magnetic force cut per second; and is, therefore, proportional to the intensity of the magnetic "field," and to the length and velocity of the moving conductor. For steady currents, the flow of electricity in the conductor is, by Ohm's well-known law, directly proportional to this electromotive force, and inversely proportional to the resistance of the conductor. For sudden currents, or currents whose strength is varying rapidly, this is no longer true. And it is one of the most important matters, though one too often overlooked in the construction of dynamo-electric machinery, that the "resistance" of a coil of wire, or of a circuit, is by no means the only obstacle offered to the generation of a momentary current in that coil or circuit; but that, on the contrary, the self-induction exercised by one part of a coil or circuit upon another part or parts of the same, is, in many cases, quite as important a consideration, and in some cases a more important consideration, than the resistance.

To understand clearly Faraday's principle—that is to say, how it is that the act of moving a wire so as to cut magnetic lines of force can generate a current of electricity in that wire—let us inquire what a current of electricity is.

A wire through which a current of electricity is flowing looks no different from any other wire. No man has ever yet seen the electricity running along in a wire, or knows precisely what is happening there. Indeed, it is still a disputed point which way the electricity flows, or whether or not there are two currents flowing simultaneously in opposite directions. Until we know absolutely certainly what electricity is, we cannot expect to know precisely what a current of electricity is. But no electrician is in any doubt as to one most vital matter—namely, that when an electric current flows through a wire, the magnetic forces with which that wire is thereby, for the time, endowed, reside not in the wire at all, but in the space surrounding it. Every one knows that the space, or "field," surrounding a magnet is full of magnetic "lines of force," and that these lines run in tufts (Fig. 5) from the N.-pointing pole to the S.-pointing pole of the magnet, invisible until revealed by dusting iron filings into the field, whereby their presence is made known, though they are always in reality there. A view of the magnetic field at the pole of a bar-magnet, as seen end-on, would, of course, exhibit merely radial lines.

FIG. 5.



LINES OF FORCE OF BAR-MAGNET.

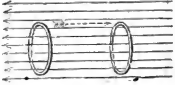
Now, every electric current (so-called) is surrounded by a magnetic field, the lines of which can be similarly revealed. To observe them, a hole is bored through a card or a piece of glass, and the wire which carries the current must be passed up through the hole. When iron filings are dusted into the field, they assume the form of concentric circles, showing that the lines of force run completely round the wire, and do not stand out in tufts. In fact, every conducting wire is surrounded by a sort of magnetic whirl. A great part of the energy of the so-called electric current in the wire consists in these external magnetic whirls. To set them up requires an expenditure of energy; and to maintain them requires also a constant expenditure of energy. It is these magnetic whirls which act on magnets, and cause them to set as galvanometer needles do, at right angles to the conducting wire.

Now, Faraday's principle is nothing more nor less than this:—That by moving a wire near a magnet, across a space in which there are magnetic lines, the motion of the wire, as it cuts across those magnetic lines, sets up magnetic whirls round the moving wire, or, in other language, generates a so-called current of electricity in that wire. Poking a magnet-pole into a loop or circuit of wire also necessarily generates a momentary current in the wire loop, because it momentarily sets up magnetic whirls. In Faraday's language, this action increases the number of magnetic lines of force intercepted by the circuit.

It is, however, necessary that the moving conductor should, in its motion, so cut the lines of force as to alter the number of lines of force that pass through the circuit of which the moving conductor forms part. If a conducting circuit—a wire ring or single coil, for example—be moved along in a uniform magnetic field, as indicated in Fig. 6, so that only the same lines of force pass through it, no current will be generated. Or if, again, as in Fig. 7, the coil be moved, by a motion of translation, to another part of the uniform field, as many lines of force will be left behind as are gained in advancing from its first to its second position, and there will be no current generated in the coil. If the coil be merely rotated on itself round a central axis, like the rim of a fly-wheel, it will not cut any more lines of force than before, and this motion will generate no current. But if, as in Fig. 8, the coil be tilted in its motion across the uniform field, or rotated round any axis in its own plane, then the number of lines of force that traverse it will be altered, and currents will be generated. These currents will flow round the ring-coil in the positive[*] sense (as viewed from the point toward which the lines of force run), if the effect of the movement is to diminish the number of lines of force that cross the coil; they will flow round in the opposite sense, if the effect of the movement is to increase the number of intercepted lines of force.

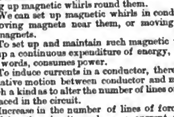
If the field of force be not a uniform one, then the effect of taking the coil, by a simple motion of translation, from a place where the lines of force are dense to a place where they are less dense, as from position 1 to position 2 in Fig. 9, will be to generate currents. Or, if the motion be to a place where the lines of force run in the reverse direction, the effect will be the same, but even more powerful.

FIG. 6.



We may now summarise the points under consideration, and some of their immediate consequences, in the following manner:—

FIG. 7.



1. A part, at least, of the energy of an electric current exists in the form of magnetic whirls in the space surrounding the conductor.
2. Currents can be generated in conductors by setting up magnetic whirls round them.
3. We can set up magnetic whirls in conductors by moving magnets near them, or moving them near magnets.
4. To set up and maintain such magnetic whirls uses up a continuous expenditure of energy, or, in other words, consumes power.
5. To induce currents in a conductor, there must be relative motion between conductor and magnet of such a kind as to alter the number of lines of force embraced in the circuit.
6. Increase in the number of lines of force embraced by the circuit produces a current in the opposite sense to decrease.
7. Approach induces an electromotive force in the opposite direction to that induced by recession.
8. The more powerful the magnet pole or magnetic field, the stronger will be the current generated (other things being equal).

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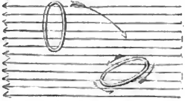
[*] The positive sense of motion round a circle is that opposite to the sense in which the hands of a clock go round.

9. The more rapid the motion, the stronger will be the currents.

10. The greater the length of the moving conductor thus employed in cutting lines of force (*i.e.*, the longer the bars, or the more numerous the turns of the coil), the stronger will be the currents generated.

11. The shorter the length of those parts of the conductor not so employed, the stronger will be the current.

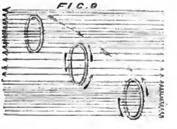
FIG. 8.



12. Approach being a finite process, the method of approach and recession (of a coil towards and from a magnet pole) must necessarily yield currents alternating in direction.

13. By using a suitable commutator, all the currents, direct or inverse, produced during recession or approach, can be turned into the same direction in the wire that goes to supply currents to the external circuits, thereby yielding an almost uniform current.

FIG. 9



14. In a circuit where the flow of currents is steady* it makes no difference what kind of magnets are used to procure the requisite magnetic field, whether permanent steel magnets or electro-magnets, self-excited or otherwise.

15. Hence the current of the generator may be itself utilised to excite the magnetism of the field-magnets, by being caused, wholly or partially, to flow round the field-magnet coils.

A very large number of dynamo-electric machines have been constructed upon the foregoing principles. The variety is indeed so great, that classification is not altogether easy. The classification which I shall adopt, is one which I have found more satisfactory and fundamental than any other. I distinguish three genera or main classes of dynamos.

Class I.—Dynamos in which there is rotation of a coil or coils in a uniform† field of force, such rotation being effected (as in the manner indicated in Fig. 12), round an axis in the plane of the coil, or one parallel to such an axis.

EXAMPLES.—Gramme, Siemens (Alteneck), Edison, Lontin, Bürgin, Fein, Schückert, Jurgensen (Thomson's Mousemill-dynamo), [Brush].

Class II.—Dynamos in which there is translation of coils to different parts of a complex field of varying strength, or of opposite sign. Most, but by no means all, of the machines of this class furnish alternate currents.

EXAMPLES.—Pixii, Clarke, Niaudet, Wallace, Farmer, Wilde, (alternate), Siemens (alternate), Hopkinson and Muirhead, Thomson (alternate), Gordon (alternate), Siemens-Alteneck (Disk Dynamo), Edison (Disk Dynamo), De Meritens.

Class III.—Dynamos having a conductor rotating so as to produce a continuous increase in the number of lines of force cut, by the device of sliding one part of the conductor on or round the magnet, or on some other part of the circuit.

EXAMPLES.—Faraday's Disk-machine, Siemens's ("Unipolar" Dynamo), Voice's Dynamo.

One machine, and one only, am I aware of, which does not fall exactly within any of these classes, and that is the extraordinary tentative dynamo of Edison, in which the coils are waved to-and-fro at the ends of a gigantic tuning-fork, instead of being rotated on a spindle.

Suppose, then, it were determined to construct a dynamo upon any one of these plans—say the first—a very slight acquaintance with Faraday's principle and its corollaries would suggest that, to obtain powerful electric currents, the machine must be constructed upon the following guiding lines:—

a. The field-magnets should be as strong as possible, and their poles as near together as possible.

b. The armature should have the greatest possible length of wire upon its coils.

c. The wire of the armature coils should be as thick as possible, so as to offer little resistance.

d. A very powerful steam-engine should be used to turn the armature, because,

e. The speed of rotation should be as great as possible.

Unfortunately, it is impossible to realise all these conditions at once, as they are incompatible with one another; and, moreover, there are a great many additional conditions to be observed in the construction of a successful dynamo. We will deal with the various matters in order, beginning with the speed of the machine.

(*To be continued.*)

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* For currents that are not steady, there are other considerations to be taken into account, as will be shown hereafter.

† Or approximately uniform. A Gramme ring, or Siemens drum armature, will work in a by no means uniform field, but is adapted to work in a field in which the lines of force run uniformly from one side to the other. But in such a field, a multipolar armature of many coils, such as that of Wilde, or such as is used in the Gramme alternate-current, or in the Siemens alternate-current machine, is useless and out of place. Indeed, the classification almost amounts to saying that in machines of Class I. there is one field of force; while in the machines of Class II. there are many fields of force, or the whole field of force is complex.

PROF. TYNDALL ON LIGHT AND THE EYE

ON Thursday, last week, Prof. Tyndall delivered the first of a course of six lectures on "Light and the Eye," addressed to young people, who densely packed the theatre of the Royal Institution. Christmas juvenile lectures were begun, he remarked, by Faraday exactly 55 years ago. Probably none of the boys and girls present had ever seen Faraday. If they had seen him they would not soon have forgotten him, and he was no doubt well remembered by the boys and girls, now men and women, who had the privilege of hearing him. When he was getting on to 70 he used still to call himself a "juvenile," and so Faraday was, for his heart never grew old. He always tried to make this Christmas course as simple as possible, and, Professor Tyndall added, he would himself try to follow his predecessor's example. He should, therefore, address himself to the youngest of his hearers; but to enable the older boys and girls present to go more deeply into the subject, if they wished to do so, he had placed in the hands of every one of them his "Notes on Light," which he took great pains to write briefly and clearly some years ago. The sun, of course, was our oldest source of light. We did not know when fire was first discovered by human beings. It must have been long before history began to be written, and it was probably first used as a source of heat, and not until some time afterwards as a source of light. The means of illumination employed at the present hour in certain parts of Ireland and Scotland were very primitive. They took a common rush and peeled it so as expose the soft, spongy pith, leaving a narrow strip of the peel behind, so as to hold the pith together. Tallow was then melted in a pan, and they passed the peeled rush through the liquid grease. Thus we had the rushlight employed, the lecturer believed, to this hour in many parts of the United Kingdom It was soon found that after the first grease coat had hardened the rush could be dipped again, and covered a second time with tallow. The process being repeated, a good thick stem of tallow surrounded the central rush, and there on the table they had lighted rushlights of the kind. We had now advanced from tallow to wax, to stearine, and paraffin, as they saw, and had thus wonderfully improved candles. Wax must have been thus used in Swift's time, for in a famous fable the witty Dean makes the bee boast, to the confusion of the spider, that whatever his own busy tribe had got had been gained by infinite labour and research, and by ranging through every corner of nature, the difference between bees and spiders being that, instead of dirt and poison, the bees had rather chosen to fill their hives with honey and wax, thus furnishing mankind with the two noblest things—sweetness and light. It was experimentally shown that the unprotected flames from our candles, gas, and paraffin lamps emit much smoke, which was eliminated when a draught was created by the use of a chimney. The brilliant Empress lamp was smokeless though without a chimney, the draught being produced by an ingeniously contrived fan. Exceedingly hot flames had been discovered which gave hardly any light until some solid body was placed in the flame. Such a flame was that of hydrogen gas, which, however, at once became highly luminous when a platinum wire was plunged into it. In the same flame a pipe-shank was quickly raised to a white heat. Still more intense was the oxy-hydrogen flame, as was shown by the instant dissipation of a small round file into a shower of sparks, and of which the Drummond light was an early illustration. The fact that a platinum wire becomes more and more intensely incandescent by the passage through it of repeated electric currents had been known for three quarters of a century. But it was only the other day that he saw at the Crystal Palace how admirably it had been turned to account in the Lewis lamp. (See p. 343, Vol. XXXV.) The platinum was here wrought into an extremely fine gauze, of which the inventor made a little cage, putting into it a very hot flame, and producing the very brilliant light which they now saw. Swan' carbon fibre was ignited in three groups by a battery of 50 cells, and, the gas having been extinguished, the theatre was afterwards illuminated by the Swan lamps presented to the Institution some six months ago. The light used for the next experiments, Prof. Tyndall explained, would dazzle the audience too much if placed naked before them, but he would cause it to stamp its own image upon the screen. The image of a pair of carbon points was then shown as passed through a pinhole first and afterwards through a lens. A whole regiment of such points was next seen to be transmitted. The rebound of light on striking a smooth surface was demonstrated. The beam of light passed through the pinhole and could not be itself seen, but only the particles of dust in the air which were illuminated by it. On burning this dust with a spirit-lamp, black specks, like smoke, were produced by the flame, which yet was smokeless. The law known to the ancients, of the equality of the angle of incidence to the angle of reflection, was demonstrated by ingenious apparatus, devised by the lecturer's assistant, Mr. Cottrell. An experiment of the same kind as that by which Professor Pepper produced the well-known ghost illustrated the relation between transmitted and reflected light. Between the busts of Newton and Lord Bacon was introduced, by an optical illusion, that of Mary Somerville. The explanation of the law of the kaleidoscope, and of the laws of reflection from angular and curved mirrors followed.

On Saturday last Prof. Tyndall delivered the second lecture of the course, the theatre being again crowded. The lecturer stated that, according to Foucault's later experiments, the velocity of light was more than 185,000 miles a second. This would be the distance run in 258 days by an express train travelling day and night, at the rate of 30 miles an hour. A word on shadows and penumbras or half-shadows followed, illustrated by simple experiments. Owing to the motion of light in a right line, opaque bodies were found to cast shadows. A wand was fixed upright on the table with the flame of an Empress lamp turned edgeways upon it. The dark shadow was at once visible on the screen, but, as was pointed out, there was no penumbra. But on turning the flame face onwards the shadow was dark at the core only, with a parallel streak of fading penumbra on each side. When the light emanated from a point, the shadow of a sphere placed in the light was a divergent cone. The bearing of these and other simple facts on the phenomena of eclipses was illustrated by diagrams. The law of actual inversion of the image in a mirror Dr. Tyndall demonstrated in its most elementary form by calling attention to the change in direction of the parting of his own hair as reflected in a looking-glass. He next spoke of refraction, which he expounded with constant reference to what is known as Brooke's model, illustrative of what happens when a ray of light passes from air into water. He showed that there was a limiting angle answering to the particular obliquity which caused the ray to graze the surface after quitting the water. It was next asked what became of the rays having a greater obliquity than that answering to the limiting angle. The diagram would show that they never left the water at all, but were totally reflected at the surface, where air and water touched. The verification by experiment followed, demonstrating the phenomenon of total reflection in the circular cell, with the help of the rectangular prism. The carbon points having been inverted, a beam of light was next deflected at right angles to itself, teaching that when light passing through water strikes very obliquely the surface where air and water meet it cannot escape from the water. Supposing, said the lecturer, he let water spout from the vessel to which he pointed, and supposing, further, that by means of a little glass window at the back of the vessel, he sent a beam of light through the water, concentrating it upon the orifice through which the water flowed, that beam would strike the surface of the jet of water so obliquely that it could not escape from the water but would be carried down, thus making the jet look like molten metal. The illumination of the liquid vein by internal reflection and with rays of various colours was then given, and was received with rapturous applause. The different kinds of lenses were described, and their applications experimentally illustrated. In the magic lantern, to which Dr. Tyndall soon passed, there was a combination of lenses. One was used purely for the purpose of illumination, the others for the reproduction of the illuminated object in the image on the screen. The slides used for the magic lantern reproduced instantaneous and transparent photographs of the Niagara Falls, rapids, glaciers, and icebergs. Before concluding, Dr. Tyndall said, he wished to make in their presence an experiment on sound, bearing directly on his subject. He had there a gas weightier than air, a gas through which sound moved more slowly than through air. This gas, called nitrous oxide, would, he expected, act upon sound exactly as a convex lens acted upon light. He had also another gas much lighter than air, and through which sound travelled more swiftly than through air. This latter gas, called hydrogen, would prove, he thought, the direct converse of the heavy gas. The professor then applied these sound lenses, as he styled them, experimentally. Having shown the sensitive flame, and illustrated its behaviour, he brought it near to the flaring point, when the reed sounded. He next brought a bubble of nitrous oxide in front of the reed. The heavy gas acted like a condensing lens, making the sound converge upon the flame, and causing it to flare and roar. He next experimented with the other gas, first augmenting the pressure on the gas-holder outside, so as to make the flame flare when the reed sounded. He then introduced his light hydrogen lens. This gas at once scattered the rays of sound, so that the flaring flame was immediately stilled. Lastly, he shook in front of the table both the heavy bubble and the light bubble, when the one fell to the floor and the other rose to the ceiling. This experiment, he said, was important, because it showed that the waves of sound could be refracted, like light, and this prepared us for the result that light also might be due to wave motion. He said he deemed this a most striking and beautiful experiment.

SOLDERING WITHOUT AN IRON.

THE following method for soldering without the use of a soldering iron is given in the *Techniker*:—The parts to be joined are made to fit accurately, either by filing or on a lathe. The surfaces are moistened with the soldering fluid, a smooth piece of tinfoil laid on, and the pieces pressed together and tightly wired. The article is then heated over the fire by means of a lamp until the tinfoil melts. In this way two pieces of brass can be soldered together so nicely that the joint can scarcely be found.

With good soft solder, nearly all kinds of soldering can be done over a lamp without the use of a "bit." If several places have to be soldered on the same piece, it is well to use solder of unlike fusibility. If the first piece is soldered with fine solder composed of 2 parts of lead, 1 of tin, and 2 of bismuth, there is no danger of its melting when another place near it is soldered with bismuth solder, made of 4 parts of lead, 4 of tin, and 1 of bismuth, for their melting points differ so much that the former will not melt when the latter does. Many solders do not form any malleable compounds.

In soldering together brass, copper, or iron, hard solder must be employed: for example, a solder made of equal parts of brass and silver. For iron, copper, or brass of high melting point, a good solder is obtained by rolling a silver coin out thin, for it furnishes a tenacious compound, and one that is not too expensive, since silver stretches out well. Borax is the best flux for hard soldering. It dissolves the oxides which form on the surface of the metal, and protects it from further oxidation, so that the solder comes into actual contact with the surfaces of the metal. For soft soldering, the well-known fluid, made by saturating equal parts of water and hydrochloric acid with zinc, is to be used. In using common solder rosin is the cheapest and best flux. It also has this advantage, that it does not rust the article that it is used on.

THE NUTRITIVE PROPERTIES OF RICE.

THE increase in the consumption of rice has lately attracted the attention of several men of science in Germany, and amongst other investigations, an attempt has been made by Professor Voit to discover the relative capacity which various forms of nourishment possess of being incorporated into the system. He has drawn up the following table of the percentage which remains in the body, and of that which leaves it:—

	Percentage incorporated.	Percentage which is not retained.
Meat	96·7	3·3
Rice	96·1	3·9
Eggs	94·8	5·2
White bread	94·4	5·6
Maize	93·3	6·7
Potatoes	90·7	9·3
Milk	88·9	11·1
Black bread	88·5	11·5

According to these results (the *Bremer Handelsblatt* remarks) meat and rice leave the smallest amount of residuum, and occasion the smallest excessive exertion to the digestion, and in fact introduce the minimum quantity of ballast into the human frame. Dr. Konig, of Münster, considers that the fact of large masses of population living on rice is easily accounted for, and in summing up the information collected upon the subject, Professor Voit remarks that potatoes, when consumed in excessive quantity, fail to nourish the frame effectively, make the blood watery, and render the muscles weak. Apart from the subject dealt with in the table drawn by Professor Voit, the question of the relative nutritive value of rice and potatoes has been investigated by Dr. König, who is of opinion that if similar quantities of both articles are compared, the former possesses four times the value of the latter in really nutritive properties It is also remarked that the introduction of rice as a substitute for potatoes is facilitated by the fact that no such variation takes place in its quality as is the case with the potato, which is liable to be materially influenced by the effects of unfavourable weather.—*Lancet*.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE third meeting of the session of this society was held on the 13th ult. at King's College, Strand, James Glaisher, Esq., F.R.S., in the chair.

The Chairman gave notice that the next meeting would be made special, for the purpose of admitting of the nomination of Prof. P. Martin Duncan as President for a third year in succession—a proposal which he felt sure would be received with entire satisfaction.

Mr. G. J. Dowdeswell read a paper descriptive of a specimen exhibited under a microscope in the room, of the lung of a septicæmic mouse. In reply to a question from the Chairman, Mr. Dowdeswell said that the object was exhibited under an objective of 1/25in. and a No. 3 eyepiece giving a power of 2,500 diameters.

The Chairman thought the experiments described were very important, from the fact of their having been conducted under such high powers. Investigations of this kind required an amount of time and a delicacy of manipulation which might well make the society grateful to any one who bestowed upon them the necessary attention. He was very glad that Mr. Dowdeswell intended to continue the same line of investigation, and that he had promised they should hear the results of his further researches.

Mr. Crisp exhibited (1) Marten's ball-jointed microscope; (2) Hartnack's (or Recklinghausen's) demonstration microscope; and (3) the latest form of Mr. E. H. Griffith's club microscope.

Mr. F. Kitton's paper "On Binocular Vision in the Study of the Diatomaceæ" was read.

Mr. Beck said that with reference to the opening remarks of the author on the value of binocular over monocular vision, he could fully bear out all that had been said. A valuable means of convincing anyone who was sceptical on the subject was to be found in a slide of *Aulacodiscus*, and he remembered that when his brother Richard showed this diatom to Mr. Tuffen West for the first time under the binocular, that distinguished draughtsman looked at it for some time in silence, and then suddenly jumping up exclaimed, "All the drawings of diatomaceæ which I have done will have to be done over again." In the earlier drawings of *Arachnoidiscus* the idea was that the markings were different on the two sides. His brother was, however, the first to show that the external surface was a beautiful curve, the interior being full of holes, which could only be seen under the binocular.

Dr. Wallich said he could fully confirm the statement that nothing showed diatoms so well as the binocular. Indeed, from a study of these objects, extending over many years, he could say that it was utterly impossible to see them in any other way. In one of the drawings of *Hydrosera* he observed that Mr. Kitton had not noted the unsymmetrical formation consisting of a little dot, which was generally surrounded by a slight ridge on one side only. It occurred in *Hydrosera* and many of the discoidal forms, and though often seen, he had never been able yet to detect what this peculiar structure was. It would be of advantage if someone would set to work to determine the point. It seemed to him to have something to do with the communication between adjacent frustules.

Mr. Crisp said that Mr. Kitton had proved conclusively the superiority of the binocular, in that he had shown the true form of diatoms, which had previously been misinterpreted by most experienced observers after observation with the monocular.

Dr. Wallich, in reply to Mr. Badcock, stated that in examining these objects under high powers, he used the thinnest slide he could find and the thinnest cover-glass. Generally, he used one of Hartnack's objectives. The only difficulty was to get the whole of the field illuminated: but it was not really necessary, in by far the larger number of cases, to use more than the central part of the field, which could always be illuminated.

Mr. James Smith said that in working with high powers under the binocular, he had always found it of great advantage to use a finely-ground glass slide under the slide on which the object was mounted. This he illuminated by using a Kellner eyepiece under the stage, bringing the image of the flame into focus on the ground slide. If a 1/4in. or an 1/8in. were used under ordinary circumstances, the black division across the field was seen; but the ground glass seemed to obliterate this entirely. He generally used a piece of very pale blue glass, ground on the upper surface.

Mr. Stewart referred to the importance of approximating the back lens of the objective to the binocular prism. With the ordinary Wenham prism, they were limited to powers of 400 to 500; but with the Stephenson arrangement, it was quite easy to work with a 1/25in. There seemed still to be persons who appeared to think that the binocular was a mere toy. It was, however, of really great importance, especially when working on an exceedingly transparent object, where the inner membranes could be seen distinctly separated from those above them, or in tracing out fine nerve-fibres, which passing over or under each other, could be resolved in a way which was entirely impossible by any other means.

Mr. Crisp pointed out the means that had been adopted for using the Wenham prism with the higher powers by fitting it into a tube which could be passed inside the objective.

Mr. Beck believed they were only as yet in the infancy of the subject of the binocular microscope, and he looked forward to the time when much more attention would be paid to its construction, and particularly to the question of ascertaining what was the proper relative distance between the objective and the Wenham prism. If the attention of opticians were more directed to the best point at which the prism should be placed to get the full field without adventitious aid in the way of illuminators, improved results would no doubt be obtained. He believed that the binocular was the microscope which would be used in the future.

Dr. Wallich said that with reference to ground glass, he might mention that some time ago he accidentally found some glass which had been near a guttapercha bottle of hydro-fluoric acid, the fumes of which had acted upon the glass and frosted it in a far finer manner than could be done with the finest emery powder. The condenser he used was the ordinary "Gillett," with which he had no difficulty. Another thing which he found very useful with the bull's-eye condenser was to fix a piece of light-blue glass on the near side of it. The light from this was so good that he could confidently recommend the plan.

Dr. Gibbes said he could corroborate all that had been said on the subject of the binocular, and especially its value when used with a 1/12in. in examining those very minute parasites to which his attention had been given, as it enabled him at once to see whether they were outside or inside the tissue.

Mr. Dreyfus's note was read, describing a safe method of packing slides in a cabinet for railway and sea transit.

The meeting was then adjourned to Jan. 10.

USEFUL AND SCIENTIFIC NOTES.

Electric Lighting from Batteries.—Electric lighting on a large scale by means of batteries has recently been carried out in Paris. The Comptoir d'Escompte is lighted by 50 arc lamps, Siemens and Gravier's, and 100 Swan lamps, the current being supplied by Jarriant and Grenet's bichromate batteries. The reason for employing this antiquated means of carrying out the lighting of the place is stated to be because no engine or gas motor is allowed on the premises for fear of fire. There are 60 batteries of 48 cells in use, each feeding an arc lamp or a group of from 8 to 10 incandescent lamps. The E.M.F. of each battery of 40 cells is about 82 volts, and the current 24 ampères. Messrs. Jarriant and Grenet estimate that each battery in full work develops energy equal to one and a half horsepower. The liquid in the batteries is renewed by special compressed air apparatus and numerous pipes.

Boiling Rice.—A correspondent of the *Miller* says:—Just put the rice into boiling water, with a little salt, and let it boil 20 minutes; strain the water away, dash it over with cold water, and strain once more; put the rice back again into the saucepan and cover with a cloth, and let it stand near the fire until required for dishing up. Thus prepared, it is a delicious dish. We used to take four times the time and ten times the trouble, but we never had a dish to bear the least comparison with rice prepared as above.

SCIENTIFIC NEWS.

ACCORDING to an ephemeris computed from Mr. S. C. Chandler's elements of the great comet (which we note is now designated *c* 1882), the following are the positions for the dates given at Berlin midnight:—

	R.A.			S. Dec.	
Jan. 6	6h.	58m.	51s.	28°	25·2′
8	6	53	46	28	0·8
10	6	48	53	27	34·8
12	6	44	14	27	7·5

For some dates, Greenwich midnight, another ephemeris gives:—

	R.A.		S. Dec.	
Jan. 6	6h.	58·4m.	28°	26′
8	6	53·3	28	2
10	6	48·4	27	34
12	6	43·8	27	8

There may be some slight errors, but the figures given will enable the comet to be found in the telescope without much difficulty, provided the weather is favourable.

Prof. Auwers, director of one section of the German Transit of Venus Expedition, that stationed near Punta Arenas, South America, has been especially successful in taking good photographs and making numerous measurements.

Mr. Cooper, of Charminster, Dorset, sends us two capital little photographs of the transit taken with a 12¼in. unsilvered mirror of 9ft. 6in. focus. The times are 2.15 and 2.45 p.m., when the planet was just at internal contact, and advanced about four diameters on the sun's disc.

The 50th year of the "Annuaire de l'Observatoire Royal de Bruxelles" finds the useful little green book thinner than usual. Besides the regular astronomical matter, there are few papers of interest; but M. Niesten gives a useful "table des comètes," and M. Fievez has a short paper on the great comet.

The facts about the wonderful eight horse-power electric light at Milwaukee, which was run by the magnetic storm, appear to be that an eight-candle Edison lamp was attached to the telegraph wire and to earth, that the auroral current did actually work it, but only to about half its capacity. An eight-candle lamp requires about ⅛ horse-power to fully develop it.

The South Brancepeth Colliery has the electric light in some of the underground workings—viz., the shaft, the sidings, stable, and engine-house. The system adopted is the Maxim-Weston, and as soon as another engine is ready the whole of the surface works will be lighted by electricity.

At the Trafalgar Collieries, Forest of Dean, some of the pumping is done by electricity. The arrangements are under the care of Mr. A. Le Neve Foster, managing director of the Pyramid Electric Company. The motor is worked from a dynamo at the surface, the wires being taken down the shaft and along the workings for a distance of 500 yards. The total vertical lift of the electrically-driven pumps is 115ft., and the water is forced through pipes 500 yards in length to the bottom of the shaft, whence it is lifted by ordinary steam-pumps.

We have received the Proceedings of the American Society of Microscopists at the fifth annual meeting held at Elmira last August. It contains several interesting and valuable papers, and a biography of the late C. A. Spencer, by Dr. Hamilton Smith.

The annual report of the Department of Mines, New South Wales, shows that there is a promise of a prosperous future for the colony when its mineral wealth comes to be fully utilised. The publications issued by the Government are of great benefit to all interested, especially a thick quarto we have before us containing elaborate reports on the mineralogy and geology of the colony.

No. 23 of the *Mineralogical Magazine* contains a paper on some minerals from the Sodalite-Syenite of South Greenland, and another instalment of Prof. Heddle's "Geognosy and Mineralogy of Scotland."

Mr. W. N. Hill, writing to the *Miller*, suggests that the "badness" of London-made bread is due to the water. He has procured samples of the water supplied in Vienna and Paris, and finds carbonates of magnesia and lime and sulphate of lime much in excess of the quantities found in London water. The principal reason, however, he admits, is the superior quality of the flour.

The Chicago and Grand Trunk Railway have added ten powerful passenger engines to its stock, the chief merit of which, so far as American engines are concerned, is that they do not emit smoke.

According to the *Times*, a "new and valuable use has been found for oyster-shells." It has been "discovered" that the shells make a capital foundation for oyster-beds.

Prof. Verrill, speaking of the position assigned to the Gulf Stream on maps or charts, says that it is placed too far from the shore by 30 or 40 miles. The dredges have never brought up any evidence of the existence of dead vertebrates, and the only evidence of man was an indiarubber doll. The fact is notable, because the dredging was made in the track of vessels, and it has some bearing on the value of negative evidence in geology.

At the last winter conversazione of the Royal Microscopical Society great interest was manifested in an exhibition of the electric light applied to microscopical illumination. The arrangement was the device of Mr. C. H. Stearn (who exhibited it), and consisted of two minute Swan incandescent lamps, one applied beneath the stage and the other above for opaque objects. The lamps were so small that they could be brought quite close to the object, and the illumination they afforded was very brilliant. A small battery was used with the lamp; but we understand that Mr. Stearn is experimenting with the view of using a small dynamo, driven by clockwork, so as to get rid of the inconvenience attendant upon the battery. He proposes to read a paper on the subject at the next meeting of the society.

The determination of vapour densities is discussed by Herr Victor Meyer in a recent paper to the Berlin Chemical Society. He expresses pleasure at finding his air-displacement method largely adopted in laboratories, and states that it was meant only for substances boiling above 440° C., and such as attack mercury and Wood's metal. For lower temperatures, it has not the absolute accuracy of the method of Dumas, Gay-Lussac, and Hofmann, and of the authors' (two) own, depending on displacement of Wood's metal and of mercury. He gives these rules:—(1) For substances which do not boil higher than about 260°, and bear heating to about 30° over their boiling-point, the Meyer mercury-displacement method is applied. Water, xylol, aniline, ethylic and amylic benzoate, and diphenylamine serve as heating agents. (2) Substances, which at atmospheric pressure are not volatile undecomposed, or do not bear heating over the boiling-point, if they do not boil higher than 310°, and do not act on mercury, are examined by Hofmann's method. (3) For substances difficultly volatile, not acting on metals, and boiling between 260° and 420°, the Meyer method, depending on displacement of Wood's alloy, is used. (4) For still higher boiling substances, and all that act on metals, the air-displacement method is employed. (5) In the extremely rare case of a very difficultly volatile substance being vaporised undecomposed only at diminished pressure, Habermann's modification of Dumas' method is applicable.

At Rheims, where 160 adhesions to the telephonic system have been received, a new latitude of action has been allowed by the Minister of Posts and Telegraphs. The subscribers will not only have the right of communicating with each other, but also with the telegraphic system proper. That is, one may, with the telephone, dictate a telegram to a telegraph office, and the reply, having come in the usual printed form, will be at once transmitted telephonically. It is also being considered at present how Rheims may be put in telephonic communication with Paris, Rouen, and other cities.

In response to an application by the English commitee for the erection of a monument to Darwin, a French committee has been recently formed under the presidency of M. Milne-Edwards. Subscriptions will be received at the Secretariat of the Institut.

To test the quality of milk, three operations (according to Herr Chludsinsky) are necessary—viz., (1) Find the specific gravity of the whole; (2) Find the volume percentage of the cream separated in 36 to 48 hours; and (3) Find the specific gravity of the milk-serum under the cream. He operates with a cylindrical glass vessel holding one litre (or 1¾ pint). At the upper part is a 0·1 cub. ctm. scale for reading the volume of cream. Below is a glass stopper. The milk filling the cylinder, and at 18° C., is weighed; if the specific gravity is under 1·028, water has been added; if over 1·031, salt. Normal milk contains 9 to 14 volumes per cent. cream, and the scale will show if the sample is too poor. To test the milk serum, the stopper is removed, 500 cub. ctm. is let flow out, and the vessel weighed again. As the specific gravity of serum is 1·032 to 1·036, the loss of weight in normal milk will be 516 to 518gr. With addition of salt it is higher, with addition of water lower.

A project for diminution of the price of gas in Paris has lately been brought before the municipal council, by the Prefect of the Seine (with consent of the Gas Company). It is proposed that after Jan., 1883, till expiration of the concession (see below), the price of the cubic metre (35½ cub. ft.) of gas for lighting and heating, should be reduced from 0fr. 30c. to 0fr. 25c., and the price for motor force and industrial uses be reduced to 0fr. 20c.; special branch pipes and meters would be required in the latter case. From 1st January, 1886, till the end of the concession, the Company and City of Paris are to apply half the net product of "exploitation" of each year, in excess of that of 1881 (viz. 39,750,000fr.), to fresh diminution of the price of gas. In compensation for the sacrifices consented to by the Company, and to favour future reductions of price, the duration of the concession, which expires on 31st December, 1905, is to be extended 27 years, i.e., to 31st December, 1932.

The canal of the Isthmus of Corinth, which was commenced on 2nd May, 1882, with 800 men, mostly Italians, and which is to be finished in five years, will be, like the Suez Canal, about 73ft. broad and 27ft. deep. For ships from the Adriatic 1fr. per ton will be charged; for ships from the Eastern Mediterranean 50c. per ton; for passengers, 1fr. each.

The projected tunnel under the St. Lawrence, at Montreal, is to be 16,000ft. long, or almost exactly three times the length of the Hudson river tunnel, and thirteen and one-third times that of the Thames tunnel. The greatest depth will be 166ft. below the entrances. The grades are not as steep as those of the Hudson river tunnel. The contract requires completion of the work (by Mr. Romillard) in three years.

An exhibition of electricity is now in progress at Königsberg; its duration is from the beginning of December to the middle of January. Like that at Munich, it is devoted mainly to technical applications of electricity.

A simple galvanometer, free from all magnetic actions, is described by M. Dubois in a letter to *La Lumière Electrique*. It is based on Joule's law, and is merely a Breguet thermometer, the spiral of which is formed of a fine strip of platina and zinc, or of platina and iron, which is traversed by the current to be measured. To compensate variations of exterior temperature, the spiral traversed by the current is suspended by means of a second quite similar spiral turning the opposite way. The first spiral has a pointer near its lower end, which end dips in a mercury cup, while an annular cup of mercury serves for the upper contact (the current passing half up one support then down the slip). The sensibility of the instrument increases with the intensity of the current.

Every one knows the classic experiment in which one terminal ball of a row of suspended ivory balls is separated and let fall against its nearest neighbour, whereupon only the ball at the other end moves, and with a velocity equal to that of the first at the moment of impact. M. Trève improves the experiment by putting metallic dust on the top of each ball. This is projected in the direction of the shock, but not all of it, only (supposing the shock from left to right), that part on the right half of the intermediate balls. In the last ball the dust is projected from the opposite side to that of the shock. M. Trève supposes the ether between the material molecules to be compressed in the direction of the shock, and to carry with it the molecules of each ball. At the moment of decompression the ether and the molecules return together to their original positions.

Some interesting experiments have been recently made at Leipsic with a steel cuirasse, the construction of which is kept secret. The remarkable results obtained prove, it is said, the very great tenacity and ductility of the metal. The steel plate is only 1$\frac{3}{10}$mm. ($\frac{1}{2}$in.) thick, and is padded with wool interiorly. Eleven shots having been fired with a Martini rifle, at about 178 yards, only two balls traversed the metal, and were lodged, completely flattened, in the wool.

It was found by M. Bert that anæsthesia could be produced with a mixture of nitric protoxide (85 vol.) and oxygen (15 vol.), if the application were made in a metallic enclosure with a certain pressure above the atmospheric. M. de St. Martin has obtained the same effect *at ordinary* pressure by adding a small quantity of chloroform to the mixture (6 or 7gr. per hectolitre). The physiological effects seem to be intermediate between those of nitric protoxide and of chloroform. Anæsthesia is very rapidly produced, and the period of excitation (which occurs with chloroform) is avoided The superiority of nitric protoxide is taken advantage of, but without pressure being necessary. (The protoxide alone, it may be mentioned, produces anæsthesia rapidly, but also, gradually, asphyxia.)

A series of finely-illustrated and instructive papers on polar auroras, by M. Angot, is at present appearing in *La Lumière Electrique*.

Herr Fischer, of Erlangen has recently accomplished the synthesis of caffein from theobromine, xanthin, and guanin. A new hydro-carbon called *benzylemesitylene*, has been prepared by M. Louise.

DOMESTIC MEDICAL HINTS.

Alcohol in Burns and Scalds.—Saturate a soft piece of fabric with alcohol, lay it over the burn, then cover it with cotton or finely picked oakum. This is the most cleanly dressing that can be adapted. It may be thought that alcohol applied to a burn will produce more pain; but try it, and you will be agreeably surprised to observe how quickly it will allay the pain. Subsequently disturb the dressing as little as possible; wet the dressing occasionally with alcohol, and the result you will find better than by any other method.

Treatment of Excessive Sweating.—In the Michigan *Medical News*, Dr. Currie says that for over thirty years he has used the following prescription, without a single failure, in sweats, from whatever cause: alcohol I pint, sulphate of quinine 1 drachm. Wet a small sponge with it, and bathe the body and limbs, a small surface at a time, care being taken not to expose the body to a draught of air in doing it. In one case, a neighbouring physician was poisoned while dressing a mortified finger. He suffered untold misery, and was drenched with perspiration for a number of days, and his life despaired of. When he saw him he ordered him to be bathed immediately in the above solution, and that this be repeated once in two hours. The third application stopped all perspiration, and convalescence began at once.

Excessive Sweating of the Feet. — Dr. Meierhof, in the *Maryland Medical Journal*, directs the patient to immerse his feet morning and night, for about ten minutes, in warm water at 115° to 120° F., in which a teaspoonful (1 drachm) of powdered commercial soda (impure carbonate of soda) is dissolved. The feet are then thoroughly dried, after which they are painted all over with a coating of compound tincture of benzoin, which acts as an antiseptic astringent and by its mechanical presence on the skin. This treatment is continued for about ten days, after which it is practised once daily, or every other day, as the necessities of the case may require.

Borax in Erysipelas.—A writer in the *Philadelphia Medical Times* says that he has for eight years made a practice of treating erysipelas by the local application of borax dissolved in glycerine, one drachm to an ounce, which is to be well rubbed in and applied on linen. The result has been to cut the disease short apparently in a few hours. In some cases he used tincture of iron internally, in some not.

Treatment of Styes on the Eye.—As a means of "backing" a stye, Dr. J. P. McGee, of Tennessee, states that the practitioner can use to advantage the following treatment :—

R. Fl.ext. belladonnæ ....gtt. iij
Aquæ pluv........................2oz.
Sig. A teaspoonful every hour. M.

At the same time he may give calcium sulphide, one eighth or one tenth of a grain every hour, for five or six doses, then every three hours, although the belladonna is often sufficient alone. Remember, this is sufficient only in the very early stage of the affection,—within the first six or twelve hours. He will find it "back" at least three of the five.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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PROFESSOR ARCHIBALD, "THE STANDARD," AND SUNSPOTTERY—A SUGGESTION—THE TIDES—DIFFRACTION RINGS—EQUATOREAL—CURVATURE OF THE EARTH—ANGLES OF A PYRAMID—THE BLACK DROP IN THE TRANSIT OF VENUS—A GEOLOGICAL QUERY—GRAVITATION.

[20894.]—I REGRET to find, from Mr. Archibald's letter (20850, p. 357), that my "strong language" appears to have impressed him with the idea that I was, in some sort, making a personal attack upon him. Let me hasten to assure him that I had no such intention. He states that I have previously quoted him in these columns. I had forgotten that I had ever done so, and must further express my regret that my lapse of memory caused me to regard him as a stranger. Imprimis, let me set him right as to a matter, not of opinion, but of fact. He talks about my betraying "an almost *parental* interest" in the article in the *Standard*. This assumes that I was the author of the article in question. He must permit me at once to disabuse his mind of this delusion. I am not in the habit of advertising myself and my productions either surreptitiously or openly, like certain of the nine friends to whom he gives a gratuitous puff; and I should assuredly never have spoken of the article in question in the way I did, had I had anything, proximately or remotely, to do with its production. Nay, more: not only did I not write it myself, but I have not the most distant idea who was the author of it; and I can assure Mr. Archibald that I have made diligent inquiry among all my friends who were likely to know, or ascertain for me, without being able to find out. "The reasons best known to" myself for my "personal animosity to a certain committee" are briefly these—that I regard that committee, like other South Kensington jobs, as a means of putting money into the pockets of particular men. I look upon it as a step in the direction of "The Endowment of Research," and as a method of getting in the thin edge of the wedge for the establishment of that "Solar Physical Observatory" which practically the entire Council of the Royal Astronomical Society refused to recommend when formally brought before it (the said Council, be it particularly noted, including, among Mr. Archibald's "polemical clique," Airy, Adams, Beckett, Cayley, Huggins, Knott, Lassell, Main, Proctor, &c.), and which was denounced by the present Savilian Professor of Astronomy at Oxford, at a meeting of that Society on November 12th, 1875, as "a gigantic job." I look upon it as an outcome of the Royal Commission on the Advancement of Science, which did so much to bring together and organise those hangers-on to the skirts of Science who do not work at it for its own sake, but are always looking to what they can make by it. I should assuredly not think it worth while to waste time upon such men, if they were not organised and working together in a way which has a powerful influence for evil on the scientific world. They affect, more or less, all societies originally founded for scientific work, and endeavour to turn them into engines for obtaining influence with the Government. This necessarily gives rise to wire-pulling and jobbery: flattery of those who will aid them, and prejudiced bias against, and abuse of, those who refuse to do so. This is wholly contrary to the spirit of Science, and can have but one effect—the degradation and demoralisation of scientific men. It is because I earnestly believe that Science must retrograde instead of advance if such influence gains the upper hand, that I have written in the way to which your correspondent takes exception; and these, and these only, are the reasons which have prompted me to denounce the miserable little sham which he takes under his protection. Far be it from me to dispute that many people believe in Sunspot Astrology. Were it not so, does Mr. Archibald seriously believe that I should ever have taken the trouble to expose its pretensions so persistently as I have done? Because scores and hundreds of people believe in quack pills, is that any reason why (say) Sir William Jenner should prescribe them; or Dr. Wilson Fox carefully abstain from deprecating their use? Mr. Archibald appears to imagine that Prof. Fritz's 100 gulden's worth is to settle the whole question straightway; much as if he were quoting a text from the Bible, and expected it at once and for ever to put a stop to all further controversy. As he asks me to translate the conclusion of Prof. Fritz's paper, which he takes the trouble to quote in German for my especial benefit, I will do so. "As the result" (says Prof. F.), "we find that, that an exact connection subsists between the variability of Sunspots, the variation of the magnetic declination and the aurora; the connection between the change in the frequency of Sunspots and the Meteorological phenomena of the Earth is *very probable*" (the italics are mine). Very well; that is the opinion of its writer—quantum valeat. It may be worth 100 gulden or 100 cents; but I venture to submit that it supplies no reason why a genteel form of out-door relief should be administered by the British nation to certain persons who are endeavouring to trade upon this connection, and to deceive the taxpayer by the assertion that the spectroscopic observation of the Sun will ever enable the weather to be foretold. There is, at least, as much literature in existence in favour of what is called "Astro-Meteorology," as there is in defence of the connection between Sunspots and the Weather, and for the same reason—viz., that the extraordinarily-diversified character of Meteorological phenomena simultaneously existing in various parts of the globe will always enable the skilful manipulator of statistics to point to *some* place where atmospheric conditions seem to favour his theory, even if they contradict it in five hundred other localities. Finally, I would assure Mr. Archibald that the opposition to scientific mendicity, if not quite so persistent as the advertisements of the school which it attacks, is deeper, perhaps, than he gives it credit for. I am happy to know that I am very far indeed from standing alone in attacking a system so degrading and demoralising to Science.

Apropos, by the way, of sunspottery, an idea has struck me which I have not yet patented, and am hence in a position to present freely to the "Committee on Solar Physics." It is that of the obvious connection which must exist between sunspots and great fires. The solar disturbance of November will be in the memory of nearly everyone who reads these lines; and I need scarcely remind anybody of the concurrent, or immediately sequent, destruction of Clevedon Court, of Lord Suffield's house, of the Alhambra, of the stack of warehouses in Wood-street, of the *Cotopaxi* in the Docks, of the fire at Hampton Court Palace, of the two successive ones at Whiteley's, of that on board the *Mary Louise* at Millwall, of the destruction of ferry steamer *Julia* at Bristol, of the fire in Jamaica, &c., &c., &c. Now, here is just the kind of "evidence" in which the Solar Physics Committee delights, and my notion is that the Government might be asked to endow a "Physical Observatory," to enable great conflagrations to be foretold from watching sunspots. The directors of the insurance companies might even possibly be cajoled into putting pressure upon the Ministry to this end—unless, of course, they were convinced in their own minds that the whole affair was an impudent piece of pseudo-scientific mendicancy artfully worked for the purpose of permanently quartering some person or persons on the National Exchequer.

"Augulus" (letter 20870, p. 361) is good enough to point out that my extremely rudimentary illustration of the manner in which the tides are formed, by no means explains the phenomena actually exhibited. Why, of course, it does not. No more abstruse question in mixed mathematics can occupy the attention of the investigator than that of the actual tidal phenomena; and in order to render the matter thoroughly intelligible, a number or two of the ENGLISH MECHANIC would have to be devoted to its elucidation; though, by the bye, the symbols and formulæ needful to represent the sum of our present knowledge of the question would be appreciable to a very select circle, indeed, of your readers. In reality, the highest part of the tidal wave is not immediately beneath the Moon, but (for a reason which must be sought in mathematical works) is at a considerable distance from her. Moreover, "Angulus" must understand that it is only the *form of the wave* which is superposed on the various parts of the Earth brought beneath it by her rotation, and not the particles of water which move—as he seems to fancy—bodily. The explanation I gave was in the form in which it was originally given by Newton. For details your correspondent must get up enough mathematics to be able to follow such works as Lubbock's. Pending this, he may consult Beckett's "Astronomy without Mathematics," and any really good work on Physical Geography, with advantage.

In reply to "R. O'H." (query 48948, p. 367), the components of 94 Aquarii are small stars (5·2 and 7·2 mags.) and an almost imperceptible haze might well obliterate the one diffraction ring, which is about all that the larger star would show. The higher magnitudes of telescopic stars emit too little light to exhibit any rings at all. My remarks had reference to the brighter stars. No very minute ones show the "disc" of which I spoke (in any legitimate sense) at all.

"E. R." appeals to me (in query 48991, p. 368) to tell him how to adjust an equatoreal which has no circles attached to it. I can only answer that I don't know.

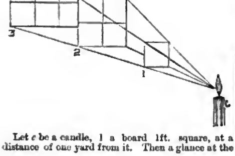
"Glatton" (query 48995, p. 368) probably knows that the mean radius of the earth is 3958·35 miles. Hence a chord two miles long must subtend an angle of 1′ 44·2176″; as the chord of an arc = 2 sin. ½ that arc. Now 3958·35 miles = 250,801,056in., so that the height of his 2-mile arc in the middle must be 8in. or thereabouts. It would pretty evidently be 8in. in 2 miles, 32in. in 4 miles, 72in. in 6 miles, and so on. This means, of course, that the distance of the visible horizon is 3 miles, when the height of the eye is 6ft.

I have not read the correspondence to which reply 48533 refers (p. 390), but the question with which "Scotch Working Mechanic" concludes it seems so simple, as it stands, that it is difficult to conceive how any discussion could have arisen about it. If each side of the pyramid be 12ft. long at its base, then evidently the distance from the centre of either of such sides to the point upon which a perpendicular from the apex of the pyramid would fall (*i.e.*, the middle of its base) must = 6ft. Dividing 6 by 8 then, we get the tangent of the angle formed by this perpendicular with any given side, and this we shall find, on reference to a table of tangents, to be 36° 52′ 12″. Double this, therefore, and 73° 44′ 24″ will quite obviously be the angle at which any two opposite sides of the pyramid will be inclined to each other.

With reference to query 49023 (p. 393), there can be very little doubt that telescopic aperture and magnifying power do exert a certain amount of influence in the production, or absence, of the "black drop" in the observation of the Transit of Venus. The two most potent causes of the appearance of this phenomenon, though, are, unquestionably, in my opinion, indifferent focussing and the use of too light coloured an eye-shade.

In the absence of any indication of the kind of evidence brought forward by the lecturer mentioned by "H. T. W." (query 49026, p. 393), common-sense would seem to indicate that depression must cause silting, and not silting depression. For the latter to take place, it would be necessary, so to speak, for the aqueous deposit to flow up-hill.

Mr. Rd. Wilding (query 49042, p. 393) attacks what he is pleased to term the "orthodox" theory of gravitation, without, obviously, the most rudimentary acquaintance with mathematics; which is somewhat as though a man should carp at the grammatical construction of a passage in Aristophanes before he had himself learned the Greek alphabet. I can, then, only offer a few of the most elementary considerations in reply to his appeal, earnestly urging him (if he be really anxious to understand the matter) to get up sufficient mathematical knowledge to enable him to study the "Principia" of the immortal Newton, where he will find ample proof of the law which he tries to impugn. That gravitation does vary inversely as the square of the distance of the attracting and attracted bodies is a matter of direct observation. Take the Moon for an example. Her path may be regarded as a deflection from a straight lines caused by the gravitating influence of the Earth; and her distance from the Earth's centre varies between 58 and 62 times our terrestrial radius. Now it is found, as a matter of direct observation, that at the former distance she falls $\frac{1}{3364}$th as far as a body does at the Earth's surface in a second, and at the latter only $\frac{1}{3844}$th as far: 3364 and 3844 being the squares of 58 and 62 respectively. Perhaps, though, a diagram may assist my querist in understanding how *all* forces emanating from a centre must vary inversely as the squares of their distances from that point.



Let *c* be a candle, 1 a board 1ft. square, at a distance of one yard from it. Then a glance at the figure will show that its shadow will exactly cover the board 2, 2ft. square, at two yards from it; the one 3, 3ft. square, at three yards from it, and so on. Whence it is abundantly evident that upon one square foot of this last board only one-ninth of the light can fall that illuminates the board 1. The centrifugal tendency (for "force" is really a misnomer in this case) varies as the square of the velocity of the body, and inversely in the simple ratio of its distance from the centre. Should Mr. Wilding care to obtain numerical results from these data, I may tell him that Neptune is 77·5958 times as far from the Sun as Mercury is, and that Mercury travels 8·81 times as fast in his orbit as the more distant planet does.

A Fellow of the Royal Astronomical Society.

SUNSPOTTERY, AND THE SOLAR PHYSICS COMMITTEE.

[20895.]—I SHOULD advise all interested in the "sunspot" theory of rainfall to read a paper by Mr. G. M. Whipple, Superintendent of the Kew Observatory, in the Proc. Roy. Soc. for 1880, entitled "Results of an Inquiry into the Periodicity of Rainfall," in which paper it is most conclusively shown that there is no indication of any period, which, it is needless for me to say, there should be, if there was any connection between sunspots and rainfall, as Prof. Archibald (letter 20850) would have us believe.

Prof. Archibald seems to attach considerable importance to the observations made in India, presumably because it is so much larger than Great Britain; but is not America larger than either? If size has so much to do with it, why did he not select that continent as well? Do not we see the same sun in London as they see in Bombay or New York? If so—and Prof. Archibald cannot say it is not—then a maximum or minimum sunspot period should have the same effect, not only here, but in New York, as well as in India. If, therefore, the rainfall decreased or increased in India at either of those periods, there should obviously be a simultaneous increase or decrease in the rainfall of London and New York.

Perhaps, however, he is partial to India, because a Solar Physical Observatory, established in that portion of the British empire at the national expense, would enable the leaders of the "Brompton clique" to live without work. For, as J. S. Mill has shown in his "Essay on Liberty," "an official body are under the constant temptation" of falling into a state of indolence; and we cannot expect the leaders of that committee to be so actuated by a pure desire to advance science that they would be different to other official bodies.

Again, if there was really a connection between solar cycles and rainfall, we should naturally expect the same effect to be produced at any given maximum as had been observed at some former maximum period. To make this more clear, we will suppose that the maximum rainfall of a particular period was found to coincide with the maximum period of sunspots; then, if the theory was correct, the periods of maximum rainfall should *always* coincide with the periods of sunspot maxima.

But such is not found to be the case, the evidence being of such a contradictory nature, that while some believe in an *increase* of rainfall about periods of sunspot frequency, others are equally confident that there is a *decrease* in the rainfall at those periods. Now, which is right? Prof. Archibald cannot say that both conclusions are correct, for that would be equivalent to saying that similar effects can be produced by dissimilar causes; or, in plain words, would be just as sensible as saying that an unlighted candle would illuminate a room equally as well as a lighted one. And yet, notwithstanding the contradictory nature of the evidence, and the illogical conclusion to which it forces those who believe in it, Prof. Archibald would have us believe that a real connection, and not merely occasional coincidences, existed between the two phenomena, apparently for no other reason than because he believes so.

With regard to Prof. Archibald's remarks respecting the Royal Astronomical Society, of which he speaks in a somewhat scornful tone, it must be evident to your readers who have read the report of the last meeting of the Society, that the Solar Physics Committee are not so indifferent to the opinion of that Society as Prof. Archibald would have us imagine. True, neither the dictum of that society, nor any other body of men, could extinguish the theory, *if* true; for the truth cannot be destroyed, though it may be stifled for a time. But when we consider the unsatisfactory nature of the evidence, and the anxiety—despite whatever may be said to the contrary—with which the endowment party are desirous of getting the management of that body in their own hands, by getting rid of such members of the council who may differ from them on this question, no matter how valuable the services such persons may have rendered to the science, it behoves all those Fellows of the Society who love science for its own sake, to do all they possibly can to prevent the sham from succeeding, and the Society from becoming a mere "machine for the distribution of patronage." Surely such astronomers as Lord Crawford, Sir G. B. Airy, and Mr. Marth, not to mention others, have done more for the true advancement of astronomy than all the members of the "Brompton clique" put together, and are more worthy of a seat on the Council than many the endowment party would bestow that honour upon.

In conclusion, I would call attention to Sir G. B. Airy's opinion on this matter—viz., "a Government (is not) justified in endeavouring to force, at public expense, investigations of undefined character, and, at best, of doubtful utility . . . . such attempts will lead to consequences disreputable to science." Certainly, the only result likely to ensue from such kind of endowment as the "sunspot ring" wish to have it in their power to obtain, would be a proof, if one were needed, of Carlyle's assertion, that "all publics are gulled with the most surprising profit."

London, December 25. **B. J. Hopkins.**

P.S.—While, as Mr. Westwood Oliver contends (letter 20875), "local influences" might account for the supposed influence of sunspots on the weather being more marked in some localities than in others, it would not account for their being of a precisely opposite character in different places. We should naturally expect their influence upon, say, temperature, to be more marked in tropical than in temperate climates; but, for all that, if they caused an increase in the temperature of one part of the world, then the temperature in all other parts of the world should be increased; though "local influences" would, of course, cause the amount of the increase to vary in different places. In support of what I have said, I would point out that, when a magnetic disturbance takes place coincident with any particular solar phenomenon, it is the same in kind, though perhaps not in degree in all places.

December 30, 1882. **B. J. H.**

SOLAR ECLIPSES AND OCCULTATIONS—THE SIMPLEST METHOD OF COMPUTING THE PHENOMENA FOR A PARTICULAR PLACE.

[20896.]—THE method which it is now proposed to submit to your readers, for bringing the calculation of solar eclipses and occultations within the reach of those who have not an extensive knowledge of mathematics must needs supply a desideratum to amateur astronomers. To demonstrate this, it must be compared with three rival methods. The first—that of Woolhouse in the supplement to the *Nautical Almanac* of 1836, (now very scarce) occupies 98 pages, the figures alone including 25 pages. The second—that of Shadwell—fills a volume of 136 pages, and the figures of each eclipse take up 2½ of those pages. The third—that of Penrose—is almost entirely graphic, but drawn on so small a scale that its accuracy can scarcely be relied upon to less than four minutes of time. It is now proposed to introduce a method, which is partly computational, and partly graphic, by means of which correct results can be obtained within half a minute, and which can be worked out in three-quarters of an hour.

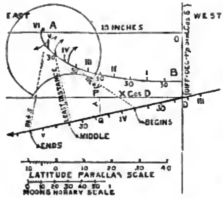
In order to accomplish this, it is necessary that there should be constructed on a detached piece of paper (afterwards to be pasted on glass so as to become transparent) a series of concentric semi-ellipses, having a common semi-axis-major 10in. long, but with semi-axes-minor in the same straight line of various lengths, 10 sin. 5°, 10 sin. 10°, 10 sin. 15°, &c., up to 10 sin. 30° inches. The ordinates to these ellipses have for their abscissæ, 10 sin. 15°, 10 sin. 30°, 10 sin 45°, &c., corresponding to the hours I, II, III, &c. These may be subdivided into intervals of ten minutes each, by drawing ordinates to the abscissæ 10 sin. 2½°, 10 sin. 5°, 10 sin. 7½°, &c. The construction of this system of ellipses is not a matter of much difficulty, and it must be treasured up for subsequent use.

We next proceed to construct a scale of equal parts, the length of *ten* divisions of which is represented by $\frac{10{,}000}{P\ \rho\ \cos.\ l}$, where P is the moon's reduced relative horizontal parallax, ρ the log. of earth's radius at the place, and l the *geocentric* latitude. Since the base of this scale involves both the latitude and the parallax, it is called the *latitude-parallax scale*, and the base itself is to be taken from an inch diagonal scale.

This done, the moon's reduced relative horary motion in right-ascension, and relative horary motion in declination (as taken from the *Nautical Almanac*), will enable us to plot by the scale the moon's relative orbit, which orbit must be subdivided by the compasses into hours and minutes, as shown in the lower scale at the foot of the accompanying diagram.

A reference to the accompanying specimen will help us to complete the calculation.

Having computed the sun's hour-angle at the instant of Greenwich time of true conjunction, let the lines O A, O D be drawn at right angles to each other; and so placed that when the ellipse A B is drawn *corresponding to the sun's declination*, δ, the place of the sun, as shown by the hour-angle, on the ellipse, may be found in the centre of the *paper*,



so as to give room for the whole drawing, and the ellipse must be *above* or *below* O A, according as the sun's declination is *south* or *north*.

The length of O D = $\left\{ \text{difference of moon's and sun's decn.}, - P\,\rho \sin. l \cos. \delta \right\}$ and D lies *above* or *below* O, according as this quantity is + or −. Through D draw D P parallel to O A, and = X cos. D the moon's reduced relative horary motion in right ascension; also draw P Q perpendicular to D P = Y, the relative horary motion in declination, and *above* or *below* D P, according as the motion in declination is *ascending* or *descending*. Then draw the line D Q, the moon's relative orbit. Let the point where this orbit cuts O D lie at that division of D Q which indicates the sun's hour-angle at the instant of conjunction before referred to, and make the hours, &c., to range each way from that point.

Lastly, from the latitude-parallax scale let there be taken an extent $(m + s)$ equal to the sum of the semi diameters reduced of the moon and sun, and then one foot of the compasses being set on the moon's path, and the other on the elliptic path of the observer, let the points be so arranged as to indicate the same hour and minute in both paths—viz., as shown in the diagram, 3h. 50m. at beginning and 5h. 10m. at ending. This will give the *local apparent* times of these phenomena, from which the mean times may be found at once.

The magnitude may be found by subtracting the least distance of the centres from the sum of the semi diameters and dividing by the diameter of the sun. In the case of an occultation, for "sun" substitute "star," and proceed as before, attaching the intervals to the time of true conjunction.

James Pearson M.A., F.R.A.S.

Fleetwood Vicarage.

TELESCOPES—CASSEGRAIN—GREGORIAN—NEWTONIAN.

[20897.]—REFERRING to my letters on this subject I wish to add a postscript and also to make a correction.

On reading over what I have said on page 317, I fear I have not clearly explained that the diameter of small mirror is considered to be that theoretically required, as shown by the diagrams on page 205, and *not* the diameter *practically* employed, which is always somewhat larger.

The formula No. 4, I find, is only true in particular cases, and should take this form:—

$$N = \frac{F}{f}\,(F - f + \Delta) \quad \ldots\ldots\ldots\ldots\ldots\ldots 4$$

which, indeed, is merely No. 3 modified to suit the Cassegrain.

A. S. L.

[20898.]—I, FOR one, must thank "Orderic Vital" for having given us his last letter, which is in fact, the first time that I have seen the matter thus dealt with, and *ably* dealt with too. Having broken through his original resolution, I trust he may now continue the discussion to which he has so usefully contributed.

The limiting ratio of the foci, when spherical curves are employed, is a very curious point, and I hope those who have the means of doing so ("A. N. H." for instance) will practically test the method of intercorrection of such curves in the manner indicated, and give us the results of their experiments. There is another point to which I should like to call "O. V.'s" attention, and that is, as to the best proportion of foci when the theoretically required curves are employed. The difficulty with these direct-vision reflectors is to *keep down* the magnifying power, because, with low powers the small mirror's diameter becomes disproportionately large, when the foci of the two mirrors are increased. There is, doubtless, *some* proportion in which there is the best balance of power with least loss of light from the obstruction of the small mirror, and this is just a point which "O. V." could, I am sure, elucidate if he would kindly do so.

L. L. L.

REFLECTING TELESCOPES.

[20899.]—MR. WESTLAKE (20861) draws attention to the importance of using as much as possible of the central portion of a mirror by making the flat as small as possible, or, better still, doing without one.

This latter plan, however, has, as he says, many drawbacks; but it occurs to me that the Newtonian and Herschelian forms might be combined by so tilting a N. mirror as to enable the plane to be fixed close to the inside, or, possibly, even on the outside of the tube.

Even if this plan were no great improvement optically, it would, I think, offer mechanical advantages in the firmer and more accessible fixing of the plane. The idea is an obvious one, and has doubtless been already suggested; if so, I should be glad to know with what results.

As to the fixing of eyepieces, I think a hint might be taken from the double nosepiece of a microscope. Would it not be a convenience if there were a rotating ring round the tube of a reflector provided with sockets into which the eyepieces could be screwed like the spokes of a ship's steering-wheel. The whole battery would then be mounted before commencing observations, and any eyepiece could be brought to bear rapidly and accurately, a suitable centralising click being, of course, provided.

Thus all danger of crossing fine screws by fumbling at them in the dark, or of losing time at perhaps a critical moment, would be avoided. The ring also might be divided, and joinable by a hinge and thumbscrew, so that it could be taken off the telescope and stowed away with the eyepieces *in situ*.

Dec. 23. **Faber.**

SIZE OF FLATS IN REFLECTING TELESCOPES.

[20900.]—SEEING the letter of Mr. Westlake, 20861, and agreeing with him as to the needlessly large flat he has been using, and wondering so large a one should have been supplied with the telescope, I will ask him why he still keeps his flat 12in. within the focus of his mirror? As supposing his tube to be no larger than necessary for his mirror, say, 13in., he might place it 5in. farther away, and by bringing his eyepiece nearer the side of his tube, still more improve its performance by reducing very much the size of his flat. On a mirror of 15in. and 8ft. 4in. focus I have for many years used a flat of 1¼in., and I know it is sufficiently large by stopping out 14in. of its centre, and yet getting the image of moon or stars to which the telescope may be directed. I am now mounting a 17¼ mirror of Mr. Calver's, 9ft. 3in. focus, and shall use in it a 2in. flat, and am satisfied that I shall get the extreme marginal rays in the eyepiece with it. The flat is carried by an arm in a sliding-plate, which carries also the eyepiece, which, being close to the side of the tube, allows the flat to be so far from the mirror as to cause so small a flat to be effective; and this old-fashioned method of carrying the flat I think far better than the modern one of a fixed plate and sliding tube for focussing. Nor have I ever experienced the asserted detrimental effect of the arm in causing rays from a star. To try this, I have placed a stout stick across the mouth of the telescope without producing any ray, and I should be dissatisfied with any mirror showing rays from a star without attributing them to the affect of the arm.

I have a 12in. mirror mounted with a flat and springs and sliding tube, &c., by Browning, and I have placed the same mirror in the tube of the 15in. and in its own tube alternately, without perceiving any difference in its performance in one or the other. I have seen it stated that the flat should be large enough to reflect the image of the sun or moon as seen in the focus of the mirror, and, consequently, much larger than is necessary to reflect only the cone of rays converging to a point in the focus; but this has always appeared to me an erroneous view of the case, as why not use a much larger object of which to form the image, and necessitate a still larger flat?

Again, if this were correct, the longer the focus of the mirror, the larger the flat that would be necessary; because the longer focus makes the larger image, so that, with a very small mirror, and a very long focus, the flat would require to be as large as the mirror.

I believe if the flat were entirely covered, excepting a hole in the centre no larger than a pea, the image of sun or moon would be found of the same size in the focus as if the whole flat were exposed. I believe we shall see this new method of mounting will be abandoned, and the old one of arm and sliding-plate be resumed, as by it a smaller and less expensive flat may be used.

In the abundant light of the large mirrors of the present day, I think the using of both eyes, as in the binocular microscope, would be an advantage when viewing moon or planets, and I tried the tubes of my microscope in the telescope; but I found the prisms required altering, to bring the two images together, as in the microscope—I suppose, owing to the longer focus; but I confess I do not see why the image in one instrument should not be affected in the same way as in the other. As the body of the microscope may be made to turn in the sliding-tube of the telescope, the position of the two eyepieces may be always adapted to that of the eyes in any position of the telescope. Has anyone ever tried this?

Philip Vallance.

REFLECTORS VERSUS REFRACTORS.

[20901.]—IT must not be supposed that I utterly condemn the reflector. In large observatories, where assistants are always in readiness to resilver and adjust, the reflector has done good work, and for those who have plenty of time to spare, is a very useful instrument.

When I penned my letter to Mr. Holmes, I had in my mind's eye the whole of the forms I have seen, Gregorian, Cassegrainian, and Newtonian. In my 'prentice days I have witnessed and helped to manipulate the first named, hundreds of times, and know the trouble there is in refiguring the large specula, adjusting the smaller ones, and the infinite bother attached to "setting" the extremely minute pinholes, necessary for the eyepieces of telescopes of that construction. Contrast this with the permanence of a refractor. I had one in use a short time ago, that has been used for nearly half a century, the optical parts as good as ever, while many of the reflectors I speak of, had not reached a decade of existence. The Cassegrain reflector I think has never been so commonly made, for I do not remember more than a dozen of that form, and my memory tells me that they too had not been made long before they required readjustment and repolishing; of course these were metallic specula. Although the silver-on-glass form now in vogue has advantages over the above, yet deterioration is continually going on in the silver, and our painstaking investigator Mr. Wassell, has proved that the glass surface too deteriorates by the continual cleaning of the speculum for resilvering I admit the comfortable position of the Newtonian, but as a very near approach can be obtained by using a zenith diagonal with a refractor, that does not outweigh its advantages of stability of performance and permanence of adjustment. One of "ours" has, I see, compared 2in. of a speculum, against 2¼in. o.g. with the advantage on the side of the speculum.

I should expect this, although theory says not. 2in. out of the middle of an o.g. 60in. focus, will show detail that a 2in. o.g of 25in. or 30in., will not —simply because no glasses of the smaller diameter are made of such great length, and produce a smaller image for magnification, and are rarely figured for astronomical work. To fairly judge, all conditions should be alike.

Prismatique.

THE DARK MORNINGS.

[20902.]—IT is a matter of common observation at this season to all who live in the northerly portion of Great Britain, that the mornings seem unusually dark, more so, in fact, than they ought to be, judging from the time of sunrise advertised in the almanacs. In other words, the afternoons seem longer than the mornings. A few words in explanation of this circumstance may not be unacceptable. Three causes contribute to this result. In the first place, the interval from sunrise to midday in the morning is less than the interval from mid-day to sunset in the afternoon, because the sun is now continually getting nearer to the equator. Consequently if the sun is 3h. 35m. above the horizon before coming to the meridian, it will be (say) 3h. 36m. after leaving the meridian before it sets. In other words, if the sun rises in the morning at 8h. 25m., it will set at 3h. 36m., *local apparent* time. But in the second place, to this must be applied the equation of time, as it is called, which at this season is additive, and amounts to 5m. This addition makes the sun to rise at 8h. 30m., and set at 3h. 41m., local *mean* time. To this must be added, in the third place, the difference of time due to longitude, say, 12m., so that finally the sun rises at 8h. 42m., and sets at 3h. 53m., thus causing the mornings to be 35m. shorter than the afternoons, according to *Greenwich mean time*.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Dec. 27.

THE USE OF CHRONOMETERS IN NAVIGATION.

[20903.]—IN the practical use of chronometers by masters of vessels at sea there are certain rules which are known to many of them by experience, but which are not found in any of the works on navigation, that I am aware of. I believe, therefore, I am the first to propound them in a definite intelligible shape.

1. If, to the time shown at any instant by a chronometer, the addition or subtraction of the error of the instrument gives a time which is in *advance* of the true Greenwich time, the ship is thereby placed *west* of its true position. If it gives a time which is *behind* the true Greenwich time, the ship is thereby placed *east* of its true position. 2. Now, if the chronometer be *slow* of true Greenwich time, its error must of course be *added*; and, therefore, if its *assumed rate* is too *large*, the ship is placed *west* of its true position; if too *small*, it is placed *east*. 3. But, if the chronometer be *fast* of true Greenwich time, its error must be *subtracted*; and therefore, in this case, if its *assumed rate* is too *large*, the ship is placed *east* of its true position; if too *small*, it is placed *west*.

James Pearson, M.A, F.R.A.S.

Fleetwood Vicarage, Dec. 27.

TRANSITS AND ECLIPSES — A CORRECTION.

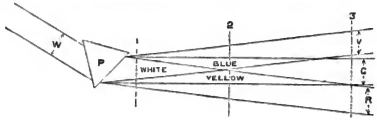
[20904.]—IN answer to "Young Astronomer," the number should be 3·6, the decimal point being omitted. I lecture extempore, and sent shorthand writer's report.

I often say that the light from some of the fixed stars that we now observe started from that star before many of us were born. These facts give an audience some slight idea of the immensity of space.

Philip Braham.

COLOUR.

[20905.]—IN letter 20792 your correspondent, Mr. S. Calton, appeals to me to make an experiment for him in combining coloured lights. I have had much pleasure in complying with his request, and I now send you the result. At the same time I have taken the opportunity of attempting to correct some misconceptions of his as to the formation and structure of the prismatic spectrum. I am sorry to see that he has again fallen foul of the "scientists" in defence of his pet theory about the primary colours. It is a pity he does not show some degree of a scientist's accuracy in his experiments and deductions from them—those with the prism, for instance, mentioned in the above letter. Having observed that the spectrum colours are gradually developed as the screen upon which they are received becomes removed from the prism, and the spectrum lengthened out, it is amazing that Mr. Calton fails to perceive that the colours chiefly shown at the farthest distance must be produced by rays which are *less* overlapped and mixed than they are when nearer the prism. He seems to imagine that the spreading or divergence of the rays leads to their overlapping and mixture instead of their separation. The accompanying diagram illustrates the course of the spectrum rays, showing where they are overlapped and where separate, and consequently which colours are compound and which simple. In this diagram let W represent a beam of parallel rays of white light entering a prism P. When refraction takes place, there emerge from the prism an infinite number of beams of coloured light, each having the same breadth as the original white beam, and inclined to each other at every possible angle within the limits of the spectrum. The most effective of these beams, however (as shown where their separation is greatest, at a long distance from the prism) are the violet, the green, and the red ones—marked V, G, and R in the diagram. Now, if the spectrum is received upon a white screen placed closed to the prism, as at position 1, it will be seen to consist (as described by Mr. Calton) of a white centre, bordered above by a narrow space of pale blue, shading off into deep blue or violet on its upper edge; and below by a narrow strip of light yellow, shaded downwards into deep red. Referring to the diagram, it will be seen that the white centre is due to the overlapping (or non-separation) of all the three beams; the blue to the overlapping of the violet beam by the upper edge of the green; and the yellow to the overlapping of the red beam by the lower edge of the green. The exterior red and violet colours are of course those of the red and violet beams where they have diverged and become separated from the green. On gradually removing the screen farther from the prism, the two outer coloured spaces are seen to become broader and to encroach upon the white, which shrinks in width, until the position 2 is reached. Here the white vanishes, and a little further movement of the screen causes the green to begin to occupy its place. Here also the blue and yellow are at their broadest, each containing one-half of the green beam. The gradual closing in of the blue and yellow spaces, and the appearance of the green immediately after they have met and seemingly overlapped one another, has very naturally led to the idea that this green must be a compound of the two. A glance at the diagram, however, shows that the green is really the colour of the green beam made visible by its being freed from the violet and red beams which, nearer the prism, entirely overlapped it. When the screen is shifted to position 3, the blue and yellow (so far as they are due to the overlapping of the green by the violet and red beams) disappear, and the spectrum beyond this position shows little else, as Mr. Calton says, than "varieties of orange, purple" (violet) "and green," the beams of these colours being entirely separated. Of course, in no position of the screen are the limits of the different colours sharply defined, as seems implied in the foregoing description. On the contrary, by means of the infinite number of variously refracted beams already alluded to, the tints are shaded very gradually into one another. I think I have now shown that the gradual development of the spectrum as the receiving screen is moved away from the prism is the effect, not, as Mr. Calton imagines, of the overlapping of three beams of light (red, blue, and yellow), originally separate, but of the gradual separation by divergence of three beams (red, green, and violet), which were overlapped and commingled at their source in the original white beam. It is difficult to conceive how Mr. Calton, after using his prism as he describes, can conclude that the green of the spectrum is produced by the spreading of the yellow and blue rays until they overlap, unless he supposes that the coloured rays travel in curved paths, or else issue, each colour, from a different part of the original beam. Only under one or other of these conditions could diverging rays possibly come to overlap after being separated.



The experiment Mr. Calton describes, in which green is produced by the (apparent) coalescence of the yellow and blue fringes of a white field of view seen on looking through a prism, is just a repetition of that wherein the spectrum is received upon a white screen. In this case, the retina of the eye is the screen, and the narrowing of the beam (by turning the prism, or otherwise) is equivalent to shifting the screen away from the prism; for it is not the mere length of path of the refracted rays which develops the spectrum colours, but the length of path as compared with the width of the original beam—a fully developed spectrum being obtainable at a comparatively short distance from the prism if we operate upon a correspondingly narrow beam of light. (In a proper spectroscope the light is admitted through the narrowest possible slit.) The green, which appears where the yellow and blue *spaces* are made to coincide, is really the colour which remains after, by narrowing the beam, the yellow has been deprived of its constituent red light, and the blue of its constituent violet. That the narrowing of the beam must have this effect will be evident on again referring to our diagram; for it is plain that if the beam were diminished to (say) half the breadth there represented, while the green would still occupy the centre, the red and violet beams would uncover it at a point just half the distance of the line 2 from the prism; and if, while the narrowing was in progress, the screen rested in the position 2, the green would be seen to grow, *apparently*, at the expense of the blue and yellow.

The same conversion of the spectrum yellow and blue into green by the abstraction of their other constituents occurs in Mr. Calton's other experiments, in which he receives the yellow and blue upon blue and yellow screens respectively. The blue screen reflects the green light out of the yellow space and very little of the red. The yellow screen also reflects green, but absorbs the violet in the blue space. If Mr. Calton will note how little of the *unmixed* violet is reflected by the yellow surface, and of the orange and red by the blue surface, and also how well the unmixed green is reflected by both, he will understand how these surfaces exert their selective action on the mixed colours.

This selective absorption and reflection by coloured surfaces explains how a mixture of yellow and blue pigments is green. The yellow pigment intercepts and absorbs most of the violet, and the blue pigment most of the red and orange, and as both pigments are equally capable of reflecting green light, that, of course, becomes the colour of the mixture.

I am not one of those who contend that it is impossible to produce a green by mixing blue and yellow lights, but I believe that no ordinary blue and yellow will do it, or make anything else than white. The coloured lights yielded by all our yellow and blue pigments, whether transparent or opaque, are shown by the prism to be composite, the yellow containing red and green, and the blue consisting of green and violet; and apparently they *are* yellow and blue simply because they contain these pairs of spectrum colours. There is no doubt a yellow light undecomposable by the prism (that of incandescent sodium vapour), and a similar blue light obtainable from the vapour of indium. What might be the result of combining these I cannot say. I have not the means of making the experiment, and I fear it must be left to one of those "scientists" with whom Mr. Calton finds it so difficult to agree.

Mr. Calton's theory that colours "exist in shadow," and are "part of darkness" is curious. But very curious indeed is his claim that it is supported by my experiments in overlapping (I suppose I must not say *mixing*) different coloured lights. If colours exist in shadow and darkness, will Mr. Calton be good enough to suggest some means of showing them *therein*? Until he does I shall continue to believe that colour exists only in *light*. Even white light is fully charged with colour, and indeed owes its apparent colourlessness to that very fact, and to the further circumstance that while every colour present in the light contributes to its brightness, the distinctive colour-effect of each is neutralised by that of some other. Mr. Calton says he "agrees with my diagram" (descriptive of the experiments mentioned above, see p. 93, No. 914 of "E.M.") "but differs with my explanation, or, rather, deduction from it." I am not aware that I gave any explanation or deduction whatever. I simply *described what I saw* in looking through the apparatus, as thus—in the space whence I *knew* that both *violet* and *green* lights were shining into my eye, I *saw* neither violet nor green colours, but instead of these a *pale blue*. And, similarly, violet and red lights gave me a pink colour, and red and green lights a yellow tint. I do not think that the expressions subsequently used, such as "green + violet = blue can be called either explanation or deduction:" it is simply a condensed statement of the fact which I observed.

Mr. Calton suggests to me another experiment with the same apparatus, using what he calls the three primary colours, red, yellow, and blue, instead of the compound ones (I admit they were compound) which I employed. Of course, he means that the red, yellow, and blue, are *not* to be compound colours, and he says that if they are *sufficiently* pure (?) they will, when overlapped in my apparatus give the result he shows in a diagram constructed like mine, in which apparently red + blue = purple; blue + yellow = green; yellow + red = orange; and red + blue + yellow = white more or less. Now, I cannot be sure whether Mr. Calton means these three colours in his diagram, purple, orange, and green, to be called "binary compounds," because he has "strongly objected to pink, blue, and yellow" (which occupied the same places in my diagram, and were produced in the way he expects his colours to be produced), being so named. If he does, it ought greatly to reduce the strength of his objection above quoted. Might I ask if he means the "white more or less" where the red, blue, and yellow overlap in the centre of his diagram, to be regarded as compounded of these three colours? for he says of the corresponding white in my experiment and diagram, "This white is not any more a combination of *colour* than the blue is a combination of purple and green." Now, regarding the experiment suggested by Mr. Calton, of course I have been unable to make it under the conditions he prescribes; for where can be got a gelatine or glass of an uncompounded pure blue or yellow? If Mr. Calton can supply it I should be much obliged to him. However, with such gelatine films as I could procure—yellow, blue, and red—colours quite satisfactory to the eye, but far from being what Mr. Calton means, I made the experiment years ago, and have now repeated it carefully. The results were very different from Mr. Calton's diagram, being shortly as follows:—Blue + red = lavender colour; red + yellow = pale orange; yellow + blue = pure white. This last being, no doubt, the result of the blue and yellow containing between them all the spectrum colours;—(analysed by the prism, the blue was chiefly green + violet, and the yellow green + red). The centre, or red + yellow + blue appeared a very pale reddish or pinkish white. Contrasted with this reddish centre the white (yellow + blue) certainly showed a faint suggestion of green. But that this was merely the effect of contrast was proved by the fact that it gradually disappeared as the attempt was made to remove the red tint from the centre by progressively diminishing the brightness of the red circle. The red tint in the centre, however, could not be abolished except by completely stopping out the red light. When that was done, the greenish hue also vanished from yellow + blue, and this space, together with the centre, shone a uniform pure white. **Walter Hardie.**

Joppa, near Edinburgh, Dec. 11.

JERKS IN RAILWAY TRAINS.

[20906.]—MR. MOLISON gives as a reason for not accepting my diagram that the angle A O A' was too large. This is no reason whatever. I made the angle—as I stated at the time—larger than it should have been, in order to make the diagram clearer. The use of the diagram is to show the motion of the carriage-frame, which produces the jerk. This motion *does* occur, whatever Mr. Molison may say to the contrary. I have several times noticed the front end of a railway carriage, fitted with the vacuum brake, "tilt up" and not "tilt down" again just when stopping. If it had tilted down again, it would have been due to the action of an unevenness of the rails upon the carriage springs.

I did not press my head against the back of the carriage to prove that Mr. Molison was wrong in saying that a passenger ought to keep his seat until the train stops. If Mr. Molison had said that, and that alone, there would have been nothing to say against it. But Mr. Molison went a step too far. He says "because in a sitting position (especially with your back against the rail) the body more readily accepts the varying movements of the carriage." It was this statement that I objected to. If Mr. Molison's theory be correct, this statement is all very well. But Mr. Molison will find, if he tries the experiment, that he *cannot* make his body accept the "varying movements of the carriage" (in the way he means) whatever position he may take up. I may say that I have given the statement a fair trial, and I think if those readers interested will do the same, they will come to the same conclusion that I have done. On one occasion, when lying upon the seat, I was thrown off it by the jerk in question. The difference in the opinions expressed by Mr. Stretton and Mr. Molison is, that Mr. Stretton says the jerk is due to a movement of the carriage, and Mr. Molison, that the jerk is due to a movement of the passenger. If the jerk is due to a movement of the passenger, the passenger *can* prevent that movement, either by lying down or by propping himself hard and fast up against the partition. I have found that *whatever* position the passenger may take up, the jerk is just as violent as ever.

When I stated that "it is not the 'inertia' of the passenger that causes the jerk," I meant that —according to Mr. Molison—it caused it *indirectly*, because if there were no inertia, by Mr. Molison's theory, there could be no opposite force or "tendency" called into play, and there would be no jerk.

Mr. Molison wishes to know to what my experiments tend. I do not set much value upon (1)—(3), I simply put them down just as I tried them. I may say I repeated each four times, to insure correctness. It is, however, to No. 4 that I would call attention. The carriage in question (*not* fitted with a continuous brake) was in the same train as the others (in experiments 1, 2, and 3) which were fitted with the brake, and consequently, it made just as quick a stop as the others. How is it less water was spilt? A passenger in such a carriage is *not* jerked as a general thing. I say "as a general thing," because, in the case of an *exceptionally* quick stop, the last carriage not being braked, runs into the others, and compresses the buffer-springs, so that a slight jerk is caused by the reaction of the buffer-springs. If Mr. Molison's theory be true, the passenger would be jerked in this carriage just as much as in one of the other carriages, because quite as much "Inertia, &c.," is called into play. The *fact can* be explained by Mr. Stretton's explanation.

It is because the carriage is *not* braked, and, consequently, no excessive weight is thrown on the leading-wheels, and no tilting-up occurs. If Mr. Molison is correct, his theory will also explain it.

"Nun. Dor." is wrong in saying that tramcars are out of the question. If Mr. Molison thinks be can prove anything by means of tramcars, he is at liberty to do so; I am open to conviction. But let him also remember that tramcars are fitted with brakes. Mr. Molison will find that, if he wedges-up the axle-boxes so as to render the springs useless, there will be no jerk, because the car cannot assume any but a level position.

It is well known that engineers object to brakes upon the leading-wheels of locomotives, because, when the brakes are applied, an excess of weight is thrown on these wheels.

Before Mr. Molison tries to deny the above *facts*, let him answer the following questions by means of his own theory:—

(1) Why is a passenger jerked in a carriage fitted with a brake, and *not* jerked in one in the same train which is *not* braked?

(2) Why cannot a passenger prevent the jerk, if it be caused by a movement on his own part?

(3) Why do not engineers put brakes on the *leading*-wheels of engines, and so afford additional retarding power, if not for the reason given by me?

Meteor.

[20907.]—I AM sorry that "H. B. T. S." (p. 384) has had a painful personal experience of jerks in railway trains; but I am afraid no very definite explanation of the cause of his special accident can be given unless he supplies the following data: the kind of brake, the method of its application at the moment, and the position of the passenger at time of jerk. Possibly, however, the following considerations will enable "H. B. T. S." to determine for himself the actual cause of the jerk from which he suffered. I believe on the South-Western the chain-brake and the vacuum-brake are used, as well as the common hand-brakes. An account of the method in which these work may be useful. From the fact that a powerful engine was on, the train may be assumed to have been a long one; and, if so—say, of 10 coaches—the chain-brake would have been divided into two sections of five coaches each, under the charge respectively of the front and rear guard. The brake is put on by bringing the drum on which the chain is wound into frictional contact with a drum on one of the axles, and when taken off, weighted levers beneath the carriages help to run the chain off the drum (I describe the main features merely, not details). It will be understood that the brake-blocks even in one section do not go on simultaneously, and it is obvious that the rear-guard may brake his section and release it without any sort of concurrence with similar operations on the part of the front guard. Suppose the rear-guard to put his brake on first, the coaches forming his section will have their buffer-springs compressed, while the drawbar-springs between the two sections will be put into a state of tension, and also throughout the whole of the front section if the front-guard has delayed the application of his brake. When the brake is released it will be seen that the action of the buffer-springs will cause the rear section to recoil from the centre towards each end, because the buffers between the two sections not only do not touch, but are actually separated by the drag of the hind section of the train, so that the effect of the buffer recoil does not always jerk a given passenger towards the engine. As soon as the brakes are released the buffers recover their positions, the coaches right themselves, and such drawbar-springs as are under tension exert their power. Or, to quote from p. 272, "the jerk referred to is that which takes place when the brake is released, or when, the train having come to a position of rest, the buffer-springs exert their power." (The position of a comma has been altered.) It will be seen that until the buffer springs have exerted their power, and left the faces of the buffers free to slip over one another, the coaches cannot entirely right themselves and obtain their normal level. Suppose the direct opposite to be the course of events. If the front-guard puts his brake on first, his section is, so to speak, over-run by the rear-section, and the coaches are pressed very closely together. The action of the vacuum brake was clearly explained by Mr. Stretton on p. 185, and "H. B. T. S." will readily understand the different effects produced when in the case of the ordinary brakes the front or rear-van is first braked. I suspect that the special case referred to was caused by buffer-recoil, but it is difficult to guess, for besides the effects produced by the different kinds of brakes and their application, other things have to be considered. For instance, in the older style, the buffers bore on the ends of a plate spring (the ordinary kind of cart-spring) arranged across the carriage frame, while the draw-bar was attached to the centre of the spring. In modern practice the buffers are connected each with a separate spring made up of rubber discs, and the drawbar also has a similar spring. The action of these springs, it will be seen, will vary with different conditions as they vary between themselves; but I think I have said sufficient to show that there is more in the action of brake gear than some imagine. The only correct principle in continuous brakes is automatic action—i.e., a brake that goes on when out of order and compels attention; a brake that may be found out of order just when most wanted is a snare and a delusion, and its use should be prohibited. As to getting out of trains, there are two methods: get out the moment the train stops (not before); if you can't, then wait until you are quite sure all the jerks are over; but, if possible, always keep a handhold of something.

Nun. Dor.

BRAKE FAILURES—TO G. J. CALVERT.

[20908.]—THE "failure" which occurred at Market Harborough, and referred to by your correspondent, is now receiving very great attention.

The Midland Company's express due to leave Liverpool at 4.5 p.m. for St. Pancras, is booked to "stop at Market Harborough when required to take up passengers for London," and upon the evening in question (Nov. 24th), this special stop was made.

The express was drawn by two engines, Nos. 822 and 1478, both fitted with steam-brakes upon the coupled and tender-wheels; the vehicles composing the train were fitted with the Clayton modification of the Sanders and Bolitho vacuum-brake; it was not, however, under the control of the driver of the leading engine. The brakes were applied to stop at Harborough in the usual way, and when the station duties were completed, the train started without anything unusual being observed (it was, of course, dark at the time).

The driver of the train-engine, as Mr. Calvert mentions, thought that the brake was out of order, as the vacuum could not be maintained; he very wisely stopped at Desborough to ascertain the cause. It was then found that the screw-coupling between two vehicles was broken, the hose-pipes of the *so-called automatic* vacuum-brake were pulled apart, and that the rear part of the train was simply hanging by the side chains extended to their full length. There is no doubt that the coupling was broken when the train was stopping at Harborough, and much alarm was naturally expressed by the passengers in the rear carriages when they found that they had ascended the well-known Desborough Bank, which is a gradient of 1 in 132, with *side chains* only; very fortunately the side chains performed their duty well; but it will be seen that if they had broken upon the incline a serious accident might have followed.

We will now consider the question of brake-power.

An efficient continuous-brake must be automatic in action; it has the power ready accumulated and stored in an auxiliary reservoir upon the engine, tender, and every vehicle ready for instant use. It can be applied by the driver or guards, and will at once apply itself in case of accident or separation of the train.

The fact that a driver can take off the brake and start from a station is clear proof that it is in working order; it is, therefore, a tell-tale upon itself. The Clayton modification of the Sanders-Bolitho Brake is supposed to be *automatic*; but the fact that a train left a station and ran for miles, with the hose-pipes pulled apart, and yet that the brake did not stop the train, proves at once that it does not fulfil the Board of Trade conditions.

When it is remembered that the failures of this class of brake caused trains to run into the buffer-stops at Portskewet Pier, Bradford, and Liverpool, that cases are occurring daily of trains being broken loose, running past stations and danger signals, and delays in consequence of its not releasing quickly when required by the drivers, your readers will see that this brake is a source of danger, not of safety. The Sanders Vacuum Brake, as first fitted to the experimental trains upon the Midland and Great Western Railways, was a fairly good brake: it would apply itself in case of a break-loose, and remain "on" until taken off, either from the engine or by means of the release valves upon each carriage. But these two companies have now rendered the brakes inefficient by drilling a leak-hole in the piston or piston-rod, by which all the brake-power leaks away in less than two minutes even under the most favourable circumstances. This *leaking-off system* is the cause of the trains running into buffer-stops and past stations and signals. Sooner or later, a serious disaster is certain to occur, especially if this brake continues to fail at Kentish-town and other crowded junctions.

Major Mariudin, in his recent report upon the Liverpool accident, remarks:—"That the unsatisfactory manner in which the train-brake behaved upon this occasion strongly supports the conclusion which was arrived at by Colonel Rich, when reporting upon the somewhat similar accident which occurred on the 25th April, 1882, at Portskewet, on the Great Western Railway—viz., *that the efficiency of this class of brake is materially interfered with by the leakage-hole in the piston-head*."

We can only ask how long will the directors of the Midland and Great Western Companies allow the safety of their passengers and trains to be risked by the use of the dangerous "two-minute" brake?

Clement E. Stretton.

Saxe Coburg-street, Leicester, Dec. 23.

ELECTRO-MOTOR.

[20909.]—THE cause of failure (20865, see letter) evidently is that the two halves of the ring have not been properly wound, or not properly connected up, the result of which has been to produce one continuous ring magnet, whilst each half of the ring should be wound in the same direction and the current sent through each helix in the same direction, so that there will be two north poles at the top and two south poles at the bottom, or *vice versâ*; the two identical poles forming together what is called a consequent pole. No. 22 wire is too small, and the resistance of the whole is much too high; but this resistance may be reduced by dividing the current between the two halves of the ring. Siemens' H armature is not a good one for a motor, either from an electrical or a mechanical point of view, and it has gone out of use except for small models. I have just completed a small motor, with an outer ring like that of "D'Elgo," and instead of a Siemens' H armature, a smaller ring with two consequent poles, which smaller ring revolves inside the larger one. The two rings are each wound with two layers of No. 20 silk-covered wire, and the arrangement gives better results than I have met with in any other form of small motor. If any person were making up a number of these double ring motors, the rings might be cast in two pieces, which would greatly facilitate the winding of the wire; and two bolts to each ring would hold the whole together. These motors might be sold with a good profit at a very cheap rate.

H. B. T. S.

[20910.]—Your correspondent, "D'Elgo" (page 361, letter 20865), says he has made a motor on the plan of the Griscom motor; but in that engine the wire on the field-magnet is No. 20 or 18, and on the armature No. 24 or 22. In your correspondent's machine the wire is stated to be No. 22 througheut. Instead of the resistances being equal, as is best for a motor engine, the magnet is 7 ohms, and the armature 2 ohms. Therefore, when the whole wire is traversed by an electric current, the magnet tends to reverse the poles of the armature at the moment when the current is changed, and, perhaps, attracts instead of repelling it. However, there may be another reason for the motor not working—viz., secondary currents produced in the motor itself; thus, when two motors are put into the same circuit, only one will work as a rule. "D'Elgo," in his letter states that his motor worked when there was less wire on it; let him then take off half the wire from the magnet, and the rest little by little until the engine works best. He will, most likely, then find that the resistances are nearly equal.

He must be cautioned his motor is liable to be heated by a powerful dynamo current, and he had better use finer wire, not thicker than No. 28 or 30.

J. Sutcliffe.

[20911.]—In reference to letter 20865 ("Electric Motor"), I may say that I am making one somewhat similar, though with a different armature. When about to wind the wire round the field-magnet, I found myself in a difficulty, not having had an opportunity of examining a motor closely.

It struck me that if I wound both helices in the same direction, that is, to make them both right-hand coils, I should have the north pole of one and the south pole of the other coming together, and neutralising each other. So when I had wound one half of the field-magnet I reversed the direction of the coil, so as to make the two north poles come together. Whether I was right or wrong in this I cannot say, as I have not completed my motor yet. As "D'Elgo's" motor worked when one side only was wound, it is possible that be wound both coils in the same direction, and that my idea is correct.

The fact of the machine when worked as a dynamo giving a current, may, perhaps, be accounted for by supposing that one side has a little more wire wound upon it than the other, and that that side gives an effective current after neutralising the other.

I offer these remarks merely as suggestions, and would like to ask some one who understands more about the matter, if nine ohms (the total resistance of "D'Elgo's" motor) is not very high. I understand that the Griscom motor has a resistance of about one ohm. **J. M'Intosh.**

P.S.—I have observed that the resistance of the quantity of wire on the armature is generally higher than that on the field-magnet.

[20912.]—It seems to me, from the description, 20865, p. 361, that "D'Elgo" has so connected his field-magnets as to give them the same polarity, and that he obtains some current when rotating it, because one has a little more wire on it than the other. **Sigma.**

[20913.]—I have in process of construction a motor same as "D'Elgo's," and will be glad if I can help him. I think, from the fact that the motor worked when one of the coils was wound, the other coil has been wound in the wrong direction, so making both poles at one end, and the other polar face simply the neutral point. Let him test the polar faces with a magnetic needle when the current is passing. If this is not what is wrong, I shall be very glad to hear from "D. E." I should like to know if the motor, when finished, and working as expected, will be able to charge a Sutton cell equal to a pint Bunsen, when driven by hand or lathe power. I am hoping mine will be of use as a dynamo as well as a motor. **Chemist.**

RINGWORM.

[20914.]—Some time ago there was a query as to a cure for this complaint; I may therefore say, and the information may, perhaps, be of service even to Dr. Edmunds, that there is nothing more effectual than the common petroleum-oil as ordinarily burnt in lamps. Some skins will not stand the application of the pure petroleum; in which case it may be mixed with olive-oil, until it is found to be sufficiently reduced in strength.

H. B. T. S.

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[20915.]—Nasal Discharge (48943).—Probably due to weakness and overgrowth. Read previous notes upon oatmeal porridge, milk, and fat bacon diet. Let the child wear flannel, thick broad-soled boots, and get out for regular exercise. Go to bed early, and avoid badly-ventilated, over-heated rooms.

Obesity (48944).—172lb. for 67in. at 24 years of age is rather too much. Leave off *beer*; if that does not suffice, drop *sugar*, and, if necessary, limit the food somewhat further in point of *quantity*. Reduce 1lb. a week in weight, nearly to 154lb. Effect this, not by over-exercise, but by putting less material into yourself. To work yourself out in order to oxidise redundant food is absurd policy, but is too often done by unthinking persons. Moreover, persons who get obese are not in a condition to stand severe exercise without risk of permanent injury.

Cephalalgia (48983).—Not due to rheumatism, but probably to irritation of periosteum or membrane lining the cranial bones. Could not be prescribed for without personal examination.

Cod Liver Oil (48989).—Useful as a nutrient when rubbed into the skin, in so far as it is absorbed into the system.

Wine and Spirits (49005).—"Housekeeper" asks—1. Why, if wine and spirits retard digestion, they are so often taken to remedy "indigestion and spasms"? The narcotic action of the alcohol benumbs the nerves of the stomach when irritated by undigested food, and thereby relieves spasm and pain. But its use, nevertheless, has to be paid for in damage to the stomach, and the wise person will avoid indigestion so as not to have to fall back upon medicines which are very useful for colic. 2. Why do so many medical men recommend the drinking of light wine during meals? Answer: Because they don't know any better. Why did so many medical men in the last generation bleed, starve, and poison every one who had the misfortune to be ill? Hot water, followed by tickling the back of the throat, is a useful and ready means of producing vomiting, and a vastly better remedy for "indigestion and spasms" than alcohol. The one dilutes and gets rid of the offending matter; the other only benumbs the stomach into bearing with it. Did "Housekeeper" ever hear of the man who, on going to his gin-bottle in a hurry, drank off its contents before he discovered that it had been filled with cold water, and was nearly killed thereby? Read the motto at head of these replies. Also read, mark, learn, and inwardly digest a valuable letter on "Drinks" (20882, page 385, No. 927) from Dr. Allinson, of Kingsland-road.

Chilblains (48862 again).—Two correspondents give advice, on which they ask my opinion (pages 366 and 391). I could not take the responsibility of advising any one to try either of the latter modes of treatment. No doubt, many children would recover *after* such treatment, just as they would after even more dangerous devices; but it is highly dangerous for correspondents to publish such advice in the English Mechanic. One correspondent is thoughtful enough to "beg a little pity for the patient not to make it scream over much," and the other explains how "the thought struck him," which he goes on to describe. Now, every man has a common-law right to try experiments which "strike his mind" on his own body, so long as he does not intentionally attempt to commit suicide. But no one has a right to try these violent and dangerous experiments upon children, or upon other people not able to be deliberative and consenting parties to the experiment. I think that as much as can safely be said for domestic practice in the matter of chilblains has been said in my note on the subject. **James Edmunds, M.D., &c.**

Grafton-street, Bond-street.

OBJECT-GLASS MATTERS—TOOLS AND GLASS.

[20916.]—The glass mentioned by "Orderic Vital" that Mr. Caplatzi has for sale, would certainly do for experimental o.g.'s; but without knowing the brand it is impossible to give curves suitable. The 'cute amateur may grind small lenses or prisms, and find that himself; the optical plate is of higher refractive power, and has greater dispersion than optical crown, and is more used for common work than o.g.'s. I have used malleable iron tools with good effect; ordinary cast iron will do nearly as well, but I prefer brass. Iron is generally used in English workshops now, and will, I have no doubt, oust brass, for economical reasons. Brass, however, gives a much better surface for dry polishing on paper than iron does. I intend in my papers on o.g. working, to give methods of tool-making that will suit the amateur.

Prismatique.

SOLUTION TO OPTICAL EQUATION.

[20917.]—The following is the solution to the equation given by "Orderic Vital" in note to letter 20860. I have solved it as a biquadratic, but have not sent the working, as it would occupy too much space:—

$$x = 2\tfrac{1}{4} + \frac{y + \sqrt{16{\cdot}75 + \frac{1}{4y} - y^2}}{2}$$

$$\text{Where } y = \sqrt{\left\{\frac{67}{12} + \sqrt[3]{\left(\frac{9371}{54} + \sqrt{\frac{283}{108}}\right)} + \sqrt[3]{\left(\frac{9371}{54} - \sqrt{\frac{283}{108}}\right)}\right.}$$

The value of x, when computed from the above, will be found to be 4·430055. **J. G. Vine.**

DIE-ENGRAVING AND AMERICAN SAWS.

[20918.]—My thanks are repeated to "Gamma" for his letter. I am ashamed to ask for more; but surely the Editor's good nature has not been overtaxed, and valuable as space undoubtedly is, what has appeared under the heading in each letter signed "Gamma" has been equally valuable, and we can all see the well has not been pumped dry. However, there must be a limit to the tax put on good nature, and I am really grateful for all that has been shown me.

As to "Gamma's" concluding remarks on American saws, he will see, on looking at the letter of "J. L.," that he referred to the saw with teeth both on back and front, one set being fine and the other coarse. It was of this saw I said it was a toy, not a workman's tool. While the saw "Gamma" refers to is, I gather from the work done, the American hand cross-cut saw with *lightning tooth*—a first-rate tool, as I know. But the other double saw I think little better than a toy. It will, no doubt, cut; but it does so under difficulties, as I have proved, having worked with three different ones. The first defect is, I consider, the saw is too narrow in the blade, 1½in. at point to 3in. at heel, though there is really no heel. Then *both* sides have the teeth set, so that in cutting anything wider than 3in. the teeth not in action rub on the sides of the kerf, and considerably increase the friction. It is true this is sought to be mitigated by the fine teeth not having so much set as the coarse. But still, the saw is made rather, I would say, for sale than for use; and of the three I have seen and used they were all too weak, and the tendency to buckle very great. **Fred. Carre.**

THE SLIDE-RULE.

[20919.]—My letter replying to Mr. Alb. Kapteyn's inquiry having been posted on the 21st December, Mr. Alfred Sheppard's communication of 22nd (20858), pages 358 and 359 (or, rather, so much of it as refers to his patent double slide-rule), requires notice, inasmuch as several years before the date of that patent, all, and far more than all, the advantages claimed by Mr. Sheppard were applied and appreciated by user of the triple radius double slide instrument referred to in my reply to Mr. Kapteyn. For such calculation as—

$$\frac{93 \times 71 \times 19}{51 \times 32} = \text{nearly } 77$$

or, sup. area of 23ft. 6in. × 3ft. 8½in. = about 87sq. ft.;
or, solid cont. of 23ft. 6in. × 3ft. 8½in. × 1′ 9½″ = about 156 cub. ft.;
or, square or cube, or fifth root of 123, about 11·1; 4·97; 2·61.;

or, $\sqrt{\left(\frac{17 \times 23}{13 \times 19}\right)^3}$ = about 1·99;

or, $\sqrt{\left(\frac{17 \times 23}{13 \times 19}\right)^2}$ = about 1·56;

or, comm. log. of 5·83, nearly 0·766; or, hyp. log. of 5·83, nearly 1·765; or, the sine of angle 81° 30′, nearly ·989; or, cosine of angle 81° 30′, nearly ·148; and innumerable others; for each calculation the settings and results being left intact to the last, and consequently capable of revision when needed. And next, so far as relates to the duo-decimal rule of Mr. Sheppard, or any other which requires the small divisions made so as to represent other than decimally, involves a special instrument for each different specialty, while equally accurate results are obtainable by the decimal rule, which applies to all calculations; so by such special rule the "light is not worth the candle," and, lastly, as Mr. Stanley, 4 and 5, Great Turnstile, Holborn, London, is a maker of both Mr. Sheppard's patent rule and also my triple radius double-slide instrument, the necessity for this communication will be obvious.

Thomas Dixon.

[20920.]—HAVING for many years been interested in the use of the slide-rule, and feeling convinced that it is capable of being advantageously applied much more extensively than is at present known, I take every opportunity of trying to add to my present scanty knowledge of its application. It was, therefore, with great pleasure that I noticed the letter of Mr. Frederick A. Sheppard in No. 926 of the "E. M." for 22nd December last, pages 358 and 359, and I lost no time in calling at Mr. Stanley's, Great Turnstile, to see whether the double slide-rule indicated presented the great advantages claimed for it by Mr. Sheppard over others in general use; but I confess I was much disappointed, and I cannot help fancying that this gentleman must be unacquainted with the excellent instrument furnished by Messrs. Dring and Fage for cubing timber, and extensively used by the Customs measurers and others for that and other purposes.

In Mr. Sheppard's rule two slides have to be adjusted in order to compute the solid contents; but in Dring and Fage's rule this is accomplished at one adjustment of the slide—thus, viz., there are four lines—two fixed and two on the slide—all in simple logarithmic proportion; but one of them—the second from the top (consequently, the upper fixed line)—is "inverted," that is to say, the square is from right to left. The other three are all precisely alike, numbered from left to right, and when the slide is adjusted at what we may call "zero," the figures of these three lines are exactly over one another, the "inverted" line being so placed that its figure 12 is also in line with the 12 of the other three lines.

To employ this rule for cubing, the *breadth* and *thickness* (in inches and quarter-inches) on the upper and the "inverted" line respectively are placed opposite one another, it being quite immaterial on which line the *breadth* is reckoned, provided the thickness is on the other, then opposite the length on the bottom fixed line will be found the *cubic contents* on lower line of the slide above it, for any length of the same breadth and thickness.

I cannot perceive that there is any more "slide-rule arithmetics" to be studied than is requisite with Mr. Sheppard's rule, and here also "the whole working remains on the rule open to inspection, to be revised by sight without removing a slide."

I am at a loss also to perceive why this gentleman sneers at "gauge-points"; for, in point of fact, some, nay, most, of the otherwise intricate calculations are solved by the use of "gauge-points," the majority of which can be readily indicated on the rule itself without confusion, and it is but little effort of memory to commit to it the two or three special ones applicable to the individual wants of an operator.

Personally, for the problems I want to solve, I generally find it shorter to calculate the "gauge-point" required by pencil (if I happen to forget it, or not to know it) than it is to make the calculation in the ordinary way by pencil; and I cannot help thinking that the "gauge-point" is only a bugbear, from people not having learnt that it is only the expression of the *product of all the multiplications and divisions* to which a sum has to be subjected.

The great desideratum as regards the slide-rule is, in my opinion, to find a method of indicating clearly quantities represented by *more than three figures*. In some cases this can, with care, be extended to four figures; but it requires sharp sight, and very accurate division of the rule. To attain correct results in five or six places of figures would be well worth the care and trouble of a second slide.

I have a very useful instrument of the slide-rule kind, called "Fuller's computing telegraph," consisting of two logarithmic scales, one being on a revolving circular disc of milled-board, surrounded by another on milled-board of equal thickness, in which the disc turns; but in some parts the divisions are so fine that I have to use a rather powerful hand-lens to enable me to decipher them.

January 1. **Gamma Sigma.**

[20921.]—I AM much obliged to the correspondents of the ENGLISH MECHANIC for their letters 20858 and 20859 in answer to mine, but I do not think that either of the solutions proposed suit my case.

I am surprised to see that Mr. Sheppard has not hitherto met with logarithms of logarithms, because this form is not at all uncommon in complicated calculations, and often the only practical way of arriving readily at a result.

The functions alluded to by me are of the form $\sqrt[n]{\left(\frac{p}{q}\right)^m}$ and not of the form $\sqrt[n]{\frac{p}{q}}\ m$. The latter, as explained by Mr. Sheppard, can be solved by the ordinary slide-rule, although there might be some difficulty if *n* is not a whole, but a fractional, number. For the former Mr. Sheppard does not give a satisfactory method of arriving at the result by means of the slide-rule. The formula in my case refers to *adiabatic* curves, in which both *n* and *m* are fractional numbers. To define more precisely, I might say that I have a couple of hundred steam diagrams, and wish to draw in each case the corresponding adiabatic curve. This, I think, can only be done by calculating for each diagram several points of the curve, and much time would be saved by using Dr. Roget's sliding rule for this purpose.

As to "A. D. L.'s" proposal to construct a sliding rule myself, I am rather afraid the work would be tedious, and of necessity inaccurate, and besides, would absorb more time than I can spare.

Alb. Kapteyn.

[20922.]—IN reply to the letter of Mr. Alb. Kapteyn (20843), p. 339, "E. M.," as I have no knowledge whatever of Dr. Roget's Rule, I can give no idea how it is arranged to obtain and apply logarithms of logarithms in the solution of such formula as "$\sqrt[n]{(p / q)^m}$" at one operation; but I would observe that when the indices *m n* refer to square and cubes, or to a limited extent higher integer indices of powers and roots, calculations are readily made by the triple radius, double slide rule, and complex indices are provided for by the circular rule, both of which may be seen advertised in the Sale Columns of "E. M.," No. 909 to 914 inclusive, and exhibited at the South Kensington Museum. Thus, substituting figures for letters in above formula as, say, $\sqrt[3]{(32\cdot5 / 5)^2}$, and using the triple radius instrument, setting 5 on top slide opposite 35 on line A. Opposite 1 on top slide is 6·5 on A, the cube root 1·867 on cube root line, and 1·867 on square root line, opposite its square nearly 3·94 on A, all visible (if need be) for re-examination at last. Or, say, to find the diameter of a solid cast-iron pillar 15ft. long, with ends rounded to safely carry 30 tons, reckoned from the formula $\sqrt[n]{(w / c) \times l^{1\cdot7}} = d$, *w* representing the weight (30 tons) to be carried, *c* the weight (2·8 tons) which a round-ended solid cast-iron pillar, 1in. diameter 1ft. long, will safely carry, *l* the length (15ft.) and *d* = the diameter in inches. By substitution $\sqrt[3\cdot5]{(30 / 2\cdot8) \times 15^{1\cdot7}}$ giving the diameter. By circular instrument reading the numbers and their corresponding logarithms opposite each other on their respective circles, as 30 is opp. its log. 1·447, 2·8 opp. its log. 0·447, and 15 opp. its log. 1·176.

1st. Having fastened the index arms B at starting line to arm C at 1·7 on number line; also arm D at starting line to arm B at 3·5 on number line, as by moving arm B to 1·176 on number line, arm C will then be at the product of log. 1·176 × 1·7 or very nearly log. 2, so the log. 1·477 − 0·447 + log. 2, giving log. 3·03.

2nd. By moving arm B to 3·03 on number line as arm D will then be opposite the quotient of log. 3·03 divided by 3·5 = log. 0·866, and 0·866 on logs. line is opposite very nearly 7·45 on number line; so practically the diameter of pillar would be taken as 7½in. **Thomas Dixon.**

Buttershaw, near Bradford.

LEGAL REPLY.

[20923.]—LANDLORD AND TENANT—WATER SUPPLY (49013).—Landlords who wish to let their houses always lay on water, and I never heard of a man taking a house without having the water laid on; but if he did so, I think he would have to lay it on at his own expense. As a matter of law, a landlord is not bound to do anything for the comfort or convenience. If the querist has entered into possession of the house, or signed an agreement, without making the landlord undertake to lay on the water, I doubt if he has any remedy. But if the querist has only taken the house verbally, and has not entered into possession, he had better refuse to carry out the contract unless the landlord first lays on the water.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall, E.C.

LATHE-PLANERS.

[20924.]—I FULLY endorse the remarks of one of your correspondents in No. 925 on lathe-planers, more especially where he refers to "J. L.'s" bolt holes for shifting the slide-rest on his planer head for extending the cut. Practically, it would be almost impossible to take such an extended cut *in the same plane*; at any rate, it would never equal one single cut over the same surface, or more truly parallel to each other. And I also think his remarks as to employing the cheap ready-made V and flat beds quite applicable; and as he justly observes, "A good set of small hand-planer castings" are not only far preferable as a mechanical job, but in the end would be cheaper.

Planing on the lathe should be confined to small surfaces, say, 2in. by 6in. long, although *I have* planed (between centres) 3in. by 6in. for a slide-rest; anything beyond this (for lathes up to 5in. centre) is beyond the scope of such a tool, the want of breadth and depth in most beds preventing much overhang and the necessary rigidity.

I have a special vertical slide and swing tool-box for planing, self-acting, fitting on the saddle, and a peculiar method of holding the work while being planed. By the way, I do recollect often seeing, many years ago, in Holtzapffel's factory in Longacre, a small planer on a *lathe-bed*, but it was used exclusively as a planer, and had the usual vertical side standards and horizontal cross slide; it was used principally for planing up V strips, dies, slides, and such like small work. The bed was, as near as I can recollect, about 5in. on top face, and in all respects it was a perfect tool. **Mechanicus.**

AUTOMATIC REGULATORS FOR GAS.

[20925.]—THE regulator described by Mr. Gartrell in last issue (letter 20863, p. 360) is, and has been, perfectly familiar to me from its first introduction. Why Mr. Gartrell brings it forward as a temperature regulator I cannot understand, as its action is perfectly independent of temperature, and depends on steam-pressure only. As a temperature-regulator it is absolutely useless, although good for the purpose for which it was designed, i.e., regulating the steam-pressure in dentist's vulcanisers. It is useless for even these, if used for dry-heat for celluloid.

Mr. Gartrell has thrown no light on the matter, and a good simple temperature-regulator for gaseous fuel is yet in the future. I have made a few attempts, and the results, more or less successful, are in the hands of different makers and users. All are more or less objectionable, if put into the hands of the general public, who require things easy to adapt, and needing no special or technical knowledge. **Thomas Fletcher.**

Museum-street, Warrington.

STANDARD SCREW-THREADS.

[20926.]—SIR JOSEPH WHITWORTH kindly forwarded me, through our Editor, his book on "Standard Gauges," in answer to my inquiry, the screw-threads from which were inserted in "Ours" of December 22nd, by A. A. Myall.

The engineer's sizes from 6in. to ¼in. are probably perfect as regards proportion of threads to diameter, which fully accounts for its universal adoption. Those from ¼in. to ⅛in., what we may call the machinist's sizes, are far from perfect—hence their non-adoption; their fault being insufficiency in number of sizes, and lack of uniformity. As to the first, between ¼in. and ⅛in. there are only five sizes inclusive, whereas the general run of machinist's screw-plates would have about ten or twelve sizes. Now, as to uniformity, we know that two pairs of dies for different diameters with the same number of threads, only lead to their indiscriminate use, which is bad (except in the uniform gas threads), the $\frac{7}{32}$ and $\frac{3}{16}$ have both 24 threads, a 32nd less has 32 threads, a 32nd less still has 40 threads. Now, 40 threads for ⅛in. is rather fine, more suitable for the instrument-making trade, where fine threads are used. What I would suggest as fulfilling machinist's requirements are the following (if we are to keep to the fractional division of the inch for screws):—

Size—	$\frac{1}{4}$	$\frac{15}{64}$	$\frac{7}{32}$	$\frac{13}{64}$	$\frac{3}{16}$	$\frac{11}{64}$	$\frac{5}{32}$	$\frac{9}{64}$	$\frac{1}{8}$	$\frac{7}{64}$	$\frac{3}{32}$
Threads—	20	22	24	26	28	30	32	34	36	38	40

However, there is much to be said against the present fractional divisions of the inch for sizes below ¼in., and, I think, nothing in its favour; it is not convenient in practice to use a rule, or even rule caliper, to measure 64ths of an inch. Why not abandon the system below ¼in., as we must use micrometer, or at least, vernier measurements, and if we get the decimal wire-gauge it would be most convenient to have the decimal screw-gauge also; but we must have more sizes than Sir Joseph has laid down: he advances from ⅛in. ·125 to ·150, and so on, to get equal divisions between ⅛in. and ¼in. This is a great jump between small sizes, and is not suited to small work, therefore found no favour with the users. If we discard the present fractional measurement, there is no necessity for retaining the ⅛in., we use the $\frac{1}{10}$th instead, therefore, I would suggest the following for the decimal screw-gauge:—

Size—	·250	·235	·220	·205	·190	·175	·160	·145	·130	·115	·100
Threads—	20	22	24	26	28	30	32	34	36	38	40

It will be noticed that this is almost identical with the last, and varies little from the sizes now in general use, with the exception that these divisions are equal, and I have not found a screw-plate yet that has equal divisions. There would be no trouble, then, in determining the size of a tap or screw. The American pocket screw-thread gauge, from 10 to 40 threads, advancing by two threads, would at once indicate the size; this useful gauge being now in common use, as also the micrometer for measuring the diameter, and the suggested sizes following closely those in general use, are powerful arguments in favour of this proposed decimal standard. **B. S. W.**

REPLIES TO QUERIES.

⁎ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[48082.]—**Single Eccentric Link Motion** (U. Q.)—This would be a crude arrangement—perhaps just permissible in a model, where all that is required is to move the piston backwards and forwards, and spin the flywheel round. If you make a rough diagram or two, you will see it is inapplicable to valves requiring to be lapped, and lead, and set, and generally petted. In fact, it would only do where there is no lap, and the eccentric is set at right angles to the crank, because it would have the same effect as turning the eccentric half-round on the shaft, but with irregularities of motion introduced by the many-jointed action.—Ploni Almoni.

[48136.]—**Eczema** (U. Q.)—It is very little use putting such queries as this. A doctor who understood his subject would require a history perhaps deeper than you can easily give, and closer than your reading of Wilson would make you believe necessary. Go to a specialist before any worse change occurs. Cannot you see that, when one local vent is closed, it seeks another and more active? If you close nature's safety-valves as fast as opened, what can you expect? It is the cause, not the symptoms, you want to find and cure.—Ploni Almoni.

[48346.]—**Wood Screw-Cutting.**—Will some practical lathe-turner in wood kindly answer this query? "S. M.," evidently, from his reply, understands nothing about the question. I have tools which accompanied my lathe on the purchase of same, which, I was informed, were for making wood screws on the lathe; but I don't know how to use them properly, neither am I satisfied that they are of the proper shapes. Hence the question. I am anxious to be able to make both the inside and outside screw, as required in a small round box with a screw top.—H. H.

[48420.]—**Clock-Chimes** (U.Q.)—"Ohio" not having received instructions from a more able pen, I will tell him how I managed the same. First, the musical part: I fixed the works of large musical box in the wood clock-case, so that the stop was at that side next the clockworks; this is done with the screws that were used to hold the works in the old musical box. Now fix the eight-day American clockworks in the case to go and keep time; and on the wheel (which has the long spindle in the centre and carries the hour-hand), drill four holes equal distance and rivet pins in same, which will be three hours' distance from each other. Now drill one hole in the side plate nearest to where musical box-works are fixed, and take stout piece of brass wire, and flatten it a little in middle; drill a hole through the flat part and rivet it to the plate; bend one end to catch the pins on hour-wheel, and the other end to lift the little lever that drops in hole of barrel on musical-box works; so, you see, every three hours the clock will play a tune. You can have same always, or can set the catch to change tune every time. The chiming I constructed thus: I took off the second and worse set of clockworks the going part, and in the plates where they had been I fitted wheel which had turned the escape-wheel, in holes drilled, so that it was turned by the main-wheel of the striking part, and on spindle of this wheel I fitted a turned hard beechwood roller to form barrel for chiming; on this barrel I placed short pins thus ˙ . for first quarter chime, and left a space, and then fitted ˙ ˙ . . four thus for half-hour, a space again, and then six pins same way, and space again, then 8 pins last quarter; then the clock strikes the hour of course on the 8-day works, which has also to set the chiming off at proper time; to do so, on the minute-wheel in centre, which carries the minute-hand, drill four holes equal distance and fix pins so that they lift a lever wire each quarter, which wire I affixed same way as before except on the other side of works—make it to lift the bent wire which has set the striking part off in it when it was used as a clock, then each quarter, when it drops, the chiming will start, move round so far as you arrange space on the barrel with each quarter's pins. This you do by soldering up the spaces in the counting-wheel which did duty when striking, and cut 4 at equal distance in so that lifter drops in one as each quarter is chimed, and rests until again set off by lever wire from the clock. Eight hammers are fitted in same way as the action of a German concertina, which work in notches cut in hard wood, a small space betwixt each and a small circular piece of iron at the end of each lever to tap the 8 bells, which bells can be bought at any clockmaker's place. I selected mine thus:

1	2	3	4	5	6	7	8
C	D	E	F	G	A	B	C

and fit them on an iron rod with a small washer betwixt each one, and then fixed them in clock-case under the hammers.—Progress.

[48509.]—**Harmonium Reeds.**—On p. 390 of present volume, a correspondent, replying to this query, conveys the idea that harmonium reeds, if made of good metal, will not be injured by the hardest possible blowing. As a player of this instrument of some years' experience, I must candidly and honestly contradict this statement. Whether the reeds are made of good metal or not, an undue force of air applied to them will tend to flatten and impair the reeds; and if this unreasonable and unnecessary manner of blowing is continued, the bad effect upon the vibrators will soon become obvious. Besides, there is no advantage in blowing too hard, even if it did not injure the reeds. One most important particular in the art of harmonium playing is the manner in which the bellows is blown. Expression is so much neglected among harmonium players of the present day, that the manner of blowing the bellows, generally speaking, is considered of little or no consequence. This is one reason that the harmonium is considered monotonous, and is so much despised among the lovers of music.—G. Fryer.

[48533.]—**Angles of Pyramid.**—The original reply of "Scotch Working Mechanic" was (see p. 279): "The distance from apex to middle of any side of base being radius, half the side of base will be the sine of half the angle made by any side with the side opposite." A triangle being thus presented to our view—viz., as I thought, one of the faces of the pyramid, I considered that the sides referred to were the sides of this triangle, instead of the plane sides of the pyramid. Now that we know that the vertical triangle between two opposite faces is meant, the reply is correct.—M.I.C.E.

[48541.]—**Measurement of the Height of Waves.**—In answer to "Inquirer," to obtain the height of sea waves the following plan is adopted:—Taking a long thin pole, paint it in alternate spaces black and white of a foot each, and with alternate bands of red and green; mark fives and tens. This is secured by a rope at its lower end to a wooden frame, about 4ft. by 4ft., covered with canvas, and sufficient ballast is attached to the frame and pole to sink the latter about three-quarters of its length, the frame being sunk at sufficient depth to place it outside the region of disturbed water, that is, to a distance not less than the length of the waves; the pole will now float upright, and the waves as they pass it will simply appear to rise up and down it, and if note be made of the number of spaces exposed between a crest and the succeeding hollow, the feet so read off is the height of the wave. Note—both pole and frame should be made waterproof. I know of no instrument to record the height of waves breaking against a sea-wall, but have read a proposal to construct one as follows:—Take a tube, open at one end and closed at the other, and connect to a registering pressure-gauge; immerse one end of the tube in the water, then as the waves rise and fall the air within the tube will be alternately compressed and expanded. This will be recorded by the gauge, and the heights may be found from the diagram.—Shipwright.

[48678.]—**Oiled Paper.**—I should advise "A Manufacturer" to use "printer's varnish," which is made by boiling linseed or nut oil until it burns. The varnish is really produced by allowing the oil to burn for some time, and it might be too viscid to sink into the paper. Thin, then, with ordinary boiled oil; but to dry quickly hang the sheets in a warm atmosphere.—S. P.

[48679.]—**Spiral Turning.**—A simple device for spiral turning will be found on p. 557, No. 360; for ordinary twisted work see p. 512, No. 358. There are, no doubt, many other places in back volumes, but the above will suit, I suspect.—Essar.

[48681.]—**Hydraulic Cement.**—What does this querist want? A cement that will harden under water, or what? His requirement that silicate of soda must form an ingredient is likely to prevent a reply.—T. P.

[48688.]—**Condenser.**—I do not think that an injector will act as a condenser, and I fail to see the advantage to be gained even if it could. What is the objection to the usual surface condenser or the jet condenser?—Essar.

[48705.]—**Size of Back Workshop.**—If you are contented to work in such a place there can be no harm; but of course you keep it well ventilated—no, I am afraid you do not, for you complain of the paraffin lamps causing an unpleasant smell. Now, kerosene, when properly consumed, produces only water and carbonic acid. If you trim your lamps properly, you will not be troubled with any smell; and if you provide for a free supply of air, you will not suffer from working in so small a shop. Many a cobbler works in a much smaller establishment, but he usually has plenty of air.—Essar.

[48713.]—**Organ in Small Room.**—This querist gives only one dimension of his proposed organ—the height, 4ft. 6in. Whether it is worth while building an organ and cramping it down to that I will leave for others to say; but providing there is plenty of floor-space, there can be no real difficulty, as all the tall pipes can be put at the back and sides; and if the 8ft. open is wanted, they can be elbowed. The bellows would be in ordinary position. You could adopt your plan, and put the windchest near floor, using very short keys; and, if you have room, place ordinary bellows at side. The double-feeder style would be better than the tall one sliding on iron rods. I cannot help you as to the voicing.—C. P. O.

[48729.]—**Oysters.**—This query is a rather curious one, and Mr. Lancaster's reply at p. 364 is rather more so. The first question to be settled is—What is a sign of life? The querist, if a microscopist, may be aware that the gills (or respiratory-circulatory organs) have a ciliary movement, which they will keep up for some time after being removed from the mollusc, so that signs of life may be present in an organ separated from the body. Probably the opening of the shell, and consequent escape of the inclosed water, kills the creature as far as general nervous vitality is concerned, by the same process as a fish is killed by taking out of water. It must be remembered, too, that by taking away the shell the great muscle is severed. It seems probable, therefore, that so far as any consciousness or "cruelty to animals" is concerned, these are at an end with the first wrench severing the muscles of the hinge. The only way to find signs of life, then, would be to put the oyster into water, and examine all the organs seriatim for traces of circulation. The ciliary motion on the gills is a favourite microscope object, in all the Lamellibranchiata.—Ploni Almoni.

[48732.]—**Indicator Diagrams.**—I have not the opportunity of referring to "F. W.'s" query again, and the substance of it has escaped my memory; but I once had a very similar diagram from a beam-engine with Cornish double-beat equilibrium valves, which were worked by tappits, so set that *the top steam and bottom exhaust opened by the same movement*, which is easily seen if "L. O. V." looks at the description, without taking space, with a sketch and description of an arrangement that is both ancient and wasteful. The engine I quote had exceptional advantages for fixing a slide-valve and steam-chest, which resulted in far more economical working. The slide-valve was of a very simple, balanced type, which is not in common use (though I have put several in), and therefore did not materially add to the friction. The data supplied by "F. W." were very slight, I recollect; therefore "L. O. V." must pardon me if I quoted a case in my reply which seemed at the time to be applicable. If it was not so, my intention was good; therefore it must plead for the execution.—Fred. Walker.

[48734].—**Electricity.**—Mr. Lancaster is right; the query does contain an error. I should have said that the 9 cells with the carbon damp with water, decomposed water fast (by fast I mean that it took about five minutes to fill one inch of test-tube, ⅝in. in diameter), and one cell filled with a solution of chloride of zinc in the porous cell with the zinc, and a mixture of saturated solution of bichromate of potash two parts, and hydrochloric acid one part, in the containing vessel with the broken carbon, decomposed it slowly (that is, it took about an hour to fill one inch of the test-tube). Now there must be some difference in these electricities, for the 9 cells, with only the carbon and zinc damped with water, would decompose water as fast as four cells (in series) filled with the solution, and yet only had sufficient magnetising power to make a very small scratching noise in the telephone, while the four cells charged made a 3½in. bell almost jump off the table. I have access to a medical battery of 32 small cells, and the current has the same non-magnetising power as the 9 cells. I shall be very glad if Mr. Lancaster or any other reader will answer my query, as I am anxious to learn all I can about Electricity.—Seaweed.

[48818.]—**The Weather.**—Mr. Colby will, I think, gather some information on this question from Symons' "British Rainfall," which is issued annually. I have only the issues of 1876 and 1878 by me; but it is a fact that the East coast of Great Britain has very different weather to the West coast so far as rainfall is concerned. Something of this is doubtless due to the prevailing winds; but the distance is so short in some cases that it is impossible to avoid the conclusion that land attracts rain. Easterly and N.E. winds are dry, because the air has parted with excess of moisture; S.W. winds are fully charged with water because they have passed over a wide stretch of ocean, some parts of which are highly heated comparatively. The figures are remarkable: in 1876 the largest registered fall was 121·99in. at Pen-y-gwryd, Merioneth; the least at Chatteris, Cambridge, 19·26in. In 1878, the largest fall was at The Stye, Cumberland, 149in.; the smallest at Keadby, Lincoln, 17·35in. From The Stye to Sunderland is not a great distance, but at the latter place only about 30in. fell. Mere altitude of the station does not appear to have much to do with the rainfall.—NUN. DOR.

[48835.]—**Fusible Plugs.**—I hold that a safeguard is *not* safe, unless it is in advance of the danger. Water will not assume the "spheroidal condition" when 3½in. above the tube; but before that occurs the plug will melt out, and warn those in charge of the impending danger, damping the fire down also. The lower cocks of most water-gauges are fixed at 4in. above the tube; so, in that case, there will be no water visible in the glass when the plug melts; and in the interest of life and limb, the level should never be so low.—FRED. WALKER.

[48835.] — **Fusible Plugs.**— It is pretty well known amongst engineers that when a fusible plug has been in use for some time it gets the side next the fire coated with carbon, and that next the water with scale. Not only so, but that part of the plug which is supposed to melt at a low temperature, usually about 300°, seems to lose its nature as it were, and many of them, instead of melting at or about that temperature, require a very much higher temperature before they will melt. I cannot explain why the alloy changes its nature; I only know that it does in every plug that I have used. Only the other day, I tested two caps side by side, one an old one, the other new. The new one melted at a trifle higher temperature than the makers' state; the old one did not melt at all. I could have melted the brass before the alloy, I believe. Therefore, as a further safeguard against accident, I change the fusible caps every six months. If "Manufacturer" is a manufacturer of fusible plugs, properly made, will he kindly send particulars and description, for the benefit of the engineering readers of "ours"?—LABOR OMNIA VINCIT.

[48847.]—**Noisy Exhaust Steam.** — I beg to correct an error in "Non. Dor.'s" reply on p. 315. He states "*large* glass marbles" confined in suitable chamber, will silence the noisy puffing of exhaust steam. They must be small, and not over ¼in. diameter as a rule; therefore, beads are preferable. The depth need never exceed 8in.; but the area varies with the area of exhaust, or that of the valve. If used for quieting the roar of waste steam, about 12 to 15 areas for exhaust, and 20 to 22 times for high-pressure boiler-valves, is entirely effective.—PHILIP S. JUSTICE, 53, Chancery-lane, London.

[48874.]—**Steam Power.**—To "F. W." AND "L. O. V."—For two days I have tried with 40lb. pressure on my boiler and cut-off earlier, but have gone back to 30lb., as I find no advantage by using 40lb., as I require a little more coal. I cannot understand "L. O. V." in what he says about ⅓ stroke being 10in. I understand it to be 12in., to be ⅓ of 3ft. stroke. If I am wrong, I hope you will explain it to me.—CARMEL.

[48888.]—**Locomotive Bridge.**—The use of the fire-brick arch is to keep the gases longer in the firebox—to give them, as it were, a more circuitous "run" after leaving the fire before entering the tubes, thus giving them more time to combine and "combust." Without an arch or water-bridge, the gases arising from the coal nearest the tube-plate would be drawn out by the lower tubes in an unconsumed state—thus leading to waste of fuel. The fire-brick, when once heated, also serves to increase the temperature of the gases which pass over its faces, and thus helps to insure their combustion before they are drawn out by the action of the exhaust. Briefly stated, then, its object is to prevent smoke, by compelling the gases to pass over a highly heated surface, and to mingle with the air coming in past the deflector, which, too, might otherwise rush directly into the tubes. It is scarcely necessary to mention that all locomotives are not fitted either with the brick arch or the water-bridge, or that some drivers pay so little attention to the matter that they run with the fire-door open.—NUN. DOR.

[48896.]—**Voss Machine.**—The description of this machine appeared in *Engineering* about 18 months ago; but there was undoubtedly a mistake as to the position of the foils. They should be on the back of the large plate, and are all the better (more effective, I think), if pieces of glass are cemented over them. Looking, however, to the trouble of attaching the foils and the buttons, and varnishing the plates, I shall, perhaps, be doing a service to some of your readers, if I call their attention to the description of a machine which appeared in *Engineering* on the 6th of last October. It is described as the invention of a Mr. Wimshurst, and is, I should say, the largest and most powerful machine of the kind in existence. Its great merit appears to me to be that it can be made at a cost which seems merely nominal compared to the price-list figures of the shops. It is a modified form of Holtz machine, with 12 large discs of glass, 32in. in diameter, and 24 slips of glass held securely by the framing above and below the spindle. Perhaps, however, your readers may have seen the description, and, being a new subscriber, I am only telling old stories. Yet, while I see such a question as the one under this head, I may still do some service by calling attention to the simple and cheap machine described by your contemporary.—AN OLD A.I.C.E.

[48922.]—**Coloured Photographs.**—See replies to queries 41409, Vol. XXXII., p. 94, and 47502, Vol. XXXV., p. 506.—W. ROBINSON, JUN.

[48933.]—**Photographic Quantities.**—Sulphate and protosulphate of iron are practically the same, the latter being merely a purer form of the salt. It is soluble to the extent of about 70 parts in 100 of water. Potassic oxalate is soluble, I think, to the extent of about 30 parts in 100 of water; but of this I am not quite sure. Of course you are aware that temperature affects the solubility of all salts more or less.—W. ROBINSON, JUN.

[48941.]—**White Background for Photos.**—Very likely a white ground was used in the cases to which you refer, though the same effect might be produced by a proper adjustment of the vignettes and care in printing, provided the photo were taken against a light ground as ordinarily used for vignettes.—W. ROBINSON, JUN.

[48946.]—**Froude on the Resistance of Fluids.**—In my reply last week, for "spars do not tow so highly," &c., it should be, "spars do not tow so lightly."—J. D. C., Capt. R.N.

[48946.] — **Froude on the Resistance of Fluids.**—In answer to "R. C. L.," to give Mr. Froude's exact words would require more space than probably the Editor could well spare, and to quote any one passage in his exposition without the context would be of little use, but a summary of his statements is as follows:—A submerged body moving in a fluid of limitless extent, and at such a depth as to produce no surface disturbance, experiences nothing but frictional resistance. The body should be symmetrical with regard to its transverse and longitudinal axes respectively, and of a tolerably easy shape, to an extent depending upon the viscosity of the fluid through which it is moving; otherwise, the stream-lines will degenerate into eddies. It will be seen that numerous shapes comply with these conditions.—SHIPWRIGHT.

[48950.]—**Battery of One Volt.**—To "SIGMA."—I only wish I could find out how to achieve what "G. P." asks of me; not for his benefit. I should straightway patent what would be a very valuable article. The nearest practical approach to it is the Daniell cell, and some say that if this is charged with nitrate of copper instead of sulphate, the E.M.F. is one volt.—SIGMA.

[48953.]—**Toning Bath.**—Acidity and alkalinity are tested for by means of litmus paper, small books of which can be obtained from any operating chemist or photo. dealer. If this blue paper turns red it indicates acidity; if this red paper turns blue, alkalinity. The acetate bath always shows more or less acidity from liberation of acetic acid by the stronger acids contained in the chloride of gold; but ordinarily speaking, this does not affect the toning. I consider the formula named rather too strong—one grain of gold to 7 or 8oz. of water being amply sufficient. There is no more economical bath that I am aware of. Some of the ready-sensitised papers in the market would probably tone all the better for a preliminary bath of alkali (say a little carbonate of soda); but there are papers which tone well enough without.—W. ROBINSON, JUN.

[48953.]—**Toning Bath.**—If "Ouvrier" makes a bath up as follows, he need not trouble himself about the alkalinity or acidity of it, as it is sure to give good results. I can speak from experience, having had the same bath in use over two years, and used only with ready sensitised paper; stock solution, chloride of gold, 8 grains; water, 8 drachms. To make up bath, take 1 drachm of above which contains 1 grain of gold; add 6oz. water (not less), 30gr. of acetate of soda, and do not use it for at least 24 hours after mixing. Wash the prints in three or four changes of ordinary tap water, till all milkiness disappears. This is very important. Immerse in toning bath; stop the toning before it reaches the desired tint, as the fixing cools the tone wonderfully. If a chocolate tint is desired, stop as soon as a slight change has taken place; if a purple tone, then stop when the chocolate is reached. Each time a fresh batch of prints is to be toned, add a little more stock solution several hours before using. For six prints add ¼ drachm; for 12, ½ drachm, and so on in proportion; but never add any more acetate of soda. I have given the above in detail, because I believe that the toning is where many amateurs fail. If the prints are kept in toning bath till the colour is that required in the finished print, then be sure you will be disappointed, especially in the case of ready sensitised paper, which is more deceiving in this respect than that sensitised at home; but its advantages are many, as it can be kept for weeks between printing and toning, which enables one to tone a week's work or more at one operation. I may add that the above bath changes colour in time, becoming a beautiful purple by transmitted light; but this is no detriment to its working properly. In fact, I think it gives richer tones then.—E. P. R.

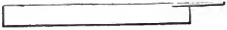
[48955.]—**Paper.**—This could be effected by coating the paper with albumen, and if necessary, to render insoluble, it could be made so by passing the paper when dry through a bath of strong methylated spirit. If unsuitable, say what you require the paper for.—W. ROBINSON, JUN.

[48961.]—**Watch Dial.**—There is a prepared enamel sold by material-dealers called "email fusible." It is a French article, and is easily applied to broken dials by simply laying a small piece on the broken part of the dial, and applying a little heat underneath from a small gas-jet. It quickly melts and spreads, and as quickly cools hard and glossy white. If it does not melt down smoothly, level it with a penknife or file, and slightly warm the surface. It then becomes glossy again. Don't let the yellow part of the gas-flame touch it, or carbon will be absorbed, and so it will be discoloured.—ALFOJOE.

[48963.—**Sciatica.**—Sleep on a blanket, not on a sheet. Put on a loose pair of woollen socks when going to bed, and pull them off before going to sleep; that helps greatly with cold feet.—SIGMA.

[48964.]—**Brake Failures.**—This question was not addressed to me; but as I was in the train, perhaps I may be able to throw a little light on the subject. I left Manchester Central by the 4.50 train. On arrival at a station (Harbro'), we were stopped by means of the vacuum continuous brake. I was in the last vehicle but one of the train. I had just been reading the ENGLISH MECHANIC on the subject of "Jerks in Trains," and as our train came to rest at Harbro' I felt a most alarming jerk. A gentleman in the carriage remarked: "That is enough to break any coupling!" After proceeding up the Harbro' incline, the train came to a stop, and we found that the jerk just mentioned had fulfilled the gentleman's prophecy, for lo and behold, the screw-coupling was broken, and our rear part of the train was pulled by what they call the "safety hook" only! It is a great mercy that our train did not run back down the incline and smash into a goods train that was following. The Midland Company seems very unfortunate in its continuous brakes. When going to Bradford in June last, about the 27th or 28th, my train ran into the Bradford buffer-stops; fortunately I was only slightly shaken. Last week in travelling from Ampthill to Hendon, the compressed water-brake (Clarke's, I think), would not work at Harlington; it was frozen.—J. JACKSON.

[48970.]—**Watch Repairs.**—After you have the turns you want a few gravers, flat and diamond shape; two or three screw ferrules; whalebone bow, with a nice fine horsehair fitted to it; and make one of your centres like drawing. Have a small hole at A, and your other centre must have holes all the way round edge like—and as near edge as possible, so that you can put pinion in turns. After having put on your ferrule and bow, put your rest to the front, and use a diamond-shape graver; then turn up your pinion same size as old one; leave a nice shoulder for escape wheel, and you will succeed. You will never drill a straight hole in a pinion with drill revolving round. You must hold drill firm in centre of turns, and fasten one of your ferrules on pinion, and turn your pinion round instead of drill, and you cannot fail to drill it straight if you have it in the centre to begin with.—HAMLET.



[48970.]—**Watch Repairs.**—Although you may do pivoting tolerably well in the "turns," you will not succeed so well as you would if you had a "Jacot" tool; that is by far the best tool for pivoting. At the same time, these tools are not used for fitting new pivots to old pinions. A specially adapted tool has to be used for the purpose. It is a much smaller tool than either of the others. It has a hollow poppet on one side, and on the other a poppet truly centred to a point at one end, and a small hole, also truly centred, at the other. The hollow poppet has a coned hole, into which the shoulder of the broken pinion is inserted, a screw ferrule having been attached to the pinion. The other end of the pinion—the pivoted end—runs in the little hole in the solid poppet. The drill passes through the hollow poppet, and finds its own centre in the pinion to be drilled. The pinion is revolved lightly with a horse-hair bow; both extremities of the pinion should be kept oiled during the operation. After the hole has been sufficiently drilled, clean it out thoroughly with a peg, and insert the prepared wire to form the new pivot. It should require just a little force to send it home in the hole, and if this is properly done nothing further is needed to keep it perfectly secure. If you are fitting a pivot to a verge escape wheel, at the wheel end, the wheel must be removed from the pinion unless you can finish the new pivot before inserting it. With other wheels such a proceeding is not necessary, as all finish can be imparted without fear of injury to the teeth. In finishing off the pivots, either the turns, with a flat-ended poppet, or the "Jacot" tool with the usual slotted and numbered poppet can be used. The only tools required—unless you go in for actual turning with bow and graver—are one or two files of different finenesses, and a bell-metal or steel polisher. A very light hand is requisite at all times, or the pivot may "come off" as apprentices say. If a pinion is so hard as to defy the entrance of a drill, it must be softened. This, however, causes discolouration. To remove this, a little polishing powder mixed with oil and applied with a flat-pointed peg, is all that is needed. Spirits of salts will remove it instantly if applied while the metal is hot, but an after-cleaning by dipping in benzine or spirits of wine is necessary to remove all traces of the acid, or rust will follow.—ALFOJOE.

[48973.]—**Flow of Water.**—To give the flow of water per hour, the following formula (Hawksley's) is a good one. $G = \sqrt{\frac{(15 \times D)^5 \times H}{L}}$ in which G = gallons per hour, D = diameter in inches, H = head in feet, L = length in yards.

For 2in. $G = \sqrt{\frac{15 \times 2^5 \times 60}{450}}$

$$\begin{array}{rcr} \text{Log. } 30 & = & 1{\cdot}477121 \\ & & 5 \\ \hline & & 7{\cdot}385605 \\ \text{Log. } 60 & = & 1{\cdot}778151 \\ \hline & & 9{\cdot}163756 \\ -\text{ Log. } 450 & = & \overline{2}{\cdot}653213 \\ \hline & & 2)6{\cdot}510543 \\ \hline \text{Log. } 1800 & = & 3{\cdot}255271 \end{array}$$

Delivery per hour, 1,800 gallons.

For 5in. $G = \sqrt{\frac{15 \times 5^5 \times 60}{450}}$

$$\begin{array}{rcr} \text{Log. } 75 & = & 1{\cdot}875061 \\ & & 5 \\ \hline & & 9{\cdot}375305 \\ \text{Log. } 60 & = & 1{\cdot}778151 \\ \hline & & 11{\cdot}153456 \\ -\text{ Log. } 450 & = & 2{\cdot}653213 \\ \hline & & 2)8{\cdot}500243 \\ \hline \text{Log. } 17{,}787 & = & 4{\cdot}250121 \end{array}$$

Delivery per hour, 17,787 gallons.
—T. ROBERTS.

[48977.]—**Concrete.**—To make good concrete, one part White's best Portland cement, four parts good sharp gravel to pass a 2in. mesh sieve, one part clean sharp river sand, thoroughly incorporated; add just sufficient water to damp the cement. The finishing-coat should be put on before the other has got set, and may be composed of equal proportions of cement and sand as above. Price for labour, about 4d. per yard.—J. T.

[48977.]—**Concrete.**—Sand and gravel will do if there is no small bits of coal through it, as the coal dissolves in the cement, leaves holes, and is very unsightly when finished. Proportions: two parts of gravel to one of cement, 2in. thick. Portland cement is the best. As I do not know the price of labour where you wish to concrete the floor, I am unable to give you the cost of same; but a good tradesman will lay down about 40 square yards per day of a floor such as you describe.—AULD REEKIE.

[48977.]—**Concrete.**—"Lano's" question is rather obscure. Does he wish to form merely a rough concrete floor, or does he require a floor with a good hard cement surface? The one is quite distinct from the other, although the term "concrete floor" is frequently applied to both. To form a concrete floor the river sand is unnecessary. Portland cement is undoubtedly the best for the purpose, and should be well mixed in the proportion of one part of cement to five parts gravel, in not greater quantities than six bushels at a time, and should be spread at the end of each mix, and to a thickness of not less than 6in. If a finished "cement floor" is wanted, then, after the concrete is thoroughly set, there should be a coat of plaster applied over the whole area 1½in. thick. Here the river sand is an excellent material in forming the plaster, which should be prepared to a stiffish consistency, in the proportion of 1 of cement to 3 of sand. This coat should have its surface left tolerably rough, to give a good grip to the final coat, which should be composed of cement and sand mixed in equal quantities, laid to a thickness of about ¾in., and be well trowelled to a smooth face. "Pit sand" is much to be preferred for this last coat, as it is not so sharp as river sand; but in either case the sand should be thoroughly washed before using. When this has quite set, it forms one of the hardest and finest cement floors that can be obtained. If such floors are laid out-doors, care should be taken to lay to proper levels, in order to facilitate drainage. I estimate the cost of a floor 50ft. by 20ft.:—Concrete as described above; labour only, in mixing and laying, £2 10s.; plaster work, do., do. (2 coats), £4.—ARCHITECT.

[48981.]—**Tempering Dies.**—Heat them in a clear fire to a clear red, then put them in linseed-oil, or grease of any kind. If too hard, not so hot; if too soft, a little hotter.—J. C.

[48981.]—**Tempering Dies.**—They may have cracked from two causes. If dipped too hot they will fly, or it may be the steel. I have often found file steel crack in anything stout. This is from the file cuts starting a crack in quenching, they never crack in tempering. Dip at as low a heat as possible, and use Stubb's steel.—TOM.

[48988.]—**Coils.**—The primary should be of No. 16, and the secondary of No. 36, both silk-covered. Fergusson's plan, of winding with one, and only one, disc in the centre, is by far the best.—H. B. T. S.

[48988.]—**Coils.**—The above not having been answered, perhaps the following may be useful:—A coil made by myself gives good inch spark. Primary, from 1lb. to 1½lb. No. 16 silk-covered wire; secondary, about 12oz. No. 40. Two layers of paper between each row of secondary. Secondary wound in two parts, and then slipped over primary, with an ebonite partition ½in. each way larger than coils. The supports should be 3½in. by 4in., so as to keep the coil above the base 1in. Primary, 7½in. long. The secondaries 3in. each, with a paraffined paper a full ¼in. beyond the wire each end, and when finished the spaces carefully filled with hot paraffin; 50 sheets of tinfoil 5 by 7 in condenser. It is absolutely essential that every Ruhmkorff be worked with sufficient battery; 1¼in. will not be got out of two pint Groves, though probably six would produce it with the above coil. Nothing but a powerful rapid current will produce a long spark from any coil.—W. G. T.

[48993.]—**Yellow and Red Timber.**—As "Devoniensis" supposes, yellow deals are often called by timber merchants "red deals," and then, of course, they are the same in price; but, strictly speaking, the term yellow pine should only be applied to the wood of the "Pinus strobus." The tree may be distinguished by the leaves being in tufts of fives; the wood is of a pale straw-colour. As an example of its use I will mention drawing-boards. The price varies from 2s. to 4s. per deal, according to quality. Red pine—"Pinus resinosa." The bark of this tree is of a red colour; the long leaves are in pairs. The wood is whitish, tinged with yellow. Being imported from Canada, it is dearer than the European sort, by, at least, the cost of freightage. It is mostly used for mast-making. The price per cubic foot is from 1s. 6d. to 2s. Dantzic or Memel fir—"Pinus sylvestris"—is often called red pine. It is whitish in colour, tinged slightly with red. This is the wood which is so largely used for building purposes. The price is about 1s. 2d. to 2s. per deal.—SHIPWRIGHT.

[48996.]—**Hydraulic Problem.**—The water would fall 7¾in. in one tank, and rise as much in the other, in 3¼ minutes, or 195 seconds, and if each tank is 10ft. diameter, 50·72 cubic feet of water would pass from one to the other in that time, being at the mean rate of ·26 cubic feet per second. It is shown in every treatise on hydraulics that the time required for a head of water to run down to zero is twice as long as that in which the same quantity would be discharged if the head were maintained at its full height. In this case it is found by experiment that the mean discharge is ·26 cubic feet per second; the maximum, therefore, would be ·52, or 31·2 cubic feet per minute.—C. SLAGG.

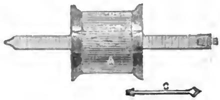
[48996.]—**Hydraulic Problem.**—Supposing the two tanks to be close together, so that the connecting pipe is very short, the simplest formula to use will be $Q = AC\sqrt{H}$ (see Hurst's handbook). A is the area of orifice in feet, H depth of water from surface to centre of orifice in feet, Q quantity discharged in cubic feet per second. In the present case, the orifice is "drowned," so H will be the difference of level between the two tanks. C is a constant, which, for very short pipes, is found to be 6. A is the unknown quantity we wish to find; the water in both tanks coming to the same level in 3¼ minutes, the difference of level when the communication is opened being 15½in., or 1·3ft. As $AC\sqrt{H}$ cubic feet is the quantity discharged in a second, 60 times that amount will be discharged in a minute, and $1 / (60\,AC\sqrt{H})$ will represent the time in minutes it takes to discharge one cubic foot for any given value of H. Call the surface area of each of the tanks S (both being the same). I will first solve the problem by the integral calculus, and then show how it may be done approximately by algebra and arithmetic. It is obvious that as H varies, the flow of water will vary; also that as the height of water in one tank is lowered, that in the other will be raised. If, therefore, we measure the height of the water from the line where the water in both tanks will be level, and call this height x, then $2x = H$, which is difference of level for any value of x or H. This value of H is to be substituted in the above expression, which gives $1 / (60\,AC\sqrt{2x})$ as the time taken to discharge one cubic foot for any given height of x. Now, if we suppose the water in the tank to be divided into very thin layers, each so thin as to be a very small fraction of the height of x, and call this $\triangle x$, the quantity of water in this thin layer will be $S \cdot \triangle x$ cubic feet; if this is multiplied by the time it takes to discharge 1 cub. foot, then $(S\triangle x) / (60\,AC\sqrt{2x})$ represents the time taken to discharge the water in this thin layer. If, then, we calulate the time required to discharge all these thin layers, while x varies from 0 to ·65 (which is half the original difference of level in feet), we will obtain an expression for the time that it takes for all the layers to discharge until both tanks are level; this time, we are told, was observed to be 3·25 minutes; the sum of all the layers between the above limits is represented by—

$$\int_{0}^{\cdot 65} \frac{S \cdot dx}{60\,AC\sqrt{2x}}$$

which is to be equated to 3·25; the integral of $(dx) / (\sqrt{2x})$ is $\sqrt{2x}$, and substituting values for S and C we get $78{\cdot}5\sqrt{2x} / (60 \times 6 \times A) = 3{\cdot}25$. As this sum is taken between the limits of 0 and ·65, we must substitute ·65 for x in the above, and after taking square root and multiplying, we will find A = ·075 square feet, or 11 square inches. If we wish to make the calculation without the aid of the calculus, we may suppose the water to be divided into layers of, say, an inch thick, or $\frac{1}{12}$th of a foot. In the above expression with the sign of integration before it, remove that sign, and instead of dx put $\frac{1}{12}$; there will be 7¾ layers (or, say 8), to pass through the orifice before the tanks are level, the height (or x) to middle of first layer is ½in., the next value of x will be 1½in., next 2½, and so on, but these must be divided by 12 to bring them to feet; add together the eight results found from the expression, and equate to 3·25, and the value of A may thus be found approximately. The answers to the other questions in the query will easily be found from the above.—M.I.C.E.

[48997.]—**Marmalade.**—The machine in general use for cutting up peel for marmalade consists of gun-metal turned plates with at least eight steel knives fixed on same, similar to a spoke-shave knife, but fastened to the plate by screws. The plates are generally about 12in. in diameter and ⅜in. thick, keyed on 2in. wrought-iron spindles, running in long bearings 6in. long, sunk in the spindle, and driven by pulleys and belting; the velocity about 800 revolutions per minute. The plates are inclosed in a cast-iron case lined with wood, with an aperture in the front on the cutting side 4½in. square, to which is fixed a wooden box and plug, 3½in. square, 10in. long. The peel being put into the box is pressed against the plates with the plug. The peel can be cut to any thickness by adjusting the knives above the surface of the plates.—JAMES GORMAN.

[48998.]—**Drills.**—In answer to "Derfla Selim" on the above, I send a small sketch of a fiddle drill



I have used for all kinds of small holes, from $\frac{1}{32}$in. to ¼in., and have always found it to act perfectly. A is a piece of square steel, turned down at each end and coned at the end B; and he can make any quantity of drills C to fit B, which can be taken out with ease, and will not occupy a deal of room altogether, thus saving steel and other room which he requires.—FITTER.

[48998.]—**Drills.**—I should provide myself with a stock of the "universal" kind, and make all the drills to fit it, if I were you. They are made at their ends somewhat like the well-known brace-and-bits. I have one in which drills, chamfers, countersinks, reamers, &c., all alike fit, and are attached and detached in a moment. I gave illustrations of some of them in my article upon drills, &c. Although I am perfectly familiar with tools exactly like "Cohen's," I have not used a tool actually his. I cannot conceive how you find a difficulty in using a tool of that kind, if you are provided with suitable drills and a vice, as, of course, you must be, being a cutler. The work of necessity has to be held against the drill, which is immovable, excepting in the matter of revolving. A catgut bow is the driving medium.—ALFOJOE.

[49001.]—**Clock-Chain.**—Take a piece of string, and wind it round the fusee till you cannot wind on any more; then leave about 3in. over; cut it off and send for your chain.—HAMLET.

[49001.]—**Clock-Chain.**—Get some wire and make a few links the size required that will work in the ratchet-wheel of the clock; then you will have the pattern to purchase by.—J. C.

[49001.]—**Clock-Chain.**—I do not think anyone can tell you how to arrive at a knowledge of the exact size of chain required for the pulley-wheel of one of the old English clocks without actual trial. The wheel has either pins set at equal distances, or has hollows in it to accommodate the links. The chain should drop freely into those receptacles or over the pins; each alternate link taking a hold on one of the pins or resting in the hollows. The chain you complain of must have been the wrong size, and so not free on and off the wheel.—ALFOJOE.

[49001.]—**Clock.**—I don't see how it should be very difficult to make that cord right. In fact, there are lots of ways to alter that; try a smaller cord. Is the cord off pulley at the top? Tack a piece of wood on the frame where you fasten the dial, so that the cord can't get too far over, and you will see that it will force it the other way.—HAMLET.

[49002.]—**Clock.**—The drum of the American should have flanges at each end to keep the cord from over-running. Possibly a differently-sized cord would remedy the error. In some clocks a small pulley-wheel is fitted in the clock-frame, which supports the movement and seat-board. This checks the cord, and acts as a guide to the over-coil. Your arrangement with a wire is frequently adopted, but it invariably chafes the cord. Can you not alter the flange at the side the cord over-runs? Three or four small pieces of wire soldered at the side would prevent it going over. They need only be just a little higher than the flange. When once the cord is on the "return," all's well.—ALFOJOE.

[49009.]—**Softening Steel.**—Heat it in a wood fire to a clear red; let it get cold without covering it up.—J. C.

[49010.]—**Hardening Plaster Casts.**—If "Alfonso" would say what kind of moulds he uses, and what he oils his moulds with, I might be able to assist him. There is a mixture used for gelatine that has the effect complained of.—AULD REEKIE.

[49010.]—**Hardening Plaster Casts.**—I think you will succeed in doing this if you dissolve some isinglass and mix it with the plaster before you run it into the moulds. I frequently have occasion to use plaster, and always succeed in getting a marble-like hardness by the addition of mucilage of one kind or another, according to the work in hand. Alum, too, has the property of hardening plaster.—ALFOJOE.

[49014.]—**Telephone Signals.**—I should think that (to use a school-boy expression) they are "stuffing you up." The noise is produced by the wind passing amongst the wires.—SEAWEED.

[49014.]—**Telephone Signals.**—The sound is merely due to the vibration of the wire: it exists with all telegraph-wires, and has nothing to do with any passing electrical currents. Suggestions for reducing the annoyances have several times been given in back numbers.—H. B. T. S.

[49014.]—**Telephone Signals.**—Surely, some one has been hoaxing "F. G.," and the humming he hears is merely the Æolian harp effect produced by the wind passing over a number of strained wires.—B. H.

[49015.]—**Engine Side-Rods.**—While a locomotive is travelling the connecting-rods never stop; when at the dead points the rod travels forward with same speed as engine; when the rod is furthest from the ground, much faster than engine; when near the ground, much slower, according to the length of crank radius as to wheel radius, and when, in neglect of the laws of momentum, a mass of iron is attached too near the periphery of wheel to carry crank over dead points, a fractured mass of iron over 3cwt. has been hurled into the air with a speed double that of the express train, and with fatal results.—W. H. PHILLIPS.

[49019.]—**Scented Soap.**—To Mr. RICHMOND.—The colouring for rose soap is finely sifted vermilion, or cinnabar; brown Windsor is coloured with burnt sugar; honey-soap, as generally sold, Piesse says, is simply fine yellow-soap, perfumed with oil of citronella; for almond-soap, essential oil of bitter-almonds is used; glycerine-soap is a mixture of ordinary soap and glycerine, perfumed with essential oils.—W. HENLEY RICHMOND.

[49019.]—**Scented Soap.**—The colouring matter sometimes used in rose soap is finely-sifted vermilion, sufficient to give desired tint. Brown Windsor is coloured with burnt sugar or umber. According to Piesse, the honey soap usually sold consists of fine yellow soap perfumed with oil of citronella. Almond soap is sometimes made with the essential oil of bitter almonds, in which case it requires no other scent or colouring; and glycerine soap consists principally of white curd soap and contains little or no scent.—J. W. BOND.

[49028.]—**Intrinsic Equation.**—If a be the width of the square, and the line joining the dog and its master, at the beginning of the chase the axis of x, the conditions lead to the differential equation $2(a - x)(d^2y/dx^2) = \sqrt{1 + (dy/dx)^2}$ and the solution of this gives the algebraical equation $2a - 3y = (2a + x)\sqrt{1 - x/a}$ or its equivalent $12a^2y - 9ay^2 = x^3 + 3ax^2$ as the locus required.—M.

[49028.]—**Intrinsic Equation**—This is a particular case of the curve of pursuit, on which see pp. 251-253, Boole's "Differential Equations," or pp. 22-26, Taite and Steele's "Dynamics of a Particle." Putting $e = \frac{1}{2}$ in the result of p. 25 of the latter treatise, we find for the equation of the curve required:—

$$2\left(x - \frac{2a}{3}\right) = \frac{2}{3}\cdot\frac{y^{\frac{3}{2}}}{a^{\frac{1}{2}}} - 2a^{\frac{1}{2}}y^{\frac{1}{2}}$$

The path of the man is taken for axis of x, and the perpendicular on it from the initial position of the dog as axis of y, and a is the breadth of the square.—J. H. M. JACOBY.

[49033.]—**Electro-motor.**—The motors used on the Portrush electric railway are, I believe, the Siemens form, but they are possibly modified from those used in Berlin. If, however, you wish to make a model, you should look in back volumes for a description of the Siemens armature, and then get a look at one of his dynamos. I believe, though, that some of the advertisers in this paper are making suitable machines. Pint bichromates are useless for the purpose of driving a dynamo for an hour at a time. If the bichromate cell is used at all, it must have plates as large as can be conveniently used. Those used with the little Griscom motor are half-gallon size.—NUN. DOR.

[49034.]—**Electrophorus.**—"Electro" should mix a little beeswax (say one-eighth) with his resin to toughen it, and let the tin be warm when the composition is poured in.—B. H.

[49034.]—**Electrophorus.**—Perhaps "Electro's" non-success arises from his not having sufficiently mixed the ingredients. If he will melt and well mix equal parts of black rosin and Venice turpentine, and then add an equal part of shellac, and, before pouring in the mixture, heat the metal-dish, there should be no cracks in the cake when cooled.—LIGURIAN.

[49034.]—**Electrophorus.**—J. H. Pepper gives the following instructions to make an electrophorus:—"A circular tin, with a rim ⅜in. deep, may be provided, about 1ft. in diameter, and into this, whilst warm, should be poured a mixture of two parts of shellac and one part of Venice turpentine, after they are carefully melted and well incorporated together." You will find a piece of vulcanite an admirable exciting-plate, especially if coated on the underside with tinfoil. When our plate of resin cracks, we simply remelt it on a stove in the tin containing the resin, without the slightest trouble.—TANK.

[49034.]—**Electrophorus.**—You say you added shellac and Venice turpentine with "improved results." Suppose you try equal parts of beeswax and Venice turpentine melted gradually in an earthenware pipkin, and then add gradually about ten times the quantity of shellac, taking care to stir all the time. Don't pour into the tin mould, but turn the latter bottom upwards, and gum a paper rim round it. Pour the resinous matter into that, and then you will have a cake that won't crack, and with a flat face to place uppermost. If you pour into the mould it is almost sure to crack. Mr. Sprague gives resin 8, shellac 1, and Venice turpentine or wax 1, and he also says that sulphur will do. I would suggest that you try a cake of cheap sealing-wax.—NUN. DOR.

[49035.]—**Colouring Toilet Soap.**—See my reply to query 49019.—J. W. BOND.

[49035.]—**Colouring Toilet Soap.**—Here is a simple way for colouring your soap: Cut common soap into thin shreds, and put them into a copper vessel. After melting, add the perfume and colouring matter, and then cast the mixture into moulds.—W. HENLEY RICHMOND.

[49036.]—**Reflector or Refractor.**—There is one thing, I think, generally lost sight of by the advocates of refractors—that is, in unsteady air the increased disturbance is due to the larger aperture of reflector, and not to the fact of its being a reflector. I have used refractors up to five-inch aperture, and, as a rule, I have found that I had only to reduce the aperture of the former (reflector) to the same diameter as I could get good discs with the latter in same air, and results were as nearly the same as possible, and that without having to wait for tube to cool, &c. As to ease of position, I think the former has the advantage; for if an equatoreal and the tube does not rotate, a diagonal in the worst positions soon makes matters equal on that head. As regards last part of query, I think if "R. K. P." saw (which he is welcome to do if near) Jupiter or Saturn with my Calver, his verdict would be that he saw him not "as through a glass darkly," but as he is; the silver film being two years old notwithstanding. I beg to thank "F.R.A.S." for his correction re Cassini's division.—J. HILDERSLEY, 76, Fortess-road, N.W.

[49037.]—**Kaleidoscope.**—A 6in. aperture is rather an out of the way size for a kaleidoscope, and the effect of such would not be so good as if it were smaller. The larger the aperture the greater should be the length. With a 6in. aperture a length of 2ft. would not be too much. A 3in. aperture is quite large enough for a length of 12in. For my own part, I prefer a straight tube, of the same circumference at each end. I have made several kaleidoscopes of various sizes, and have always found that the smaller ones produce by far the best effect.—G. FRYER.

[49038.]—**Tinpot Battery.**—In the first place, I must protest against this useful contrivance going down to posterity as the "Tinpot Battery." Why not call it "Bennett's Battery"? That is the only way the inventor is ever likely to be repaid, and very poor pay it is. I find it best to cut up the tin plate, and put it inside an earthenware pot, or jar, as the meat-tins soon leak, one wire soldered to it, and another to the zinc. I use caustic soda, which I make myself, as I have previously described. I made about a gallon of strong solution for about 6d.; but I would prefer to buy the caustic soda, if I knew where to get it in small quantities. The porous cell is filled with solution, and as much poured on the iron scrap as will wet it thoroughly. I have just coppered the ends of six carbon plates with one cell. I merely added a little more solution to the battery, as it appeared to dry up. A zinc plate or rod, which has been used and allowed to dry without scrubbing, is no use. I dip them in sulphuric acid-and-water each time before using. I don't think it is so suitable for bells.—OS.

[49038.]—**Tinpot Battery.**—Some months ago I made six of these cells. I took the greatest possible care with them, and sealed the porous pots air-tight with paraffin-wax, after filling them with caustic soda. All I got to repay my trouble was a current about equal to a Bunsen's. After a week of occasional use the current entirely failed. I put them by for a short time, and then found the tops of all the porous pots were disintegrated. "Labor Omnia Vincit" has done all right, except in using caustic potash instead of caustic soda.—SEAWEED.

[49039.]—**Incombustible Paper.**—Soak the paper in strong solution of alum water: this will render it fireproof. The latter part of this query is too indefinite to admit of a useful reply.—G. FRYER.

[49041.]—**Dent's Electrical Contact.**—The contacts are made of platinum. The springs are very light, similar to detent springs of marine chronometer. I have not the "E. M." index by me, therefore cannot refer you to the number and page where the drawing and description may be found. If my memory serves me aright, there was an important point omitted in this description—viz., the jewelled pin in the 'scape-wheel pauses on the completion of the 60th second, at a point past the line of centres on the semicircular piece at the bottom of the lower-contact spring. This effectually prevents any retardation of the 'scape-wheel at the beginning of the next second, but rather aids it to escape. I have not tried mercury and creosote. My experience with regard to the magnetic attraction, instead of gravity, driving the clocks, is entirely at variance with yours.—EDWARD M. NELSON.

[49041.]—**Electric Clocks.**—I use platinum contents, arranged so as to give a slight rubbing motion. The pin on the wheel is round, with one side filed away, so as to let the contact spring fall clear. Thus the pin is nearly in the shape of the capital letter D. I drive the dials by the recoil of the armature-spring. The upper part of the click, or detent, which is attached to the armature, is sloped at an angle of about 45°, and a set-screw placed at right-angles to this slope, so that when the wheel has been drawn one tooth forward, the sloped piece of the click, or detent, is against the set-screw, and the click, or detent, cannot rise to allow a tooth to pass it; but when the next stroke is made, the sloped piece of the click is put away from the set-screw, and the click can then rise over the tooth. This locking is absolutely secure, and one of a similar nature has long been in use in one of the step-by-step telegraphs. My gravity-arm electric pendulum, which is unaffected by variations in the current, continues to work well.—H. B. T. S.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, Ploni Almoni has replied to 48082, 48136; Progress, 48429.

48392. Polariscope Slides, p. 192.
48398. Parker-Smith Brake, 193.
48404. Safety Matches, 193.
48409. Telescope Driving Clock, 194.
48412. Gunter's Quadrant, 194.
48413. Ornamental Slide-rest, 194.
48415. Steam-Cock, 194.
48416. Brush Electric Lamp, 194.
48428. Arithmetical Progression, 194.
48432. Electric Railways, 194.
48439. Foundry Practice, 194.
48440. Crucible Steel, 194.

48655. Model Locomotive Coupling-rods, p. 281.
48656. Model Axle-boxes, 281.
48658. Printing on Bone, 282.
48661. The Laws of Moving Bodies, 282.
48665. Jams and Pickles, 282.
48669. Methyl and Ethyl Cacodyl, 282.
48673. French Locomotives, 282.
48677. Sharpening Gimlets, 282.
48680. Horizontal Slot Drilling Machine, 282.
48686. Saddles, 282.
48702. Model Loom, 283.
48707. Glass Colouring, 283.
48708. Wood Turning and Bobbin Making, 283.
48714. Hydraulics, 283.
48717. Screw Presses, 283.

QUERIES.

[49043.]—**Problem.**—Will anyone of "ours" oblige me by an answer to the following proposition, I having sought in vain for one in mathematical books? The proposition is as follows:—

$$\frac{1}{\text{hyp. log. } 10} = \frac{1}{2\cdot302585092994 +} = \cdot4342944819 + =$$

the modulus of the common logs., or logs. to the base 10.—If I take any number of decimals of the divisor 2·302 +, after a certain figure in the quotient ·43129 +, the remaining figures of the quotient are incorrect, the number of correct figures depending on the number of decimals taken in the divisor. I want to find some means whereby each succeeding figure in the quotient shall be correct, however far it be continued. The operation in common arithmetic, or a reference to any book in which I can see the work already done, would greatly oblige—W. COURTER.

[49044.]—**Extracting Paraffin Oil from Floor.**—Can paraffin oil be extracted from a floor? If so, how? The oil has been accidentally spilled.—J. D. L.

[49045.]—**Electric Clock.**—Would Edward M. Nelson kindly give a drawing of his electric-clock motion, and size of magnet and armature, with size and quantity of wire on magnets?—W. D.

[49046.]—**Rewiring Grand Piano.**—W. H. Davies said I should have measured between the bridges. I now send the length of the shortest and longest—3in. treble, 5ft. 7½in. bass. If you will please to insert the lengths, you will greatly oblige—F. STALFOX.

[49047.]—**Solder for Iron and Brass.**—Would any correspondent inform me of a solder which would unite iron and brass? Pewter solder is not strong enough for my purpose. I have tried what is called hard silver solder; but find that it scales off the iron. I used borax. Perhaps I ought to have used some other flux.—G. GREENWOOD.

[49048.]—**Legal.**—A husband and the two trustees appointed (on a woman's behalf) in a deed of separation are all dead, leaving the widow, a son, and a daughter—both of age. It was stipulated in the deed that some property (mortgaged to half its value) should, at the woman's death, be sold and equally divided between the children. (1) Is it necessary, and whose duty is it, to appoint fresh trustees? Or (2) could the children, with their mother's consent (now, or at her death), act as they please with the property? (3) In the event of no trustee being appointed, who has absolute power over the property?—RAMPART.

[49049.]—**Burnt Sugar.**—Can you give me a receipt for burnt sugar to colour spirit of the strength of 40 over proof, without making the spirit opaque? Ordinary burnt sugar will colour spirit up to 15 or 20 over proof, and the spirit be perfectly bright; but the same colouring used for spirit over that strength makes it cloudy; arising, I believe, from the stronger spirit not dissolving the burnt sugar.—J. M. S.

[49050.]—**Pumps.**—In the construction of a direct double-acting pump, should the chamber be larger than the suction-pipe, or in what proportion should they be to one another?—ENGINEMAN.

[49051.]—**Permanent Magnets: Horseshoe, Flat and Round Bar Shapes.**—In making the above, what is the proper name of the steel used? Will Bessemer steel (which can be got for 2ts. per cwt.) answer, or is it necessary to use similar steel to that required for turning tools for making taps and dies, &c., which costs from ninepence per lb. and upwards?—GRAEB ADMI.

[49052.]—**Brashear Silvering Process.**—Would Mr. Wassell be good enough to give all the proportions of the ingredients he now uses in the Brashear silvering process? Mr. Edward T. Scott would find that if he had a small part of the shoulder of his object-glass made conical to fit a hollow cone in the end of his microscope tube, they would be well centred in spite of inaccuracy of screw.—ROBT. E. CRICKETT.

[49053.]—**Oil-Sheet Dressing.**—I have tried the best boiled oil, and put litharge in it, with vegetable black, and it dries; but in a few days it turns quite greasy, and it does not wear well. Can I put anything in to prevent this? Is terebene a good dryer?—PAX.

[49054.]—**Ross Battery.**—In "ours" of August 4, p. 492, is a description of a new battery, by Mr. Ross, of Camberwell, specially adapted for the electric light, and free from noxious fumes. Has any subscriber to the "E. M." tried it, and if so, will he kindly communicate results? It appears an ingenious adaptation, and I should have thought it would have attracted some attention, or have been advertised by the patentee ere this.—APPRENTICE.

[49055.]—**Alloying and Annealing German Silver.**—Would some of "ours" kindly inform me the right proportions of alloying, and the best way of annealing, German silver, so as to prevent cracking when "pickled" after being made up?—J. P. N.

[49056.]—**Lathe-Head.**—Will some able correspondent tell me how to make a model for a 4in. lathe-head back-gear, with three speed pulley, each speed 1¼in. wide, and with a division plate on? If you could supply me with a sketch drawn to scale, I should feel obliged. It is intended for a screw-cutting lathe. Will you also say what the distance should be between the head end and the gap?—J. W. D. NICHOLSON.

[49057.]—**To Mr. Wetherfield—Easement of Air and Eaves.**—I have a large threshing-barn which has been in the possession of my father and me upwards of 70 years. The barn is built on the outside of my ground, and is covered with thatch. The adjoining property was a cottage and garden, between which there was a passage used by my servants as well as by the owner of the cottage and garden. The thatch on my barn was last repaired about 16 years since. The eaves then, as now, project over 2ft. in places, from the foundation of the barn. The then owner made no complaint. There is also a boarded window in the barn about 3ft. wide, opening under the eaves in the threshing-floor, for the purpose of winnowing corn and light when required, put in, no doubt, at the building of the barn. No living person can prove to the contrary, and the owner of the premises, as above, never made objection, but would frequently come and chat with my men through the window whilst they were at work in the barn. About seven years ago the owner of the above premises sold the property. He was then about 80, and was born in the cottage in question. The purchaser of the cottage and garden has recently put up some buildings about 18in. from the foundation of my barn, in one place not more than 17in., whereby the window in the threshing-floor of the barn cannot be opened, and also has given me notice to cut the thatch off the eaves of the barn where projecting more than 18in. Can he legally do these things?—W. H. T.

[49058.]—**Medical.**—To DR. EDMUNDS.—I have a daughter who will be eight years of age on the 28th of January, 1883; she is tall and healthy-looking, but not what you would call stout. She has enjoyed moderate good health until two or three months back, when we noticed a slight twitching of the right arm and leg, which will continue for the part of a day, and then stop—only to begin again. Sometimes it will be a day or two, and even three days. I have taken her to a local doctor, and he recommends cold baths in the morning; but we had to give them up—she nearly went into fits when sponged in the bath. He gives her medicine that contains a large quantity of steel, so he tells me; but she does not improve. If you could recommend any treatment that would be beneficial, I should be glad.—AN ANXIOUS FATHER.

[49059.]—**Electric-Light Machines.**—Will "Sigma" further help me out of a difficulty I find myself in with regard to the wire and bobbins passing over the exciting magnets of magneto-electric light machines? The flat poles of the steel horseshoe inducing magnets are 1in. wide, 9-8in. apart; and I am desirous of coiling as much wire as possible on the bobbins traversing them, but yet so as not to produce disadvantageous induction in the outer helices, by reason of their diameter arriving (in part section) at the S. end of inducing horseshoe magnet before the iron core of same bobbin has left the north pole end; or does no induction of any consequence occur by only a segment of the helices approaching the opposite pole while the mass of wire is being strongly induced by its iron core's passage over the other pole? I am most anxious, before coiling a lot of valuable silk wire on the bobbins, to ascertain if contrary induction can be set up in the outskirts, as it were, of large coils passing over steel horseshoes (on the Alliance machine system), with the N. and S. ends as near together as described, having 4cwt. of steel magnets in the machine, must be my excuse for inducing "Sigma" to again oblige; and I shall be most happy to fully describe the machine and its illuminating power (if any) when completed, by—ELECTRA.

[49060.]—**Vice for Bench.**—I, and doubtless others, would feel greatly obliged by a detailed description, with sketch, being given of the American double-jawed vice, mentioned in your issue of Dec. 15th ult., by R. T. Lewis (see reply 48976)?—PARALLEL.

[49061.]—**L.N.W.R. Engines.**—Could some one inform me who the maker, and what the technical name is of the class like Ida 311? Also, what the size of cyl., and number both of engine and shed of Achilles, Lucifer, North Star, Vampire, and Atlas?—AN ENQUIRER.

[49062.]—**Zinc Tanks—Milk and Ammonia.**—Would any readers of the "E. M." be good enough to give any information in reference to the following?—I use a great deal of butter-milk every week; sometimes it has to remain in the tank (which is of zinc) three and four days. Does the tank injure the milk? (2) Give (as simple as possible) any rules as to how I can tell good ammonia from bad? I use a great deal of it at times, and an inferior quality spoils my work.—EGO ALPHA.

[49063.]—**Gaiffe's Peroxide of Manganese and Leclanche "Agglomerate" Batteries.**—The experience of those readers of the "E. M." having employed these batteries will greatly oblige, as to their respective constancy, durability, amount of work to be obtained before requiring recharging; rest required after, say, half an hour's work with medical coil; if two, each of pint size, would be more constant, and last longer before requiring recharging, than one of quart size?—MEDICAL COIL.

[49064.]—**Legal.**—Will Mr. Wetherfield kindly advise as under?—A. dies, leaving his personal property by will to his wife, and at her death to be equally divided between her two children, B. and C., the wife being sole executrix. Can she will all the property, at her death, to B.?—A. B.

[49065.]—**Legal—Title by Adverse Possession.**—Will Mr. Wetherfield kindly advise in the following case?—A man (A.) 16 years ago took possession of a house, by forcing the padlock off the door, without any warrant or title whatever, the property of an old gentleman (B.). Now B. always allowed his sister (C.) to enjoy the profits, and act as owner of this and adjoining property. For some time he refused to be a party to any law proceedings; but the property becoming more valuable, he consented to bring an action in the County Court: unfortunately, employing a solicitor he knew nothing about (who, afterwards, it appeared, bore a very bad name—his partner getting struck off the rolls), when the case was called, he asked for an adjournment, which the judge refused, as the grounds were insufficient, and told him to go on with his case. He declared he could not, and was non-suited. B. having had to pay defendant's costs, declined to proceed further. A.'s defence was, his mother had bought the house—simply a lie, easily disproved. B. and C. are both dead, and the house has come to a niece (D.). Will Mr. Wetherfield kindly say, Does the fraud of his mother's buying the house invalid his claim? Is the action 10 years ago sufficient interruption to bar 12 years' adverse possession? As the house is, and has been since he had it, used as a brothel, would this be recognised in law as an occupancy? C. had to eject several tenants from adjoining houses for so using them; at last letting them as warehouses at less rent, which they still continue. Would Mr. Wetherfield kindly tell me where I must apply for a copy of a will made and sworn to in Bath in 1861, and how I could ascertain the cost?—VICTIM.

[49066.]—**Envelope-Machine.**—Can anyone give a description of the new envelope-machine (Sturge's patent No. 4799, 1882), which is said to be capable of turning out envelopes creased, folded, gummed, and embossed, in a single action? and oblige—A. M. J.

[49067.]—**Oval Chuck for Wood Turning.**—Will one of our subscribers kindly explain, and give drawing of an oval chuck for wood-turning, which will make an oval 12in. by 20in.?—LATHEMAN.

[49068.]—**Induction Coil.**—To MR. LANCASTER OR "SIGMA."—It is my desire to make an induction coil that will give 1½in. spark, and for which purpose I have got 1lb. No. 16 cotton-covered wire for primary, and 6oz. No. 36 and 6oz. of No. 38 for secondary; the 38 wire is broken in seven parts, and I want to know how to solder and insulate the soldered parts. I am aware that I will not be able to obtain 1½in. spark from the 12oz. of wire; but am willing to buy a pound of 36 or 38. Please say if that will be enough, and say whether it would be more advantageous to get 38 or 36, and whether the 38 or 36 should be wound on primary first? The core which I intend for coil is 8in. long and ⅞in. diam. The coil ends are 5in. in diam., and of bog deal, and are turned on the same principle as Mr. Andrew's. I have been told that paraffined foreign note is the best insulator that I can use; say how many sheets to put between layers of coil?—INDUCTION COIL.

[49069.]—**Model Electric Engine.**—To "R.W."—I have been trying to make an electric engine after your diagram on p. 39, Vol. XXXV., reply 46217, but did not succeed in getting it to work. Please explain it more definitely. You give the connecting-rod as 1in.; and if one end is fastened to the axle of the flywheel, and the other to the beam, as per diagram, how is the wheel to revolve, unless a pitman or a slot in the beam is used? How is the keeper fastened, and to what? Also, how long is the rod holding the contact-breaker, and how fastened? Are the flywheel and beam standards both of the same height? If so, the sketch seems to be improperly drawn. I cannot get the contact-breaker to dip properly, and would like information as to the stroke. My magnets are each 3in. long, of 7-16in. iron, and bobbins 1⅞in. long, containing 4oz. of No. 22 wire. I have three bichromate cells, which I used to test them, and the iron seems to be too hard, since the keeper is attracted after the circuit is broken, although I softened the iron. I trust you will kindly consent to answer my questions, as I am very anxious.—GEO. W. TEA, Pittsburg, Pa.

[49070.]—**Brush Dynamo.**—I have castings for above. Diam of ring, 6in., made for eight segments; model of 16 lighter. Will someone kindly say most suitable gauge of wire to use, and what light I may expect from it with arc lamp?—R. J. R.

[49071.]—**Induction Coils.**—About a year ago our friend, Mr. Lancaster, promised some papers in "ours" which were to contain full and complete instructions for making these machines. Week after week they were said to be just ready; but still they came not, nor have they yet appeared. Having occasionally within the last three or four months seen his name appended to replies, I conclude he has quite got over his unlucky accident last spring; and therefore I should like to know if the idea of giving us these papers has been totally abandoned? If they are coming out like "Dyer," I should be glad to get them. From "Dyer" and back vols. I have made a ½ to 1in. spark coil; but old instructions are so contradictory, that I should much like to have the latest ideas of our experienced friend on the subject, and I don't think I am alone in my wish.—B. H.

[49072.]—**Use of Marine Glue.**—There has been lately some discussion about the making of marine glue; but, so far as I know, nothing was said about the method of using it. This is just what I want to know. Will someone kindly tell me?—ELLEN E. RICHARDS.

[49073.]—**Electric Clock.**—Would some reader of "ours" say if I could make an ordinary eight-day clock go with the earth battery of a few cinders? Thus: I want to make it go without winding, only to use pendulum, 'scape-wheel, and two next ones to carry the hands, all but wheel for weight, and no weight. My clock (as all good old ones will) will tick and move on properly, carry hands without a weight by simply moving pendulum; consequently, a battery of cinders will do that, if it does what has been stated in these pages. Will some one tell me how to proceed?—PROGRESS.

[49074.]—**Stained Glass.**—Would some reader kindly tell me how to do the following?—In purchasing a toy house for my boy, I see the glass for windows are richly stained in some clear colours as the best stained—not a mere daub of paint, but bright colour when looked through, and, of course, they are not pieces of real stained glass, because two and three colours are on a piece; and if I knew what is used, and providing it would stand the sun, I would etch the "Last Supper" on a fanlight, and colour it.—Progress.

[49075.]—**Gas-Engine.**—Can any reader give instructions how to make a gas-engine?—G. Cosham.

[49076.]—**Making Circular Bellows.**—Will any reader tell me what is the construction of a circular forge bellows? I can use almost any tool, and think I could make one if I knew the design, as, how the ribs are arranged and kept in place inside, &c.? What size is necessary to get enough to weld 2in. by 2in. iron? What are the usual proportions, as width to height, length of stroke, rise of top part, &c.?—Tom.

[49077.]—**Pyrometers.**—I should feel obliged if any one would kindly tell me how the above are made? I want to measure from melting-point of tin to bright red-hot iron.—Tom.

[49078.]—**Spontaneous Combustion of Oils.**—Will any correspondent kindly inform me which classes of oil are most and least liable to spontaneous combustion?—J. T. S.

[49079.]—**Oil-Proof Steam Joints.**—Wanted cement for steam joints that will resist the action of oil. I have endeavoured to lubricate the steam before being used in the cylinder of engine, but find that all putty joints get soft directly.—J. T. S.

[49080.]—**Legal.**—To Mr. Wetherfield.—Under the new Woman's Property Act, can a man be compelled to support his wife, she having an adequate private income? Has the husband no control over the wife's property? How does the Act apply to wives living with their husbands?—H. W. B.

[49081.]—**To Poultry Breeders.**—Can anyone give reliable information respecting the selection of eggs, so that the majority of chicks hatched may be pullets?—W. J. M., Brighton.

[49082.]—**Magnesian Cement and Emery.**—What is magnesian cement, and how is it applied to the discs of rice decorticating machines? What size of emery is generally used?—Highlander.

[49083.]—**L. & S.W.R. Goods Engines.**—Will some one kindly give me the numbers of the following, viz.?—Anglia, Scotia, Hibernia, Cambria, Medea, Montrose, Giraffe, Bison, and Stonehenge.—W. P. B.

[49084.]—**Administration.**—To Mr. F. Wetherfield.—When an administrator divides the residue of an estate among those who are entitled to such, and receives a stamped receipt from each recipient, is such receipt sufficient, or ought it to be given on forms procurable from the Revenue office? Is it imperative that a return (balance-sheet) should be made to Somerset-house of all disbursements? Will administrator ultimately get a discharge? There was no will; estate under £100, and seven recipients.—Thos. Miller.

[49085.]—**Starr-Bowkett Society.**—A question has arisen as to whether the balloting for shares in one of these Societies is mathematically correct. Supposing there are 209 members, the system of balloting is to put, say, white balls numbered 1 to 10 for the units, blue balls, 1 to 10 for the tens; and for the hundreds three red balls 0, 1 and 2. The question is, ought not the red balls to be put, say, 1 to 10 (and not 3), similar to the units and tens, so as to make the balloting correct.—S. B. B. S.

[49086.]—**Collimators.**—Can some better-informed correspondent tell me what are the advantages and disadvantages of long and short collimators to spectroscopes? I have observed that in using a short collimator that it is necessary to adjust the slit extremely close; on the other hand, that with a longer collimator, the slit may be comparatively much wider, and yet show the lines quite thin. Now it would appear that since the long collimator offers the advantage of a wide slit, with the accompaniment of a larger quantitity of light (a desideratum in star spectroscopes, where the quantity of light is decidedly limited), that spectroscopes would be constructed with very long collimators to reap this advantage; and particularly that this principle would be applied to star spectroscopes, which are generally constructed with collimators of short length; and also to spectroscopes intended for the observation of solar prominences where the excessive light would suggest the use of a short collimator, and necessarily a narrow slit. I take this opportunity to thank "M.I.C.E." for his beautiful solution of the geometrical query requiring the locus of the focus of a revolving varying ellipse in a cylinder.—W. A. H.

[49087.]—**Equatorial Circles.**—Many thanks to "J. C. L." for his answers about R. A. and Declination Circles. One further question; Having made my circles and verniers, how am I to fix them at any particular hour, and use them as a means of "adjusting my equatorial"? The instructions in books on adjusting equatorials presuppose circles properly placed. How, therefore, am I at any particular moment of time to fix the circles with verniers, showing right declination and R. A. of any celestial object when it is on their being already properly fixed that I am to rely in order to adjust my equatorial, and use it to find the celestial object. Have I made myself intelligible?—Tyro.

[49088.]—**Decoration of Room.**—Will any reader of "ours" kindly give me his advice respecting the decoration of my "den"? I have an oak mantelpiece, tile-stove and hearth fixed, and I propose to supply furniture of oak. What would be the most suitable way to treat the pine woodwork of the room, doors, skirting-board, &c.? Would it not be well to paint it, and if so, in what way? Would two shades of green, say, do, or should it be oak grained? Also what would be the best manner of dealing with the ceiling? What should be the prevailing tint? Lastly, in choosing a carpet for such a room, to what styles am I restricted?—Sartundra.

[49089.]—**Pronunciation of Hebrew.**—Will some reader of the "E. M.," who is a Hebrew scholar, kindly help me in this difficulty?—I have book of Genesis in "English-Hebrew," by Greenfield. He gives the pronunciation of long a (kamets) as "a" in the word all. Wishing to go rather farther into the language, I have just purchased "Arnold's First Hebrew Book." There I find the pronunciation of long a given as "a" in father, besides a few other variations from Greenfield's book. I am at a loss to reconcile these differences, as I imagined there would be an established pronunciation of Hebrew recognised in England. I shall be glad to know what is the usual pronunciation of "kamets," and also some explanation of these differences in pronunciation.—Nun Lamed.

[49090.]—**The Largest Ironworks.**—Where are the largest ironworks in the world? Steel is included, and the question refers to output as well as to number of hands.—W. N.

[49091.]—**Cold Feet.**—To Dr. Edmunds.—I shall feel extremely obliged if you will give me some instructions that may help to relieve me from the distressing complaint of cold feet. A few months back I was attended by a medical man for indigestion and inaction of the liver, and I received benefit from his treatment; but two or three weeks after, discontinuing the use of his medicine, the symptoms returned but were not so severe as before, and now I am troubled with my feet and hands being icy cold, my feet especially, and when I wake in the morning I feel so very tired.—Clerk.

[49092.]—**Constant Battery.**—Will "Sigma," or some other correspondent, versed in electrical matters, kindly inform me which form of battery will, for the longest period, supply in a closed circuit a continuous current that shall be comparatively unvarying? Also, please state E.M.F. of same, and for how many hours, days, or months it will supply current under above conditions without recharging?—Lucnian.

[49093.]—**Making Pencils.**—Can any of your readers tell me how the lead in pencils is formed—whether it is simply done by pressure or mixed with some substance to make it hold together, and can they give me a method of making ground colours into thin sticks, similar to the lead in pencils?—Alpha.

[49094.]—**Bell Telephones.**—I have a duty-paid pair of Bell telephones, but they have single bar magnets (which are not so good as the ones now in use), and the cases are mahogany and very ugly-looking. I wish to know can I get new magnets and new ebonite cases of modern style, and have them numbered, &c., as the present ones, and not render the instrument invalid.—Amateur.

[49095.]—**G.E.R. Locos.**—Nos. 200, 210, and 220. Wanted dia. of wheels, date, and who built by.—Dublin.

[49096.]—**Isle of Wight Locos.**—How many? Also a brief description of these engines.—Dublin.

[49097.]—**Indian, Australian, and New Zealand Mounted Police.**—Will some of your numerous readers give me information respecting any of the above forces—pay, promotion, duties, &c.? I wish to join one of the above, and am not particular which, but do not know how to go about it.—Non. Com.

[49098.]—**Water Tank.**—I built up the end of a shed, forming a recess about 16ft. long, 8ft. broad, and 5ft. deep. This I cemented well inside, and for some years it held an immense quantity of water (for washing, not drinking), but it now leaks, and I would be very glad to know if I can staunch it by any process, such as painting or tarring, &c., over the coating of the cement.—Centurbant.

[49099.]—**Lathe.**—I have a 6in. back-geared lathe with gears ¼in. pitch, but I find it is rather noisy when working. Would 5-16in. be strong enough for metal turning? Also, would a ¾in. or ½in. gut band transmit as much power as a flat belt 1in. wide? I am thinking of altering mine, and would be thankful for information.—Cottonopolis.

[49100.]—**Varicocele.**—Will Dr. Edmunds kindly give a cure for the above? I have been bathing it with cold water, and wearing a suspensory bandage for about three months, but it does not get any better.—Anxious.

[49101.]—**Yacht Building.**—To "J. J. A., Liverpool" or "Vanderdecken."—Will either of these gentlemen help me in this matter? I am desirous of building a small yacht, 25ft. on keel, 8ft. beam, and 7ft. depth, with flat floor and light draught of water, and should be glad to know dimensions of keel, timbers, planking, &c., length over all, and best materials for various parts; also a few particulars as to cabin fittings and deck plan. A little information on this subject (with sketch) will, doubtless, be of interest to other readers of "E. M." as well as to—E.

[49102.]—**Steam Boiler.**—I shall feel obliged if any reader will tell me the safe working pressure of a copper boiler, one 1-16in thick; also one ⅛in. thick. Size of boiler 15in. long, 6in. diameter.—T. J.

[49103.]—**Sun Eyepieces.**—Can any friend tell me which solar is the best for general use—the Dawes, or polarising, and what are the special advantages of each?—W. G. T.

[49104.]—**Brewing Pan.**—I have been putting a rim on the top of a brewing-pan. The rim is 6in. deep, and ½in. thick, and edge way up. I have put it loose on the top, and then put four holdfasts in to hold it in its place; then I got 3cwt. of metal borings and salammoniac; when the pan gets hot with the liquid, the pan expands; then it shifts the metal borings, and then it leaks, and won't hold water for the next brewing. I should be very much obliged if any one could give me any information how to make it stand, or how to put the rim on to make it stand?—S. Thomas, Leeds.

[49105.]—**Artificial Foot.**—Having had the misfortune to lose one of my feet, I should be very glad of a few hints in making an artificial one. On p. 71, Vol. XV., there is a description of how they were made, and it says (No. 3, right-hand bottom corner): "The bearing being taken in the taper . . of thigh." Are there any improvements since that article was written, as I understand the bearing is taken below knee? Is the leather, as shown in Fig. 3, sufficient to bear one standing on it, or is the leather socket inclosed in a wooden casing? Can the steels be bought in London, and the price, and what are the best shape of steels? What kind of rivets are the steel and leather fastened together with? Any other information will be thankfully accepted by—Timber-Toes.

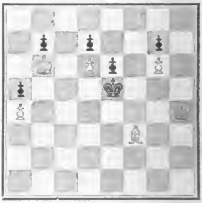
[49106.]—**Motor for Workshop.**—I am about constructing a motor for use in my workshop, and to blow a nine-stop organ in the adjoining room, and I should like the opinion of one or two of ours as to the best form—steam or gas. With regard to the first, I have a ½-h.p. boiler, and have nearly completed the engine; but seeing so many new gas-engines in the market makes one think one might be more suitable, only they make such a noise, and, I am afraid, are rather difficult to make, as the silent ones are so complicated; but against these must be set the facility for starting directly it is wanted, with no boiler or danger from explosion, &c. Our friend, "Sunlight," seems to have become eclipsed with his gas-engine. By the way, how did "Dun Browne" get on with his? I should like to see that engine, if anywhere near London. He will find my address in "Wanted Column."—F. Kimpton.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCXIII.—By W. T. Pierce.

Black.



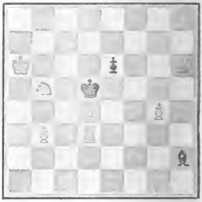
White. [6+6

White to play and mate in four moves.

PROBLEM DCCCXIV.—By D. Mackay.

(From Truth.)

Black.



White. [6+3

White to play and mate in two moves.

SOLUTION TO 809.

White.	*Black.*
1. K to Q B 6	1. Anything
2. Mates	

SOLUTION TO 810.

White.	*Black.*
1. K to K B 6	1. Anything
2. Mates	

Mr. Meyer has also constructed the following two-mover, in which Black threatens 35 checks:—

White: $\frac{K}{K\,5}$ $\frac{R}{K\,R\,3}$ $\frac{B}{K\,R\,7}$ $\frac{Kt}{K\,B\,4}$ $\frac{Ps}{K\,B\,6,\,K\,Kt\,3}$ and

Black: $\frac{K}{K\,R\,4}$ $\frac{Q}{K\,B\,2}$ $\frac{Rs}{Q\,Kt\,7,\,K\,8}$ $\frac{Bs}{K\,5,\,Q\,R\,8}$ $\frac{Kt}{Q\,R\,4,\,K\,B\,3}$ $\frac{Ps}{Q\,2,\,K\,Kt\,2}$

White to play, and mate in two moves.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 809, 810, 811, and 812 by Schmucke; to 809 by W. T. Bayne; to 807 by S. Folwell; to 809 and 811 (but not author's) by J. B., of Boxford.

ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries	Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera	Nos. 475, 480, 894, 897.
Bookbinding	Nos. 613, 627, 770.
Cements	Nos. 377, 729.
Coils, induction	Nos. 613, 620, 636, 640, 779, 797, 832, 885.
Coils, medical	Nos. 844, 868.
Copying processes	Nos. 750, 753, 761, 762.
Electric bells	Nos. 545, 558, 797.
Electric machines	Nos. 368, 380, 628, 750, 840, 846.
Electro-magnets	Nos. 756, 772, 783, 864, 872.
Electro-plating	No. 883.
Lacquers	Nos. 429, 475, 622, 866.
Magneto-electric machine	Nos. 376, 569, 783, 826.
Nickel-plating	No. 808, 811.
Silver-plating	Nos. 830, 868, 869, 870, 871, 874.
Varnishes	321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 3, and unacknowledged elsewhere:—

A. MACNAB.—J. H. Dopping.—W. C. Hughes.—Mottershead and Co.—Rev. Dr. Richards.—Halsey and Co.—Foster and Andrews.—C. Birchall.—Jabez Francis.—Moore and Brown.—G. Calver.—G. A. Ames.—W. T. Hare.—G. Toune.—F. A. Millar.—Capt. Lysaght.—W. McCartan.—J. K. Esdaile.—R. Smith.—L. New.—A. F. Scott.—W. H. Hyde.—G. Binswanger and Co.—Rownson Drew and Co.—R. E. Harrild.—G. Crowsley.—T. Fletcher.—P. Vallance.—C. P. Morgan.—R. Melhuish.—J. Wood.—J. Hagger.—J. Mabson.—Sampson Barnett.—R. Mills.—Leonard von Malein.—Rev. J. H. Cole.—E. R. Dale.—Edu Boulay.—Capt. Keith Gordon.—Dr. J. C. Robertson.—Rev. A. Willan.—R. Martyn.—L. Johnston.—F. Weatherhogg.—G. Weight.—E. E. Braine.—G. P. Johnson.—Lestar.—Blickneus.—Frank Smith.—G. Hullett.—Oovrier.—Young Pattern Maker.—An Anxious Enquirer.—Nunquam non Paratus.—Darkey.—Screw.—S.—Farmer.—John White.—Scotus. Paper Hanger.—Harry Grosvenor.—Roi ne Puis, Souza je Suis.—L. L. L.—Milverton.—J. H. Schucht.—War.

A. B. C. (For one row, see p. 126, No. 525. That has diagram of bellows too. For 2½ rows, see p. 483, last volume.)—E. JOHNSON. (For dulcimer, see pp. 97, 168, present volume.)—G. L. G. (It is a sign of aqueous vapour in the atmosphere, and is generally, we believe, followed by rain.)—J. JACKSON. (The best plan would be to apply to a few of the companies for estimates for lighting. To recommend one system would be invidious. Cannot you manage to see for yourself some of the many installations that are now working? 2. The wire is of too small a gauge for the purpose. See the lectures by Prof. S. P. Thompson, commenced this week.)—GEORGE. (Under the circumstances, he would not reply; but he has already recommended others to apply to the herbalists.)—X.Y. ROSCREA. (Do you mean the mixture of red-lead and oil?)—GEORGE CANHAM. (Not how to make, but descriptions of how made.)—ELECTRIC. (See recent back numbers.)—TOM. (1. There is no rule. Several alloys melt at a lower temperature than tin—for instance, 8 bismuth, 5 lead, 3 tin, melts at 212°Fahr., but the mean of the melting points of the components would be over 500° Fahr. 2. Only by heat. It should be moulded on and vulcanised in position. 3. They are moulded up of soft rubber and blown out.)—ASTEROID. (Full particulars can be obtained of the Secretaries of the respective societies. See p. 510, Vol. XIII.)—E. W. F. (It is indiarubber dissolved in bisulphide of carbon or mineral naphtha. The solution is sold ready prepared.)—PROGRESS. (Apply to some of the large stationers, sending sample. Shall be pleased to have description of machine.)—H. G. WILLIAMS. (A method was given so recently as Nov. 24, p. 281, Moleskins, and the question has been many times answered in back numbers. Corrosive sublimate is not needed. 2. Fill up with a mixture of copal varnish and vegetable black, or with Brunswick black or asphaltum dissolved in turpentine.)—E. G. T. (Yes, camphor does improve it, and you can add as much as the oil will dissolve; but what about expense? It is adopted by those who use mineral oil for magic-lantern lamps. 2. It depends upon the nature of the film. Try soda solution, or a weak acid liquor. 3. Aniline, water, acetic acid, glycerine, sugar, and gum in varying proportions. See p. 378, Vol. XXXIII.)—STRETCHING AND VARNISHING. (Answered so recently as p. 201, last volume.)—AMATEUR. (Gilding picture-mounts answered on pp. 271, 291, last volume.)—CIVITAS. (See p. 94, Vol. XXXIII., and the indices.)—T. C. NORWOOD. (It is probable the patentee himself could not tell you the best proportions. The components are cemented together by means of resin or treacle, and subjected to great pressure. 2. You can use canvas, a thick cylinder of blotting-paper, or a bullock's windpipe. They are simply unglazed clay, baked in the usual way. 3. About equal parts, with enough resin to cement them together. They are compressed by hydraulic machinery.)—X. Y. (See answer to "Touton" last week. The enema is most important.)—ONLY A LEARNER. (You can use oak, paper, or copal varnish. The best would depend on the purpose the wood is to be applied to. Copal is hardest and best wearing, but see that you get it good.)—AMATEUR PAINTER. (Unless wanted in very large quantities, it is always cheapest to buy varnishes. Good oak varnish is made by dissolving clear pale resin in oil of turpentine, in the proportion of 3½lb. to the gallon. Gum anime will do; but if you want a better article use copal. The hard varnish you mention would be made of copal. The other would have oil added. The gum is fused, hot drying oil added, and then boiled until "stringy." It is thinned with turpentine. Different makers have different recipes.)—JOHN R. STEWART. (We have not yet heard of any process of case-hardening iron by electricity. The usual method is to pack the pieces of iron in an iron box, with parings of hoofs and leather, and animal charcoal dust. Put the lot into a fire and make red-hot through. After about two hours turn the pieces out into cold water. There is scarcely a back volume which does not contain information on the subject.)—A COLOUR-MAKER. (Zinc sulphate is the white copperas of the oil-shops, and is made on the large scale by roasting native sulphide or blende until it is converted into sulphate by oxidation. The salt is then washed out and purified by calcination, &c. There is a good deal of it about in laboratories where they use such batteries as employ zinc and sulphuric acid—*e.g.*, Bunsen and Smee.)—T. D. COOK. (Merely showing the invention privately will not hinder you from obtaining a patent; but you had better be careful as to your confidants. We cannot advise with regard to the commercial development of inventions.)—E. R. B. (A good formula for camphor liniment, for sprains, rheumatic pains, &c., is: Camphor, 2½oz.; oil of lavender, 1 fl. dram.; rectified spirit, 17 fl. oz. Dissolve the camphor in the above, and then add 3 fl. oz. of stronger liquor of ammonia, shaking all together till well mixed.)—SOUTH DEVON. (If the facts are as you state, you can demand a half-year's notice, terminating at the time at which your tenant took the house, or, failing that, the rent up to that time.)—WESTWOOD. (A solicitor had better be employed and, *at once*. Land-holding law-makers have not made the path easier than possible for heirs-at-law of small freeholds.)—J. W. C. (The personal property goes to the sister entirely, the freehold to the heir-at-law.)—CONSTANT READER. (It is a singular fact that "Constant Readers" are those who most frequently ask for information we have given over and over again. Yours is a modest request. You want a good paste blacking, a blue-black copying ink, and all kinds of inks in general use. If you will only look through the indices you will find references to these subjects in many volumes.)—MALL-STICK. (There are several works of the kind, the titles of which can be obtained from most booksellers. We believe Lockwood and Co., Stationers' Hall-court, publish one; Brodie and Middleton, Long-acre, publish another. You should procure catalogues.)—YEAST. (Probably the article on p. 461, No. 826, will give you the information required. If not, there are many recipes in back volumes.)—GLASS EMBOSSER. (The acid referred to is hydrofluoric. The method of using it has been described many times, most recently on p. 156, last volume.)—ONE IN DISTRESS. (Skin diseases are so very troublesome and difficult to diagnose, even by an experienced medical man, that it is impossible you can be helped except after personal examination.)—PROXY. (1. "Unhappiness" is not a sufficient reason for divorce. Make the best of your wife—or induce her to make the best of you—much the more difficult matter we expect—and live down unpleasantness. 2. Yes, when once the decree is made absolute. 3. The law does not recognise "agreements to a divorce." You will probably find the Queen's Proctor intervening on your behalf, and that unpleasantly if you contemplate any such method of unshackling yourself. 4. Most probably. 5. In certain cases, and always in a case of judicial separation only.)—STUDIOSUS DESPERATURUS. (Probably diabetes. Consult a medical man.)—HUB. (Try the recipe given under "Domestic Medical Hints" this week.)—KLOFRON. (The phenomenon was noticed at the time; but it was too transient for any one to say certainly what it was. Most probably it was cloud.)—A. (You will have to make application to the Chief Controller of the Money Order Department, and, under certain regulations, will be allowed to see and borrow the original P.O.O.—at least, we were some years ago, for production in a court of justice.)—G. M. (Inflammation is but a result or symptom of some disease. You had better consult a medical man personally, or take your wife to Dr. Edmunds at the Temperance Hospital.)—J. W. (Very likely to be injurious if you are taking the pills on your own responsibility, and without medical advice.)—W. H. (If the bankruptcy or liquidation proceedings fail, the debtor stands in his old position; but a debtor who has made up his mind to swindle his creditors overcomes with the greatest ease all the obstacles you mention by creating a lot of sham creditors, who, of course, outvote the real ones. The present condition of our bankruptcy laws, after all the tinkering they have had in recent years, is about as bad as ever, and yet it would be a hard matter to make a perfect bankruptcy law which, in a mercantile community like ours, should not crush credit or press very heavily on honest but unfortunate debtors.)—G. B. TAYLOR. (Whenever a correspondent who fancies himself born to set all creation right begins to talk "of the errors poor Newton fell into," of "childish and irrational scientists," and the rest of it, we know some more than usually outrageous nonsense is coming, and the letter more speedily than usual finds its way to the w.p.b. Truth and its seekers are ever modest.)—ORION. (The suggestion has been made before, and one attempt was made to carry it into execution, and actually to manufacture high-class appliances at a cheap rate for members. Such efforts could only be generally advantageous, we are of opinion, when made in connection with a strong local society—such as that at Liverpool.)—FRANK. (Write Mr. J. T. Chapman. See advertisement on front page.)—GERALD HARLEY. (For thought-reading, see the indices of Vol. XXXII. for the latest notes on the subject.)—REGINALD HANNAN. (Have you tried loading the bottom end?)—A. NAWARRY. (Indian ink and a sable, or a pencil and ground glass. See a discussion on lantern transparencies in Vols. XXX. and XXXI.. 2. Several recipes in back volumes. Solution of nitrate of silver or bichloride of platinum, or quick the surface with strong nitric acid, and rub on a touch of Indian ink. See p. 409, No. 797.)—P. HILTON. (You will find one with the price in the catalogue of any large optician.)—W. D. H. (No difference, except in the vehicle. 2. Oil best for purpose. 3. The plain gives best results. 4. Yes.)—L. W. D. (It can be done. As deep as you like, and as close as you like. 2. Not quite so well.)—LONDON. (Made of a couple of pieces of zinc bearing on ends only, with tape in between and over them.)—H. P. HITCHCOCK. (All particulars can be obtained of the secretary to the Institute, 8, Copthall-buildings, E.C.)—B. H. (Answered to these initials on p. 369. Boil the tar to expel all water, and thin with turpentine.)—A POOR ASTRONOMER. (See pp. 505, 607, 621, Vol. XXXIV.)—J. W. B. (A series of letters in Nos. 613, 616, 627, 636. There is an article on p. 377, Vol. XXX., which may suit, and many replies in back numbers.)—CAMERA. (See "List of Back Numbers" printed at head of this column first week in each month.)—ONE ALARMED. (If you had specified the nature of the "alarm" required, we might have been able to refer you definitely to a page in a back number. You can have one to merely ring a bell or knock down a dozen tea-trays, or anything else that will make a noise. If a bell will do, see p. 17, No. 885, and the indices of the last four or five volumes.)—MALVERN. (See the lectures by Prof. Thompson, commenced this week.)—A NERVOUS PATIENT. (One in No. 826; others in No. 783, No. 569, No. 376.)

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◆

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◆

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Vertical **Boiler,** 5ft. by 2ft. 6in., with Horizontal Engine combined, 4in. cylinder, only worked a month.—Price £30.—Harger Bros., Settle.

Complete set of **Soldering Tools** and Instructions, free for 15 stamps.—Harger Bros., Settle.

Joiner's **Saw,** webs 12in. and 14in., ½d. per inch, free. Harger Bros., Settle.

One-yard nickel-plated Spring **Measure,** splendidly finished, free for 9 stamps.—Harger Bros., Settle.

Model Locomotive, ¾in. scale, Great Northern 8ft. Express, half finished, £5.—H. Ward, Church-street, Whitehaven.

Good **Club "Fit-up,"** 7 cloths, wings, gasfittings, and proscenium, £25.—Gardner Hadley, F.A.D.C., Fordingbridge, Hants.

Lathe Castings, and partly fitted lathe-work, also finished parts and lathes complete, cheap.—Pearce, Pellatt-road, Dulwich.

8in. centre gear **Lathe** for foot, 9ft. bed and slide-rest. Also planing machine, cheap.—Pearce, Pellatt-road, Dulwich.

Well made **Bench,** with 4in. leg vice; takes to pieces; suit amateur. £1.—M., 105, Venice-street, Liverpool.

Electric Clocks. Pendulums, Signals, Electric Chimes. Can be easily fixed to any clock. Materials for amateurs.—J. Cooper, 26, Lichfield-road, Aston, Birmingham.

Microscopic Objects, prepared for mounting, 18 specimens, some rare, post free 15 stamps. All requisites for mounting.—Mason, 25, Park-road, Clapham, London, S.W.

A new **Autophone,** 22 reeds, with music. Anyone can play it without the knowledge of music. 35s.—J. Clark, 144, East Reach, Taunton.

Two-cell Bunsen **Battery** for sale, in wood tray, complete. Only once used. What offers?—A. Rose, 87, High-street, Stoke Newington, London.

Minerals.—Hundred separately named varieties, including emerald, opal, sapphire, ruby, 10s. Apply for list. Slow type specimens, separately named, post free, 250, 6s.; 100, 2s.—Collector, 42, Tachbrook-street, Pimlico, London.

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For Sale, "**English Mechanic,**" 31 volumes, 27 bound, 4 unbound.—C. Shepherd, Rotherwood, Oakhill-road, Putney.

A marvellously simple but astounding piece of **Mechanism** for 1883 is our Electro-Dynamic Engine, 12in. armature, capable of developing 10,000 to 20,000 foot-lbs. power. We shall supply Castings and Working Drawings, so that any amateur, no matter how inexperienced, will be enabled to fit same up. Particulars, with Lithograph, will be sent on receipt of six stamps. Intending purchasers will please give their names in early, a large number being already spoken for.—A. Dunnington, Accrington.

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Half horse-power Horizontal **Engine Castings,** only 12s. 6d. Upwards of 1,000 sold last year. Design.—A. Dunnington, Accrington.

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Three-jaw **Chuck Castings,** 3s. per set. Forgings, 1s. 3d.; working drawing, 8 stamps.—A. Dunnington, Accrington.

Splendid Model Locomotive **Engine Castings,** 30s. Lithograph, 4 stamps.—A. Dunnington, Accrington.

Send 5 stamps for a **Working Drawing** of a Model Horizontal Engine, 1in. by 2in. cylinder.—A. Dunnington, Accrington.

Combined Governor and Stop-Valve **Castings** for ½ horse-power Engine, 3s. Working drawing, 6 stamps.—A. Dunnington, Accrington.

The above **Castings** are of the best and softest of metal. Enclose stamp for lists, testimonials, designs, &c., to A. Dunnington, Imperial Chambers, Accrington.

Cheap **Rubber Stamps.** Your name, 10d.; address, 1s. 6d.—Wright, Rubber Stamp Manufacturer, 34, Parkstone-road, Peckham, London.

Electro-Motor, well finished, and with driving pulley, 6s., post free. Larger sizes to order.—J. Sutcliffe.

Electric Boat, screw propeller, with bichromate battery, complete, 12s. 6d.—J. Sutcliffe, 33, Cedar-street, Hulme, Manchester.

Stocks and Dies, new—¼, ⅜, ½in., 7s. 6d. List free.—F., 134, Lord-street, Wolverhampton.

Boxwood **Reels** for Electro-Magnets, ¼, ⅜, ½ inch bore 1¼, 1½, 1¾ each, postage extra.—Electric, 6, Pomona-place, Fulham, S.W.

Silk-covered **Wire,** 24, 26, 4s. 9d., 5s. per lb. Other sizes equally low. Postage extra.—Electric.

Bicycles, Tricycles, Fittings. List free. Cheapest house for best make. Blacksmith's Tools.—Patten, "Onward Works, Wolverhampton.

Holly Treadle **Fretwork Machine,** never used with saws, pattern, &c., 13s. 6d.—E. Tunnard. See below.

Circular Feed **Sewing Machine** for Bootmakers' cost £12. Good order. Cash, 35s.—E. Tunnard. See below.

Aerial Suspension for Magician, complete, cost 100s. Price 45s.—E. Tunnard. See below.

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Lady's 9c. Horizontal Gold **Watch,** almost new, good order. Cash 20s.—E. Tunnard, 11, South-street, Greenwich.

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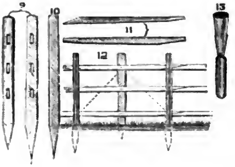
Engine Cylinder, 4¼in. bore, 10in. stroke, slide-valve, piston, &c. finished. Price £1.—17, Wakefield-street, Warrington.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 12, 1883.

HOME CHIPS.—VI.

Railings and Fencing.*

ONE of the best railings (at the price) is made of sawn fir and larch. If it was not introduced in the railway mania days, it has at any rate been very extensively used since that time. No equally stiff fence is so quickly made. The larch poles are sawn to form posts of their thick ends, and rails of the thinner portions, and the heavier posts are mortised, while the lighter ones, also sawn lengthwise, are used as supports midway between the larger ones. All are alike roughly pointed with the axe, and driven into the ground as piles, with a heavy wooden bitel (an essential tool for work of this kind), and I may remark here that a bitel of apple-tree is accounted specially durable. The length and size of the posts depend, of course, on the character of the fence, whether light or heavy; but the main posts may be, as a rule, 10ft. or 12ft. apart. They should be driven into the ground 2ft., and the intermediate ones 18in., but something depends on the kind of soil, and whether it has been previously disturbed. Figs. 9, 10, and 11 will illustrate sufficiently the above details, the first being the mortised posts, Fig. 10 the intermediate, and Fig. 11 the rails. The complete fence is shown in Fig. 12. The mortises are cut out rapidly with a stout gouge, Fig. 13, called a socket-handled gouge, the chisel being of similar make. This is the best form for all rough and heavy work. Of course, an auger can be also used; but most men used to the work will do it as rapidly without, or nearly so. The rails are flattened and sloped by the axe at each end to enter the mortises, one on the top of the other, like two pieces cut for splicing; and the small end of one always goes in with the large end of the next. Having all ready, the first work is to set a line along the ground as a guide; then the first stout post is set up against it and driven, taking care to keep it upright and the sawn face at right angles to the line, so that the rails may stand square and true. A rail is then picked up, and one end placed in the mortise, while the next large post is set up at the right distance measured by this rail; and this is done each time, as the rails are not always of precise length. Two people ought to work together at setting up the fence, but it can be done by one. The three or four rails are now placed in their places in the fixed post, and also in the one that is to be set up; and the latter is then driven till the rails appear horizontal. Three more are now placed, and the third post driven; and so on till the whole are set up. The light intermediate posts require no mortises. They are simply placed with their flat sawn sides against the rails, and driven as deep as necessary, and they are then nailed to the rails. There is no need to pin or nail the rails in the mortises, as they cannot get away. Wherever fir and larch grow extensively, as in Dorset and Hampshire, and the southern counties generally, or the Scotch firs can be procured, no fence is cheaper than this one; and so serviceable is it, that it might pay in cases where fir is not indigenous, but has to be brought from some distance by railway. With this question, however, I have not to deal. I wish I could tell my readers how to make hurdles of split stuff, which are so useful as a temporary fence; but I cannot—that is to say, I cannot give them the grand secret of splitting the material, although I have seen it done hundreds of times. The tools are simple, but the knack of getting the cut to run straight and out of winding, is only acquired by practice, and of this I have had none. However, it is hardly an operation of carpentry, though it is one of Home Chips; and as I cannot give practical instruction, I shall pass it by. Hurdles of *sawn* stuff can be made after the pattern of the continuous fencing last described. Two mortised uprights, pointed to go into the ground, with an intermediate plain one nailed on, makes a sufficiently useful hurdle, but is improved by diagonal struts of half-inch flat stuff, nailed on to meet at the centre-post, as shown by the dotted lines in Fig. 12. The rails, however, would be made to fit the mortises, and nailed or pinned through. This need not be described in fuller detail, after what has already been explained. The tenons, however, are not in such a case cut at all. The mortise is made the size of the rails, which are, at most, very slightly sloped off to enter and make a tight fit.



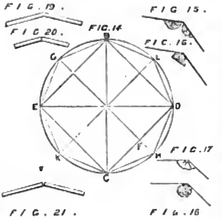


FIG. 18.

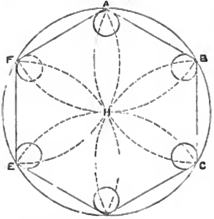


FIG. E. A.

I will now proceed with building operations, commencing with a summerhouse, which, if now commenced, will be all ready for occupation by the time the trees are again clad in their summer robes. The plan shall be octagon—the material fir, if it can be had, and, if not, the design can be carried out with such material as may be available. If a plan of such building is drawn—I have made one here to ⅛in. scale, founded on a circle representing a diameter of 8ft.—it will be found that the interior angles are 135°, and it is here the posts have to stand, to which the boards are to be nailed. But we shall not readily procure the posts sawn to this angle. If so sawn, they would, of course, fit in quite neatly, like Fig. 17. We can, as a rule, only get a round post, or a half-round; or, if again sawn, a quartered one, and in none shall we obtain the desired angle.

We must try, nevertheless, to meet the difficulty. We can set up a pair of half-round posts in each corner, Fig. 15, and obtain two flat surfaces at the angle required, only it needs great care in setting them up to face truly; or we can put one with the round side outwards, or use a round post like Fig. 16 or Fig. 18, trimming it with hand-axe, if at any place the boards do not lie close, as will be the case if there are knots or excrescences; otherwise, the bark may be left on to show on the inside of the house. The boards will find a bearing on the round posts at a short distance from the angle where they meet; and at this point the nails will be driven, two nails to each board. Figs. 19, 20, 21 show on a larger scale the meeting of the ends of the boards. In the two first, an exact bevel is necessary to each. In the last, they are sawn off square, and then one long strip of triangular section is fitted into the angle afterwards. The last is, I think, on the whole the easiest, because it is a matter of planing only with the grain; and when done, it has a very neat appearance, as all the sawn ends are quite hidden. But I have not yet stated how to set out the plan of the house.

We first need a circle 8ft. across (or less or more at pleasure), marked on the ground. Drive a short stick into the spot which is to be the centre, and loop a bit of string over it; and at the distance required (4ft. in this case), attach another pointed stick or bit of iron rod that will mark, or hold a pointed lump of chalk and the string. Here are our compasses with which we can proceed to make the required circle. Next drive in, at any point in this circle, a short peg. Have a supply of a dozen pegs, and attaching one end of a string to the first driven, stretch it across exactly through the centre to the opposite side, and where it touches the circle drive in another peg. This is one diameter. Leave a string from peg to peg, and across it, at exactly right angles, stretch another, and drive two more pegs. You now have accurately marked the four corners of a square. Stretch a cord between any two adjacent pegs, find the middle of it, drive a pin, and carry a cord from it across through the centre to the opposite side, and drive a pin there. Take up the first pin and put it back to the circle on this diameter (it was stuck in upon the side of the square because it was necessary to divide this in half; but now we have got the line we need, we can move it back). Repeat the same with the other remaining part of the square and circle, and we have a peg at each angle of the octagon. Probably this reads "complicated," but I will repeat the process by help of the Fig. 14, which will clear it up. Begin by a peg at A, from which describe the circle;

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* This article should have appeared in continuation of that on p. 367, and before the last on p. 349. The numbering of the cuts will show the proper order.

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drive-peg at B, and stretch cord past A to C. Leave this cord and stretch another from centre A to D, exactly at right angles to the first cord, and peg at D. Carry the cord from D through A to E, getting the second diameter at right angles to the first, and peg at E. You now have the four corners of a square with peg at each, and you want to find points intermediate between them, but *on the circle*. Now stretch line (say) from B to C, bisect at F, and pro tem. drive peg from which to carry string past A to G, where drive peg, and from the latter work back again past A to H, and pull up the peg at I and put it at H. Do the same on the other part of the circle, and the octagon will be truly set out. All this can be very quickly done, though it needs many words to describe. You can, of course, if preferred, after you have got one line of the octagon correct, cut a bit of lath to the length of it, and use it to set out the rest. But as you have the string and pegs which are necessary to begin the work, it is quite as easy and quick a process to go right on to the end. The open part that will be left as an entrance may take up one or two divisions of the octagon. The whole from K to H can be left, or only from C to H (or any other). Take care to leave the warm side open, south or west, or S.W., and if you live in an exposed place, I should have but one section open. In any case, the eight posts are to be fixed, for the reason that they will be all needed to support the roof of the building. Before proceeding with details of construction, I have thought it well to add a ground-plan of a six-sided summer-house, Fig. 19A, which will, of course, need fewer posts, and may be more suitable in some places. Here the angles at which the boards meet will be 120°, but the round posts will answer. Fig. 20A shows how these posts may be cut, provided a saw-mill is near, or that the sawyers can be made to understand exactly what is required.

The post is first sawn lengthwise in halves, and then a cut is taken as at *a*, which takes off one-third. This would probably be easily managed if explained, and it will make a far neater job, and one easier to work. Failing this, of course it will be necessary to adopt the plan already described; and this will be the case, in all probability, more often than the other. To set out a hexagon is quite as easy as to set out an octagon. Mark a circle as before; put a peg at *a* as a centre, and taking a length or distance to the centre of the main circle, and looping the marking-peg to the string at the place, sweep an arc from J to B, and stick pegs at both. Loop the string in succession over B, C, D, and where the marking-point cuts the circle put in pegs, and your hexagon is done; or measure from A to centre, H, and cut a stick of that length, and, setting out at peg A, measure the chords to B, C, D, &c., as the stick will be the length of each side of the required figure.

J. L.

EXPLOSIVE DUSTS.

ALTHOUGH it is now fully recognised that the dry dusts of organic substances when disseminated in the air form explosive mixtures, awaiting only the proper temperature and the firing spark to start them in their destructive work, the actual cause of explosions in flour-mills is still much of a mystery, and a subject of dispute amongst millers, and also amongst fire-insurance companies. Experiments have proved conclusively that "shot-firing" in coal-mines is a very dangerous proceeding, even in those free from explosive gases, unless special precautions are taken to "lay the dust" by means of water. In some conditions, too, it is possible that an explosion may be started by a flame surrounded by an atmosphere laden with particles of very fine and dry coal; for it is obvious that particles coming into contact with a flame will be ignited, and may communicate the requisite temperature to a sufficient volume of the atmosphere to produce a flash, and that again may produce other small explosions through the workings of a mine until possibly reaching some spot where the conditions are suitable, a general explosion follows with the usual results. That it is possible to fire fine coal in this manner has been demonstrated many times in the laboratory, and there is much reason to believe that many colliery disasters have been brought about by the incautious firing of a "shot" which has either communicated flame direct to the coal-laden air in its vicinity, or by concussion has driven flame out through the lamp-gauze, and so started an explosion or fire in some more or less distant working. The causes of explosions in flour-mills are not easily discovered, for although the dust is there ready to take fire, it is not quite clear whence the spark arises that is the starting cause of the explosion. In all probability the spark is created by some portion of the machinery —possibly a nail, or some other foreign substance, getting into the smutter, where the intense friction causes, perhaps, a shower of sparks, which ignite the dust and communicate the flame until some portion of the mill is reached in which the atmosphere is in such a condition, from the presence of fine dust, that an explosion is the result, with the wreck of the mill. Instances of such catastrophes are not unknown in this country; but in the United States they occur so frequently that many of the fire-insurance companies would as soon think of insuring a gunpowder factory as a flour-mill, and not a few of those which do undertake the risk seek to evade their duties on the plea that an explosion is not a fire. It is important, therefore, to put the question on a scientific basis, and to show that explosions caused by dust are really as much fire-risks as the effects of an explosion of coal-gas. As the question is a very pressing one in America, the Millers' Associations have taken it up, and a very pertinent lecture was recently delivered by Professor Tobin, of the Kentucky Polytechnic Society, before a meeting of Fire Underwriters held in Chicago. It appears that that gentleman was invited by the Kentucky Millers' Association to address them on the subject of "Flour Explosions," and having once entered into the question he was enticed to go further, and accordingly prosecuted his researches until he was able to formulate hypotheses based upon experiments, and to offer advice to those having charge of mills. Starch forms the bulk of ordinary flour, and also of flour-mill dust, but in the new processes of grinding wheat the miller first cleans the grain by brushing or agitation, and secondly passes it through rollers which open out the "crease," and enable him to get rid of the germ and the incidental impurities left from the brushing. In that operation a small quantity of flour is made which is blown with the impurities into the dust-room. Practically the dust from the wheat and that obtained from the crushed kernels, are almost identical in physical properties; but the wheat-dust is more inflammable than the starch or flour-dust. Starch itself is combustible, and in its normal state contains about 18 per cent. of water; but if it is thrown in the shape of flour on to a fierce fire, it will retard the combustion of the coal by excluding oxygen, unless it is scattered so thinly that it is intimately mixed with air. Most people are familiar with the use of lycopodium in producing the "stage lightning." That substance is the highly-inflammable powder found in the spore-cases of Lycopodium clavatum and L. Selago, commonly called club-mosses. In bulk, a flaming torch may be plunged into it and extinguished; but if a little is blown across the flame of a candle or a gas-jet it flashes into combustion instantaneously. The spores of the Lycopodium are of an oily nature, which helps to render them especially suitable for the purpose; but, flour carefully dried (that is so as to expel the moisture without carbonising it) will answer, and, if thoroughly mixed with air, will explode violently—the violence being inversely as the proportion of moisture in the flour. The explosion here is not in the nature of gunpowder or nitro-glycerine explosions, but is due to the rapidity of combustion of the particles of flour or of Lycopodium, which, generating heat, expands the surrounding air, the gases produced by the combustion of the flour being carbonic acid and water vapour. Explosions have also occurred at wood-working establishments where spouts are employed for conveying dust and fine particles of wood, shavings, &c., to a receptacle near the boiler furnace; but in nearly all cases the state of the atmosphere has been exceptionally dry. To illustrate the explosive properties of various dusts, Professor Tobin uses a hollow shaft about 7ft. in height, having a hopper at the top and a Bunsen burner at the bottom. A trigger at the top opens the hopper and allows the dust to descend in a fine shower, and as the sides of the shaft are perforated with many holes for the free ingress of air, the contents of the shaft or tube are in a suitable condition for rapid combustion, which commences as soon as the dust reaches the gas-jet, and ends in a sort of explosion which blows the hopper off the shaft and ignites it. The moisture of the air is well known to be much less in the United States than in Europe, and in certain conditions it becomes so low that to those unaccustomed to it, it is actually uncomfortably dry. The humidity varies, too, with the time of day, as well as with the season of the year, but in the hot months the air is driest about mid-day, or in the early afternoon. If the external atmosphere is dry, it might be supposed that the air of a flour-mill would be drier still; but carefully-conducted experiments made by Prof. Tobin last August reveal the fact that in a well-appointed and substantially built flour-mill at Louisville, the air of the grinding and bolting-floors was found to be on several occasions actually more humid than the external air—a fact to be accounted for, he thinks, by evaporation of the natural moisture of the wheat in the course of crushing by the rollers, which are heated by the friction and resistance of their motion and the work performed. Flour, however, like other dusts, has a tendency to absorb moisture, and when it reaches the flour spout it is in a state to absorb it greedily; hence the air of dust spouts and flour-shafts shows a comparative absence of moisture. Even on a rainy day, with the external air showing a humidity of 87 per cent., the air of the dust-shaft had only 60 per cent. In many mills, the dust-shafts and flour-spouts are made of wood, which is gradually deprived of its moisture by the almost constant stream of dry air pouring past it, accompanied by dust, which is also ready to absorb any moisture it may encounter. It is here where fire originates; and local explosions cause the deposited dust to be shaken into the air of the mill, and an explosion follows that wrecks the whole building. It is a notable conclusion to Prof. Tobin's lecture that the last fact he mentions is the destruction of the very mill in which he had carried on his experiments. He recommends that besides building as substantially as possible, those parts liable to take fire should be constructed of uninflammable materials; that the mill should be kept as free as possible from dust, and in dry seasons should be daily filled with vapour or steam. Unprotected lights should, he thinks, never be used—a remark which is fully appreciated by millers, as they are amongst the best customers of the electric-lighting companies.

Flour-mill explosions are not so frequent in this country as in America; but now and then they occur, and the cause is the simple fact that dry dust of organic matter, intimately mixed with air, is capable of burning with such rapidity, that in its effects it simulates the action of gunpowder.

THE ACHROMATIC OBJECT-GLASS.—XIV.

By W. BRADBURY.

(Continued from page 352.)

I SHALL now quote some remarks on the preceding question, containing the opinions of "Prismatique"; they seem to bear out the correctness of theoretical deductions.

First, with regard to the inner surfaces:—"My practice proves that the inner side of the flint is generally theoretically wrong; but there is the little difficulty of mounting such. Trade customers will not have 'contact insides'; 'riders' are worse to them.

"Achromatism cannot as yet be got from tables; it is only in its infancy in its most perfect form, and known only to a few. The fact that spherical and chromatic aberration are intimately related is patent to me when two or three glasses are selected for their consistency for correction of colour. I have not the slightest doubt that the first surfaces of all good object-glasses are elliptical, if they could be tested; that the emergent surfaces are hyperbolic I do know; but the inside concavity is often parabolic, sometimes hyperbolic, seldom elliptical or spherical. The Foucault test is not applicable to curves of such short focus as occur in o.g.'s; the test we use (only as a primary one) does not to absolute certainty distinguish between a parabolic and a hyperbolic curve. The object-glass is finally corrected, as a whole, after the concave surfaces are got to give a correct image, at a position that is generally assumed to prove actual sphericity. As those surfaces are, more often than not, altered afterwards, the form actually arrived at is a thing no one can tell; a glass that gives a good image is a good glass."

"In practice, local correction for figure is the general mode even to get perfect definition at 3in. aperture. In smaller work, even for the short focussed lenses in cameras and opera-glass o.g.'s, the method employed for some of the surfaces ensures at the start a removal from the spherical to the elliptic form. I am convinced that this figure is the great factor in the mode of getting achromaticity. For if two prisms will achromatise each other by alteration in position, does not this prove that shape, as well as approximate curvature, is necessary? The parabolic shape given to concave surfaces is undoubtedly to correct an opposite error in the convex;—it should not be so by rule; but if a good result is obtained, that is the optician's end and aim."

Secondly, with regard to the ordinary arrangement of lenses, the same authority says (referring to that which I have previously denominated the "English type of object-glass"):—

"This form is the best I know of, for least secondary spectrum. According to my judgment, the outside of crown lens is slightly elliptical. This is, however, to correct a want of absolute sphericity in the other curves. The inner side of crown is hyperbolic, and of flint parabolic—as pronounced as is required in specula, if not more so. None of the glasses in use will make even a 3in. object-glass, free from both spherical and chromatic aberration, with all the curves spherical."

These are some of the results of a long experience, among many classes of the best work. They serve to show the close agreement that exists between theory and practice, in assigning certain forms for the attainment of a special end; and in the matter of spherical error the coincidence is still more observable. In this case it is unnecessary to take into account the minute variation due to spherical dispersion; consequently the results have a definite value.

In the elimination of the secondary spectrum, the selection of proper glasses for combination is an important item. It may not be possible with existing specimens, to find two which shall admit of being perfectly achromatised by a general arrangement; but the amount of residual colour will be much greater in some pairs than in others. According to Brewster's experiments, the less the difference in dispersive power, the less will be the amount of outstanding colour. This would indicate the suitableness of a flint of low density, with a crown of high dispersive power. It might be said, why not use two lenses, both of flint glass? since there are many varieties, differing very much in their optical properties. But I believe it has not been found practicable to secure decent chromatic correction with two different flint lenses. A tolerably large difference in refractive power seems to be requisite also; and as an increase in dispersion generally entails an increased refraction, and *vice versâ*, we cannot apply the first condition rigidly, without introducing more serious deficiencies by violating the second. The older kinds of crown glass had generally a much higher refractive power than most of the modern qualities: the indices of one sort are given in Fraunhofer's Table, which seem to be higher than any at present known. Crown glass of high refractive power does not appear to be very much used in modern work. The opinion of "Prismatique" is, that "the influence of high refraction in crown glass is detrimental, all things being considered; sometimes it is used in small object-glasses, but all larger work are made with lighter crown and heavier flint."

A glass known as "St. Gobain plate" has long been used for the convex lenses of telescopes. Its refractive index is about 1·515, and it appears to have been the glass used in the combinations to which Barlow applied his formula. He also mentions a flint glass made by Guinand, whose refractive index is 1·63, and dispersive ratio compared with the plate is ·545; but beyond this notice, I have met with no particulars of the optical qualities of this species of glass. Mr. Wenham speaks of using Swiss flint in microscope objectives, which had very different qualities from that of English manufacture. I quote the following from his "Essay on the Construction of Microscopic Object-glasses":—

"It is usual to denote the quality of glass by its density, but this in reality forms no accurate criterion of its dispersive power. Formerly, under this impression, I procured a quantity of dense flint, made by Chance, of Birmingham; very hard, white, and free from liability to tarnish, and, to all appearance, as good a quality of glass as I had seen. Its density was 3·867; but on trial, I found it unfit for the construction of the highest powers, as its dispersive power was lower than the Swiss 3·686 or even 3·630, that I had employed previously; while its refraction was much greater. Some ingredient had been added, which increased the refraction, and probably lessened the dispersion; and of course in a correcting concave, the latter quality alone is needed, and the lower the refraction the better."

Hence it is evident that a higher refraction does not always carry with it a higher dispersion. In a series of glasses of the same sort by the same maker, we are doubtless correct in ascribing higher dispersion to the higher refractive indices; but in comparing two glasses of the same sort, but of different manufacture, we cannot say that because one glass has a greater index than the other, it will necessarily have a greater dispersive power. It is to be regretted that no systematic experiments on the refractive and dispersive powers of the glasses that have been, and are, employed in optical art, have been made and published. Possibly, some opticians may have found the necessity or usefulness of such a collection of data; but, so far as I am aware, no such information has been published, if we except the small table of Tulley. Unless those who use will state their requirements to those who make, and by publication of experimental data, render possible the comparison of processes and results, we cannot hope for much improvement in the qualities of optical glass. Mr. Wenham appears to have felt the want of such a table, for he says—"It would be very desirable that a series of experiments should be made with various combinations of all the known materials that can be used in glass-making, and the resulting compounds worked into equilateral prisms, and their refractive and dispersive powers tabulated with the component ingredients. Data obtained from working them into small lenses furnish only a rough approximation to the mean dispersive power of the combined flint and crown having the best apparent effect. The result of the investigation would unquestionably be valuable, and we might possibly be able to discover compounds which would neutralise the secondary spectrum."

I am not aware that any special advantage as regards the union of scattered colour, have resulted from the use of three lenses instead of two. Dollond's triplet principle was introduced as a means of more easily correcting the spherical error; but with modern methods of working, this does not appear necessary. By the use of three lenses, three instead of two, spectrum lines may be theoretically combined; but I have no information as to how such a plan would answer in practice. Such a combination partakes of the dialyte principle; indeed, it may be regarded as a single objective, with the correctors in contact with it. Of course, three different species of glass must be used, two being crown and one flint, or *vice versâ*; and the pair will always have opposite foci—that is, one convex and the other concave. Probably, such a plan of objective has seldom or never been tried.

As an illustration of the use of the triplet formula given on a previous page, I will compute the proportionate foci of two combinations of this character—the first having two crown and one flint; the second, one crown and two flint lenses. It is scarcely to be expected that the same proportions would answer in practice; neither can any definite conclusion be drawn respecting the character of the focal image. We have only tabular values on which to base our calculations, and these may or may not be exactly correct. The glasses supposed to be used shall be the four first mentioned in Chance's table, and we will combine both the lines C and G with the E line. The index of E does not appear in the table; but it may be taken as the mean of D and F, and this value is not far from correct. The preliminary step is to find the dispersive powers of the glasses: first, with regard to the lines C and E only; and, secondly, with regard to E and G only, taking E as the mean ray from which we estimate in each.

Taking the various differences for C E and E G, and dividing each by its proper value of E less 1, we have the following dispersive powers:—

	C E		E G
Hard crown ..	·0109	..	·0149.
Soft crown....	·0113	..	·0164.
Light flint ..	·0155	..	·0224.
Dense flint ..	·0176	..	·0265.

In the first combination, the two crown glasses shall be combined with the dense flint, to give a compound focus of 100. The three focal reciprocals shall be denoted in their proper order by x, y, and z; also, the compound focal reciprocal is ·01. The flint is the second lens in the combination. To save calculation, it is better to take the ratio of the dispersive power of each crown to that of the flint; that is, divide the two crown values of C E by ·0176 and those of E G by ·0265. We have then three equations—

$$\left.\begin{aligned} x + y + z &= \cdot 01 \\ y + \cdot 619\,x + \cdot 642\,z &= 0 \\ y + \cdot 562\,x + \cdot 618\,z &= 0 \end{aligned}\right\} \begin{matrix} (1) \\ (2) \\ (3) \end{matrix}$$

We have, as yet, made no supposition regarding the character of the foci; but from (1) it is evident that *one* at least must be positive; the other two may be one or both negative. From (2) and (3), x and z must have opposite characters. To find these values, first subtract (3) from (2), then $\cdot 057\,x + \cdot 024\,z = 0$, or $x = -\cdot 421\,z$. Substitute this value for x in either (2) or (3), and we find $y = -\cdot 382\,z$. These values for x and y being put in equation (1), it gives z positive, and equal to $\cdot 01 / \cdot 197$, so that its reciprocal f_3 is 19·7. Whence f_2 is negative and equal 51·5, and f_1, also negative, is 46·8. Hence, the soft crown lens is convex, and the hard crown and dense flint both concave. These are the order of foci; but we are not restricted to any arrangement of lenses. Fig. 6 shows one convenient plan:—

1st lens. Hard crown, convexo-concave-negative focus	46·8
2nd lens. Soft crown, double-convex, positive focus	19·7
3rd lens. Dense flint, double concave, negative focus	51·5

Thus the correction of a strong crown lens is effected by means of two weaker concaves of flint and crown glass.

Next, it shall be assumed that the combination consists of a hard crown lens, and two others of light and dense flint respectively.

As before, it is more expeditious to take the ratio of dispersive powers; and as the crown is the odd lens, divide each of the flint values of C E by ·0109, and the E G values by ·0149; then we have—

$$\left.\begin{aligned} x + y + z &= \cdot01 \\ x + 1\cdot4227y + 1\cdot615z &= 0 \\ x + 1\cdot5037y + 1\cdot777z &= 0 \end{aligned}\right\} \begin{aligned} &(1) \\ &(2) \\ &(3) \end{aligned}$$

Subtracting (2) from (3), we find $y = -2z$, and then from (2) $x = +1\cdot229z$. These values being replaced in (1), give f_3, or dense flint focus positive, and equal 22·9; f_2 is negative, 11·45; and f_1 positive, 18·63. So that the combination is similar to Fig. (7), and consists of—

FIG. 6.

FIG. 7.

1st lens. Hard crown, double convex, positive focus	18·63
2nd lens. Light flint, double concave, negative focus	11·45
3rd lens. Dense flint, double convex, positive focus	22·9

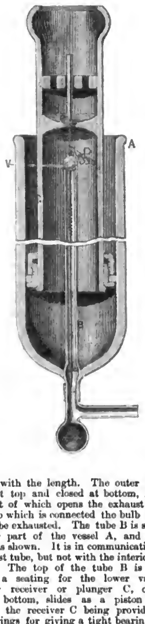
This is a reversal of the other combination: for we have one strong concave corrected by two weaker convex lenses of different kinds of glass.

(*To be continued.*)

GIMINGHAM'S IMPROVED AIR-PUMP.

SINCE the introduction of the incandescent electric lamp a number of patents have been taken out for improvements in mercurial air-pumps (see p. 442 last volume), and one of the most notable is that illustrated by the annexed engraving. This pump is the invention of Mr. C. H. Gimingham, of Newcastle-on-Tyne, a gentleman whose skill in the production of curious complications of glass bulbs and tubes is well known in all the laboratories of this country. The object of this invention is to provide an air-pump by means of which a high vacuum may be obtained without the circulation of mercury as in the ordinary mercurial air-pumps. An outer vessel is provided open at top, the exhaust tube or passage leading from the vessel to be exhausted opening into the bottom and terminating in a pipe carried up some considerable distance into the vessel, and having a valve seating at its top. Sliding in the outer vessel is a hollow receiver or plunger, furnished with a leather or other washer at its lower end, to fit and slide tightly as a piston in the outer vessel. The upper end of the hollow plunger is formed with a valve seating upon which rests a stopper or valve called the upper valve. This upper valve is connected by a flexible connection with another stopper or valve to fit against the valve seating on the pipe, which is carried up inside the outer vessel from the exhaust passage. This is called the lower valve. It is provided with a spring which tends to pull it down upon its seat. The hollow plunger is connected with a slide having a reciprocating motion derived from any convenient motor. The outer vessel contains mercury, which when the hollow plunger is in its highest position, rises partly into the plunger, but not to the level of the opening upon the pipe rising from the exhaust passage, and which, when the plunger is in its lowest position, rises slightly above the upper valve.

On the upward stroke of the hollow plunger air is drawn from the pipe leading from the vessel to be exhausted into the plunger past the lower valve. On the hollow plunger descending the flexible connection between the upper and lower valves slackens, and the lower valve is brought down upon its seat and closes the exit of the pipe from the exhaust passage; the mercury then rises over the valve and forces the air which was in the hollow plunger past the upper valve. Thus, at each up-stroke of the hollow piston air is drawn from the vessel to be exhausted past the lower valve into the hollow plunger, and on each down-stroke of the plunger the air so drawn thereinto is forced therefrom past the upper valve. The portion of mercury escaping past the upper valve effectually seals it, and the piston rings of the plunger are also luted by a layer of mercury above them.



The accompanying drawing represents in sectional elevation an air-pump constructed according to the invention, the mercury, however, being omitted, and the width being exaggerated as compared with the length. The outer vessel A is open at top and closed at bottom, into the lower part of which opens the exhaust tube or passage, to which is connected the bulb or other article to be exhausted. The tube B is sealed to the lower part of the vessel A, and extends upwards as shown. It is in communication with the exhaust tube, but not with the interior of the vessel A. The top of the tube B is ground to form a seating for the lower valve V. A hollow receiver or plunger C, open at top and bottom, slides as a piston in the vessel A, the receiver C being provided with packing rings for giving a tight bearing. The upper end of the receiver is formed with a valve seating P, upon which rests the upper valve provided with a spindle supported by a guide I, having air passages therethrough. To the upper valve is attached a wire, flexibly connected with the valve V, which valve is connected to a spiral spring tending to retain it upon its seating. The flexible connection is of such a length that when the receiver C is at the top of its stroke the valve is just lifted from off its seat on the tube B. The receiver C is attached to any convenient motor by which a reciprocating motion can be imparted to it, the bulb at the top of the receiver being provided for convenience of connection with the motor. Mercury is contained in the vessel A, and rises into the receiver C, reaching to the level of the opening at the top of the tube B, when the receiver is in its highest position, but only just past the valve P when the receiver C is in its lowest position. When the pump is in action, on the upward stroke of the receiver C, air is drawn from the vessel that is being exhausted up the pipe B and past the valve V, which is lifted from its seating by the pull of the flexible connection. On the down-stroke of the receiver the connection slackens, and the valve V is brought down upon its seat by the spring and closes the exit from the pipe B, the mercury rising in the receiver C and past the valve P, forcing before it the air which was drawn into the receiver by the previous up-stroke. By repetitions of these alternate movements of the receiver a very complete vacuum may be created in the bulb or other vessel attached to the tube. The vessels A and B may be of any convenient material, such, for example, as glass, metal, or ebonite.

SIMPLE PROCESSES IN QUANTITATIVE CHEMICAL ANALYSIS.

Estimation of Iron.

WEIGH accurately ·3 gram of fine piano wire, transfer to a beaker, add a sufficiency of water and hydrochloric acid, cover the beaker with a large watch-glass, and heat on sand-bath till the wire is dissolved. Now add a few drops of strong nitric acid, and continue heating. The nitric acid will at first produce a dark colouration, and if sufficient has been added the solution will suddenly turn pale yellowish brown with considerable effervescence. Remove the vessel from the sand-bath, and when cool enough add very cautiously an excess of ammonia, at the same time stirring the liquid. Heat nearly to boiling, then allow the ppt. to settle; pass the supernatant clear liquid through a filter, and thereafter transfer the ppt. to the filter, wash well with boiling water; dry the filter and contents, ignite in a tared *porcelain* crucible and weigh. The weight represents the iron as ferric oxide Fe_2O_3. 100 parts of ferric oxide represents 70 iron.

Estimation of Magnesia.

Dissolve 1 gram of magnesium sulphate in about 50cc. of cold water in a beaker, add a solution of ammonium chloride, then an excess of ammonia. Should a ppt. form on the addition of the ammonia, add more ammonium chloride till it dissolves. Now add an excess of a solution of sodium phosphate, and stir the mixture without touching the sides of the vessel with the rod. Allow to stand about 12 hours in the cold, and then filter. Wash the ppt. with a mixture of 4 parts of cold water and 1 part of ammonia, till the washings only give a slight opalescence on being treated with an excess of nitric acid and a drop of silver nitrate. Dry the ppt. and remove from the filter-paper according to the directions already given; ignite strongly, add filter ash and weigh. 100 parts of the magnesium pyrophosphate thus obtained contains 35·7 magnesium oxide MgO.

Estimation of Sulphur.

Weigh ·5 gram. of potassium sulphate, dissolve in a beaker with hot water, add a few drops hydrochloric acid, heat to boiling, then add a solution of barium chloride, till precipitation ceases, boil gently for some time, allow the ppt. to settle, wash by decantation several times, using hot water, collect on filter, continue washing with hot water till the filtrate gives no ppt. with sulphuric acid; dry and ignite upon platinum: weigh. 100 parts of the barium sulphate so found contains 13·74 of sulphur, or 34·34 of sulphuric anhydride.

Analysis of Limestone and Ironstone.

A. Weigh 2 grams of the finely-pulverised ore into a watch-glass, place in the water-oven for two hours; reweigh; the loss in weight × 50 = per cent. of *moisture*.

B. Weigh 1 gram. of the ore, transfer to a porcelain basin, add about 50cc. of water and 20cc. of hydrochloric acid, heat for a few minutes, then add about 15 drops of concentrated nitric acid; boil gently for 20 minutes on the sand-bath, add more water and boil again; filter and wash well with boiling water; dry, burn and weigh × 100 = per cent. of *silica* (sand).

C. Heat filtrate from B in a beaker or porcelain basin, add an excess of ammonia, filter and wash well with boiling water, dry and ignite the ppt.

in a small porcelain crucible—weigh, × 100 = per cent of iron as Fe_2O_3; calculate into $FeCO_3$ thus:—

Fe_2O_3 $2FeCO_3$
160 : 232 : : weight found : x.
x = per cent. of *ferrous carbonate.*

If phosphates are present they are precipitated along with the iron.

D. Heat filtrate from C, add ammonium oxalate and an excess of ammonia, heat to boiling, filter, and wash with hot water; dry and ignite the ppt.; weigh, × 100 = per cent. of *calcium carbonate.*

E. Evaporate the filtrate from D. to dryness in a basin, stirring continually when approaching dryness; transfer the residue to a small basin by means of a spatula, heat over flame of lamp till all salts of ammonia are expelled, allow the basin to cool, add a little water and a few drops of hydrochloric acid, heat and filter. To filtrate add a solution of sodium phosphate and an excess of ammonia. Let stand for some hours in the cold, filter cold, wash with water containing ammonia, dry, ignite and weigh, × 100, and calculate into $MgCO_3$ as follows:—

$Mg_2P_2O_7$ $2MgCO_3$
222 : 168 : : weight found : x.
x = per cent. of *magnesium carbonate.*

F. Subtract the sum of the percentages of moisture, silica, ferrous carbonate, calcium carbonate, and magnesium carbonate from 100, and the difference gives per cent. of *organic matter.*

NOTE.—100 parts of calcium carbonate represent 56 of lime, and 100 parts of ferrous carbonate 48·27 of metallic iron.

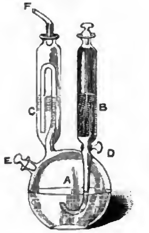
STATEMENT OF RESULTS.

LIMESTONE.	
*Calcium carbonate...	71·20
Ferrous carbonate	4·27
Magnesium carbonate	6·89
Silica (sand)	13·14
Organic matter	4·11
Water	·39
	100·00
*Equal to lime	39·87
IRONSTONE.	
*Ferrous carbonate	57·46
Calcium carbonate	14·1
Magnesium carbonate	4·29
Silica	18·53
Organic matter	5·48
Water	·14
	100·00
*Equal to metallic iron	27·24

Estimation of Carbonic Acid.

To estimate the carbonic acid in limestone, and other carbonates, an apparatus such as is shown at Fig. 7 is necessary. It is of blown glass. B contains nitric or hydrochloric acid, C sulphuric acid; D is a glass tap.

FIG. 7.



Two grams of the powdered carbonate is put into the apparatus with a sufficiency of water at the opening C; the stopper is then inserted, and the whole weighed. Allow some of the acid from B to enter A. Carbonic acid will then be liberated and escape at F, being dried in its passage through the sulphuric acid at C. Continue to decompose the carbonate cautiously, with more acid from B, until the effervescence ceases. Boil the fluid A very gently on sand-bath, and finally attach a flexible tube to F, draw air through the apparatus, and when quite cool weigh. The loss in weight × 50 = per cent. of *carbonic acid*

In my next I will give processes for the analysis of copper pyrites, volumetric estimation of iron and copper, estimation of potassium, and the analysis of solder.

Esthos.

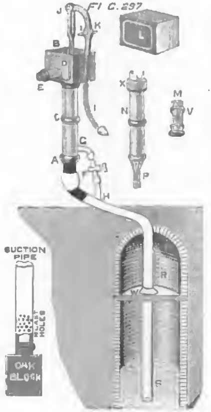
PRACTICAL NOTES ON PLUMBING.—LVII.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 398.)

IN Fig. 297, M is the nozzle, and N the barrel; these parts are cast in iron or gun-metal and other shut-up moulds with slightly taper cores, then soldered up as follows:—Soil the inside of the front L, Fig. 297, cut the hole as shown at D, Fig. 297, and fit the nozzle in up to the shoulder V; then take it out and shave the inside part of the hole within the head, after which, soil the inside part of the nozzle, and stuff a clean-cut wad of paper into the end V of the nozzle, and shave round the outside down to the shoulder, after which fix it and solder it into the head; next fit the barrel into the head, soil and shave it, say, from 1½in. to 1¾in. all round; next soil the outside part of the barrel shoulder at X, and, by placing the head upside down, you can readily solder the barrel on to it, when the pump is ready for fixing, or for the suction to be soldered on. *Notice*, the top of the barrel should protrude through the bottom of the head, say, 1in.: this prevents bits of brick, gravel, &c., from so readily falling down the barrel. The head is at times made round, and at other times with round front and flat back, so that it can be fixed with ears, as at N, Fig. 296, against a post or plank, as shown at H, G, and C. Fig. 296. Of course, the plank for support may be fixed in a shoe as at Q R S T, Fig. 350, or as at Z, 339, or let into the earth; or it may be fixed against a wall with a handle working from the back of a plank, as at K, Fig. 300. The fixing of these pumps so exposed is subject to three evils—namely, the frost of winter, theft, and the possibility of children putting things into the barrel.

FIG. 297



Suction and Rising Main Pipes—Size of.

It is important that the suction and rising main pipe should be of a sufficient diameter to allow the water to pass without undue friction; for instance, suppose the barrel C, Fig. 297, to be 4in. diameter, and the suction-pipe R to be 1in., by working the handle it will be plain that the water when passing through the 1in. suction-pipe will travel 16 times faster than through the 4in., and at the expense of needless labour, which is solely caused by friction. This is apt to be overlooked by most plumbers, but it is of more importance than is generally supposed. In practice it may be observed that the pumps which work lightest on the hand are the tree pumps. Why? Simply because their bore is of a larger diameter, and as a rule the bucket is not too far from the surface of the water within the well, which will be hereafter spoken of.

All suction-pipes and rising mains should be at least one half the diameter or one-fourth the area of the barrel; that is to say, a three-inch barrel should have a one and a half inch suction-pipe, and if of a very long length, this suction-pipe should be larger. The same rule holds good for double-acting pumps, as each barrel forces or draws the water at different intervals, or, in other words, alternately. I have referred to, and explained the use, size, and action of, the air-chamber, and only have to say that whenever a sudden jerk is felt upon the lever, or a chattering or thumping noise is to be heard within the pipes of a pump, whether it be upon the suction or rising main, an air-chamber is required, and of sufficient size to prevent this, which is due to the sudden stopping of the advancing column of water at each back-stroke of the pump (this is not so much felt in wheel or frame pumps, the action being regular). Should there be an air-chamber fixed, it is pretty certain that it is in the wrong place. The air-chamber should be fixed as near to the pump as possible; it may be that the chamber is full of water by reason of the air escaping through a pinhole, &c., in the material, or it may be caused by bad brazing, soldering, &c.; or perhaps, as I once found one in the well some 200 feet deep at Fairfield House, Hornsey, fixed upside down. This latter pump rising main, although a frame or wheel pump, was a continual nuisance, on account of its bursting. The plumber who fixed the pump had for some months a regular repairing job. I was called in, and at once, on discovering the chattering, concluded that there was no air-chamber; but there was! I inquired if it leaked, as an air-chamber, if leaky, will show the water running down the sides, unless the leak is in the dip-pipe, which is a thousand chances to one that it is not. There was no leakage. I knew something was wrong, and down I went. The air-chamber was of the shape shown at Y, Fig. 294; but the one shown at D, Fig. 294, is the most likely to be found fixed upside down, simply because the top is the largest, and many London plumbers, though excellent roof and closet hands, take it for granted that this is the bottom, and argue the point that the water should run from R to A, on account of the taper, which at first sight seems very reasonable. A simple method of ascertaining whether the air-chamber is charged or not is by sounding it, or by pricking a small long hole (on the top), say with the end of a carpenter's sharp chisel, or the point of a pen-knife or fine bradawl. This I did, and found the air-chamber to be full of water. The air-chamber was cut out, when, instead of the water running out, it remained full, which at once showed that the air-chamber was fixed "wrong way about." If you turn the air-chamber A B C, Fig. 294, upside down, you will see that the water cannot get away, because the dip-pipe holds it up. When you get the cylindrical-shaped air-chamber, as shown at Y Z, Fig. 294, instead of the conical, you can distinguish the top from the bottom by pouring a little water into it, or by pushing a stick down the one end, when you will feel the end of the dip-pipe. The dip is always the same as the dip of the D-trap.

(*To be continued.*)

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PROFESSOR TYNDALL ON LIGHT AND THE EYE.

IN commencing the third of his six Christmas holiday lectures on "Light and the Eye," Prof Tyndall reminded the boys and girls who had assembled to listen to his familiar chat on these scientific topics, that the two former lectures had been devoted to the elucidation of certain properties of light. That day they had to examine the living optical apparatus by which vision is produced. In his last lecture he had shown them how images were formed, first by a single lens, and then by a combination of lenses. Continuing the subject of compound lenses for a short space, he would make two experiments with a solar microscope. To some present they might be familiar, but they would be new to most of them. In the nozzle they saw before them there was first a lens used for the purpose of illumination, then came the picture to be illuminated, and lastly, the lenses which produced the vastly magnified image of that picture. The immense powers of the solar microscope would enable them to see how the minute processes of crystallisation in the genesis of chloride of ammonium and decomposition in the instance of acetate of lead were carried on. The demonstrations were perfectly successful, and as the chloride began to crystallise in the former experiment, and in the latter the leaden trees or ferns were seen dropping their fronds into the water as they grew too heavy to stick to the magnetic pole, and again when, on the reversal of the electric current, they floated away in misty filaments, to cluster once more around the other platinum wire as branches of a new stem, there was loud clapping of hands. The whole business, as the lecturer did not forget to remind his young friends, was conducted in the darkened theatre, which was converted into a veritable camera obscura, such as photographers used. His own assistant, Mr. Cottrell, would forthwith be photographed before their eyes by Mr. Murray. The former gentleman accordingly seated himself in front of the lens, and was illuminated with the electric light. The position of the lens was pointed out, as well as that of the screen on which the image was to be formed, and due reference was made to the inversion of the image. The picture once taken, Mr. Murray was allowed to enshroud himself in his dark hood to develop and fix the negative. In a very short space of time the picture was thrown upon the white sheet or screen, Dr. Tyndall not forgetting to point out that since it was a negative picture Mr. Cottrell's palish face was endowed with an Ethiopian hue. To occupy the spectators while the image was further developing, the inverted image of a candle was shown on the ground-glass screen of the photographer's camera, whence Dr. Tyndall at once passed to speak of what he described, pointing to a diagram giving a transverse section of the eye, as the most wonderful camera-obscura of all. He proceeded accordingly to give, in the most popular style, an account of its various parts—its objects, its lenses, and its wondrous living screen, the retina. By way of further elucidation, the transverse section of the organ of vision was further shown in a model. This done, those present were summoned to thoroughly grasp the conditions necessary to distinct vision. A large bolt-nut was filled with water to represent an artificial human eye, with tracing-paper behind for a retina, and a thin lens in front. A pair of lighted candles presented themselves as the first objects, next an illuminated watch-face, the hands being seen to turn round. A luminous explanation was given of both short and long sight, and of the means by which the errors of vision thus caused might be rectified. The lecturer, in illustration of the conditions of distinct vision, drew the watch-face nearer to the artificial eye, when a mere blotch was all that was to be seen on the retina, but on scraping the tracing-paper away the image was formed behind it. The same purpose was answered by introducing a bi-convex lens, which rendered the image perfectly sharp. By drawing the watch-face too far from the nut, there was again a blurred image, the focus falling within the nut. The introduction of a bi-concave lens changed the blurred image into one sharp and distinct, thus removing the defect. The luminous zone surrounding bi-concave spectacles on the screen was due, he said, to the divergence of the rays which was caused by spectacles of that kind. His own spectacles gathered up rays, and produced exceedingly sharp images of the carbon-points. Among the illustrations of persistence of visual impressions was one discovered by Dr. Tyndall the day before. A white taper was passed across a beam of light, when a luminous circle was seen.

Professor Tyndall's fourth lecture dealt with the eye as a sentient apparatus, one capable of conveying the impressions made upon it to the brain, and of exciting there the sensation of light. There was a colour at the back of the eye called the visual purple. This purple became bleached when the image of an illuminated object fell upon the eye, and various devices had been applied in cases of the eye's removal from its socket to render the image permanent. Breaking ground now upon a new portion of the subject, as the lecturer said, he could not do better than repeat the experiment of the great Sir Isaac Newton, by which he discovered the nature and constitution of light. Newton made a hole in a window-shutter, and allowed a sunbeam to pass through it and stamp itself as a round disc upon the opposite wall. He then placed a glass prism in the path of the beam, fully expecting to see the beam turned aside by refraction, but at the same time confident that the refracted image would be white. What he really saw, as a repetition of the experiment showed, was the prismatic spectrum with its seven colours, into which white light had, in fact, been analysed. The colours they saw on the screen were red, orange, yellow, green, blue, indigo, violet. Because a prism was used in producing them, they were commonly styled prismatic. Newton reblended the colours in various ways, and always found that when the mixture was properly made the original white light reappeared. They would follow the great philosopher in the synthesis, as they had done in his analysis; and to make the effect more plain and striking, the lecturer allowed the light to fall from a slit upon the prism, instead of from a hole, and without going further reblended the colours by means of a cylindrical lens, which, as he graphically expressed the effect, squeezed them together, producing a rectangle of perfectly white light. Next, resorting once more to the circular aperture, he built up from the coloured spectrum an image of the carbon points of the electric light which produced it. Abandoning now the common glass prism for Thollon's, he obtained a far more brilliant display, leading up to an examination of how the colours of natural objects—foliage, flowers, grass, and dyes—were produced. When the spectrum fell upon a red-flannel screen, they saw that red was the only colour given back by the flannel. What became of the other colours? They had been drunk in or absorbed, which was the scientific term, and had been destroyed, as light, by the flannel. The red light plunged into the flannel, struck on its fibres, and was reflected back to the eye. The fibres of the flannel were transparent to the red, and reflected the red, while the same fibres were opaque to all the other colours of the spectrum. This was the universal rule. A coloured body always sent back to the eye the particular light to which it was transparent, and no matter how vivid the light might be, bodies not transparent to it appeared black when the light fell upon them. Dr. Tyndall then produced on the screen a brilliant circle of red light, to which he exposed in succession a red, a green, and a blue disc. What, he asked, must be the result? There was neither green nor blue light in the red circle. Hence, the light giving the green and blue discs their colour was wanting. How, then, must these appear when the red light and no other fell upon them? The green and blue showed black, red, on the contrary, being redder than ever. On the removal of the red glass the blackness at once vanished, being replaced by the true colour.

THE EAR IN HEALTH AND DISEASE.

Dr. R. J. BLAIR CUNNINGHAME, Superintendent of Statistics in the Registrar-General's Department, delivered a lecture on "The Ear in Health and Disease," before the Edinburgh Health Society on Saturday last. Diseases of the ear, the lecturer remarked, were of very frequent occurrence. Their consequences were often very serious, affecting the comfort of the patient, his social pleasures, his local relations, his success in business, his intellectual development, and even the duration of his life. It was, perhaps, unfortunately somewhat true, that the very frequency of ear diseases and of deafness not very severe, were apt to make people affected with them, especially if no pain resulted, careless, and induced them not to think anything about the matter. This was a very great mistake, because affections of the ear ought to be attended to at once, as not a few deaths every year occurred from disease of the brain and its covering, which sprung in the first instance from affections of the ear. After describing the anatomy of the ear, and explaining the physiology of hearing and sound, the lecturer passed to speak of the disease of the ear. The ear flattened against the head, he remarked, was due to pressure; and this form of ear disease was more common to women, and was due to the wearing of the cap and bonnet strings. It tended to close up the outer tube, so that the wax which formed in the ear could not escape. The covering of the ear with anything hard upon it ought consequently to be avoided. Growths might occur in the ear by the wearing of ear-rings, and small inflammation, resulting from piercing, sometimes attacked the lobe of the ear, in which abscesses were apt to form. If these should occur, the best thing to do was to apply a little piece of wet lint. Referring to frost-bite, he said that the circulation in the ear not being so strong as in other parts of the body, it was liable, when exposed, to become dead and white-looking, and frozen. In such a case heat or even warmth should not be applied, as reaction took place too quickly. What was needed was gentle friction at first. A blow on the ear might cause the rupture of a blood-vessel and great swelling, and a form of skin disease frequently attacked the ear. When so affected it was red, and sometimes moist and very itchy, and rubbing or a stroke only tended to increase the inflammation. In the early stages of this affection; cleansing was necessary—washing with soap and warm water. Pulling the ears, which was not unfrequently done as a punishment to young children, should in no case be resorted to, as it was often attended with serious injury. Inflammation, and even disease of the bone might result, and in this way cause the death of young people. Deficiency of wax was considered by many a cause of deafness, but it was not so; and in alluding to this subject, the lecturer strongly impressed upon his hearers that pricking of the ear with a pin, or anything else, often caused great injury being done to the drumhead, which caused deafness. There were two cavities in the body into which a pin should not be put—namely, the mouth and the ear. For excess or hardening of the wax, which sometimes was accompanied by noises in the head, pains, and deafness, an easy remedy was to be found in the use of the syringe with a little tepid water. If they found the wax hardening, a little clean water, or with a little soda in it, might be put into the ear, and when any foreign bodies got into the ear, the simplest treatment was the use of the syringe. When insects got into the ear, generally causing intense pain, a little warm water, or a drop or two of oil, should be dropped in. If this were not effectual, the syringe must again be used. The best way of treating boils in the outer tube of the ear was to fill the ear with warm water from a spoon, or squeeze it from a sponge, but poulticing ought to be avoided. To prevent injury to the ear when bathing, and especially when diving, it was a very good plan to place a small bit of wadding in the ear. Alluding to the drumhead being often ruptured by loud sounds, the lecturer pointed out that the opening of the mouth, as was done by gunners discharging large guns, allowed the air to reach the ear through the air-valves in the throat connected with the ear, at the same time as it entered by the tube of the ear, and the effect of the wave-sound was thus equalised and prevented injury. Speaking of the effect of blows on the side of the head and ear, he advised parents and teachers never to apply to a child that form of punishment. If punishment was actually necessary it was better to go lower down. When injury to the drum resulted from picking, the best plan was to leave it alone, and not to put in any drops. Referring next to diseases in the middle ear, Dr. Cunninghame, speaking of running ears, said the disease was situated behind the ear, and, on account of the close contact with the brain, was exceedingly dangerous, as inflammation so early set in. One cause of this disease was often the dregs of scarlet fever, and he pointed out how extremely essential it was to give careful attention to the ear, especially if the child complained of pains in the head or ears. Another result of this inflamed condition was the presence of growths. These never occurred except as a consequence of running ears; so by attending to the one they might prevent the other. He recommended cleanliness, the washing out of the ear with tepid water, and the use of the syringe to prevent matter accumulating. The most common cause of deafness was the result of cold, perhaps neglected as not being serious; and as one means of preventing this draughts ought to be avoided. In conclusion, cleanliness was recommended as a means of taking care of the ears, and mothers were counselled not to twist up the end of a towel and force it into their children's ears, as what could be removed by the end of the little finger was sufficient. On the subject of deaf mutes, Dr. Cunuinghame highly approved of the German method of training them by labial or lip speech to make them useful members of society.

DYNAMO-ELECTRIC MACHINERY.—II.[*]

By Prof. S. P. Thompson, B.A., D.Sc.

Relation of Speed to Power.

THEORY shows that, if the intensity of the magnetic field be constant, the electromotive force should be proportional to the speed of the machine. Numerous experiments, by many different workers, have shown that this is true, within certain limits, for those machines in which the field magnets are independent of the main circuit, that is to say, for magneto and separately-excited dynamos. It is not, however, quite exact, unless the resistance of the circuit be increased proportionately to the speed, because the current in the coils itself reacts on the magnetic field, and alters the distribution of the lines of force. The consequence of this reaction is that, firstly, the position of the "diameter of commutation" is altered; and, secondly, the effective number of lines of force is reduced. So that, with a constant resistance in circuit, the electromotive force, and therefore the current, are slightly less at high speeds than the proportion of the velocities would lead one to expect. Since the product of current into electromotive force gives a number proportional to the electric work of the machine, it follows that, for "independently excited" machines, the electric work done in given time is nearly proportional to the square of the speed, and the work drawn from the steam-engine will be similarly proportional to the square of the speed.

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[*] Extracted from the Cantor Lectures, delivered before the Society of Arts.

In self-exciting machines, whether "series" or "shunt" in their arrangements, a wholly different law obtains. If the iron of the field-magnets be not magnetised near to saturation, then, since the increase of current consequent on increase of speed produces a nearly proportional increase in the strength of the magnetic field, this increase will react on the electromotive force, and cause it to be proportional more nearly to the square of the velocity, which again will cause the current to increase in like proportion. But since the magnetisation of the iron is, even when far from saturation point, not exactly proportional to the magnetising force, but something less, it is in practice found that the electric work of the machine is not proportional to the fourth power of the speed, is not even proportional to the third power of the speed, but to something slightly less than the latter.

As mechanical considerations forbid too high a velocity in the moving parts, it is clear that, if there be a limiting speed at which it is safe to run any given armature, the greatest amount of work will be done at that speed by using the most powerful magnets possible, namely, electro-magnets, rather than magnets of steel.

Field-Magnets.

The coils of the field-magnets of a dynamo cannot be constructed of no resistance. They, therefore, always waste some of the energy of the currents in heat. It has, therefore, been argued that it cannot be economical to use electro-magnets in comparison with permanent magnets of steel, which have only to be magnetised once for all. Nevertheless, there are certain considerations which tell in favour of electro-magnets. For equal power, their prime cost is less than that of steel magnets, which, moreover, are not permanent, but require remagnetising at intervals. Moreover, as we have seen, from the fact that there is a limiting velocity at which it is safe to run a machine, it is important, in order not to have machines of needlessly great size, to use the most powerful field-magnets possible. But if we do not get our magnetism for nothing, and find it more convenient to spend part of our current upon the electro-magnets, economy dictates that we should so construct them that their magnetism may cost us as little as possible. To magnetise a piece of iron requires the expenditure of energy; but when once it is magnetised, it requires no further expenditure of energy (save the slight loss by heating in the coils, which may be reduced by making the resistance of the coils as little as possible) to keep it so magnetised, provided the magnet is doing no work. Even if it be doing no work, if the current flowing around it be not steady, there will be loss. If it do work, say, in attracting a piece of iron to it, then there is an immediate and corresponding call upon the strength of the current in the coils, to provide the needful energy. This point may be illustrated by the following experiment:—Let a current from a steady source (see Fig. 14) pass through an incandescent lamp, and also through an electro-magnet, whose cores it magnetises. When once established, the current is perfectly steady, and none of its energy is wasted on the magnet (save the negligible trifle due to the resistance of the coils). But if now the magnet is allowed to do work in attracting an iron bar towards itself, the light of the lamp is seen momentarily to fade. When the iron bar is snatched away, the light exhibits a momentary increase; in each case resuming its original intensity when the motion ceases. Now, in a dynamo where, in many cases, there are revolving parts containing iron, it is of importance that the approach of a recession of the iron parts should not produce such reactions as these in the magnetism of the magnet. Large, slow-acting field-magnets are therefore advisable. The following points embody the conditions for attaining the end desired.

a. The body of the field-magnets should be solid. Even in the iron itself currents are induced, and circulate round and round whenever the strength of the magnetism is altered. The self-induced currents tend to retard all changes in the degree of magnetisation. They are stronger in proportion to the square of the diameter of the magnet, if cylindrical, or to its area of cross-section. A thick magnet will, therefore, be a slow-acting one, and will steady the current induced in its field.

b. Use magnets having in them plenty of iron. It is important to have a sufficient mass, that saturation may not be too soon attained.

c. Use the softest possible iron for field-magnets, not because soft iron magnetises and demagnetises quicker than other iron (that is here no advantage); but because soft iron has a higher magnetic susceptibility than other iron—is not so soon saturated.

d. Use long magnets. Again, the use of long magnets is to steady the magnetism, and therefore to steady the current. A long magnet takes a longer time than a short magnet to magnetise and demagnetise. It costs more than a short magnet, it is true, and requires more copper wire in the exterior coil; but the copper wire may be made thicker in proportion, and will offer less resistance. The magnetism so obtained should be utilised as directly as possible, therefore

e. Place the field-magnets or their pole-pieces as close to the rotating armature as is compatible with safety in running.

f. Avoid edges and corners on the magnets and pole-pieces if you want a uniform field. The laws of distribution of the magnetic lines of force round a pole are strikingly akin to those of the distribution of electrification over a conductor. We avoid edges and points in the latter case, and ought to do in the former. If the field-magnets or their pole-pieces have sharp edges, the field cannot be uniform, and some of the lines of force will run uselessly through the space outside the armature instead of going through it. Theoretically, the very best form to give eternally to a magnet is that of the curves of the magnetic lines of force.

g. Reinforce the magnetic field by placing iron, or better still, electro-magnets, within the rotating armature. In many cases this is done by giving the armature coils iron cores which rotate with them; in other cases, the iron cores, or internal masses are stationary. In the former case there is loss by heating; in the latter, there are structural difficulties to be overcome. Siemens has employed a stationary mass within his rotating drum-armature. Internal electro-magnets serving the function of concentrating the magnetism of the field, and of so providing a continuous magnetic circuit, have been used by Lord Elphinstone and Mr. Vincent. A similar device obtains in Sir W. Thomson's "mouse-mill" dynamo, and in Jürgensen's dynamo.

h. In cases where a uniform magnetic field is not desired, but where, as in dynamos of the second class, the field must have varying intensity at different points, it may be advisable specially to use field-magnets with edges or points, so as to concentrate the field at certain regions.

Pole-Pieces.

i. The pole-pieces should be heavy, with plenty of iron in them, for reasons similar to those urged above.

j. The pole-pieces should be of shapes really adapted to their functions. If intended to form a single approximately uniform field, they should not extend too far on each side. The distribution of the electromotive force in the various sections of the coils on the armature depends very greatly on the shape of the pole-pieces.

k. Pole-pieces should be constructed so as to avoid, if possible, the generation in them of useless Foucault currents. The only way of diminishing loss from this source is to construct them of laminæ, built up so that the mass of iron is divided by planes in a direction perpendicular to the direction of the currents, or of the electromotive forces tending to start such currents.

l. If the bed-plates of dynamos are of cast-iron, care should be taken that these bed-plates do not short-circuit the magnetic lines of force from pole to pole of the field-magnets. Masses of brass, zinc, or other non-magnetic metal may be interposed; but are at best a poor resource. In a well-designed dynamo, there should be no need of such devices.

Field-Magnet Coils.

m. In order to be of the greatest possible service, the coils of the field-magnets should be wound on most thickly at the middle of the magnet, not distributed uniformly along its length, nor yet crowded about its poles. The reason for this is two-fold. Many of the lines of force of a magnet "leak out" from the sides of the magnet before reaching its poles, where they should all emerge if the mass of the magnet were perfectly equally magnetised throughout it whole length. Internally, the magnetisation of the magnet is greatest at its centre. At, or near the centre, therefore, place the magnetising coils, that the line of force due to them may run through as much iron as possible. The second reason for not placing the coils at the end is this; any external influence which may disturb the magnetism of a magnet, or affect the distribution of its lines of force, affects the lines of force in the neighbourhood of the pole far more than those in any other region. It is for this reason that in Bell's telephones, where it is desired to make a magnet most sensitive to variations in intensity, the coils are fixed on at the pole. In the field-magnet of a dynamo, on the contrary, where the magnet is wanted to be as steady and constant as possible in its magnetic power, the coils should not be placed on the poles.

n. The proper resistances to give to the field-magnet coils of dynamos have been calculated by Sir Wm. Thomson, who has given the following results:—

For "Series Dynamo," make the resistance of the field-magnets a little less than that of the armature. Both of them should be small, compared with the resistance of the external circuit. The ratio of the waste by heating in the machine, to the total electric work of the machine, will be—

$$\frac{\text{waste:}}{\text{total work}} = \frac{R_M + R_A}{R_M + R_A + R_X}$$

$$\text{and } \frac{\text{useful work}}{\text{total work}} = \frac{R_X}{R_M + R_A + R_X}$$

where R_M is the resistance of the magnets,
R_A „ „ of the armature,
R_X „ „ of the external circuit.

For a "Shunt Dynamo," the rule is different. The best proportions are when such that

$$R_X = \sqrt{R_M R_A}, \text{ or that}$$

$$R_M = \frac{R_X^2}{R_A}$$

also the ratio of useful work is;—

$$\frac{\text{useful work}}{\text{total work}} = \frac{1}{1 + 2\sqrt{\frac{R_A}{R_M}}}$$

An example of the latter may be of advantage. Suppose it was wished that the waste should not be more than 10 per cent. of the useful work, the ratio of the formula must equal $\frac{10}{11}$, or $1 \div 1\frac{1}{10}$. Hence $\sqrt{\frac{R_A}{R_M}}$ must equal $\frac{1}{20}$; or R_M, the resistance of the field-magnets, must be 400 times R_A, that of the armature.

Armature Cores.

o. Theory dictates that if iron is employed in armatures, it must be slit or laminated, so as to prevent the generation of Foucault currents. Such iron cores should be structurally divided in planes normal to the circuits round which electromotive force is induced; or should be divided in planes parallel to the lines of force and to the direction of the motion. Cores built up of varnished iron wire, or of thin discs of sheet-iron separated by varnish, asbestos paper, or mica, partially realise the required condition.

p. Armature cores should be so arranged that the direction of polarity of their magnetisation is never abruptly reversed during their rotation. If this precaution is neglected, the cores will be heated.

Armature Coils.

q. All needless resistance should be avoided in armature coils, as hurtful to the efficiency of the machine. The wires should therefore be as short and as thick as is consistent with obtaining the requisite electromotive force, without requiring an undue speed of driving.

r. The wire should be of the very best electric conductivity. The conductivity of good copper is so nearly equal to that of silver (over 96 per cent.), that it is not worth while to use silver wires in the armature coils of dynamos.

s. In cases where rods or strips of copper are used instead of mere wires, care must be taken to avoid Foucault currents by laminating such conductors, or slitting them in planes parallel to the electromotive force; that is to say, in planes perpendicular to the lines of force, and to the direction of the rotation."*

t. In dynamos of the first class, when used to generate currents in one direction, since the currents generated in the coils are doing half their motion inverse to those generated during the other half of their motion, a commutator or a collector of some kind must be used. In any single coil without a commutator, the alternate currents would be generated in successive revolutions, if the coil were destitute of self-induction currents, whose variations may be graphically expressed by recurring sinusoidal curve, such as Fig. 10. But if by the addition of a of a simple split-tube commutator the alternate halves of these currents are reversed, so as to rectify their direction through the rest of the circuit, the resultant currents will not be continuous, but will be of one sign only, as shown in Fig. 11, there being two currents generated during each revolution of the coil. If two coils are used, at right-angles to each others' planes, so that one comes into the position of best action, while the other is in the position of least action (one being normal to the lines of force, when the other is parallel to them), and their actions be superposed, the result will be, as shown in Fig. 12, to give a current which is continuous, but not steady, having four slight undulations per revolution. If any number of separate coils are used, and their effects, occurring at regular intervals, be superposed, a similar curve will be obtained, but with summits proportionately more numerous and less elevated. When the number of coils used is very great, and the overlappings of the curves still more complete, the row of summits will form practically a straight line, or the whole current will be practically constant.

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* It will be observed that the rule for eliminating Foucault currents is different, in the three cases, for magnets and their pole-pieces, for moving iron armature cores, and for moving conductors in the armature.

u. The rotating armature coils ought therefore to be divided into a large number of sections, each coming in regular succession into the position of best action.

v. If these sections, or coils, are independent of each other, each coil, or diametral pair of coils, must have its own commutator. If they are not independent, but are wound on in continuous connection all round the armature, a collector is needed, consisting of parallel metallic bars as numerous as the sections, each bar communicating with the end of one section and the beginning of the next.

FIG. 10.

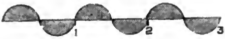


FIG. 11.

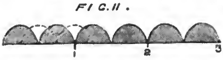
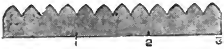


FIG. 12.



w. In any case, the connections of such sections and of the commutators, or collectors, should be symmetrical round the axis; for if not symmetrical, the induction will be unequal in the parts that successively occupy the same positions with respect to the field-magnets, giving rise to inequalities in the electromotive force, sparking at the commutator, or collector, or other irregularities.

x. In the case where the coils are working in series, it is advantageous to arrange the commutator to cut out the coil that is in the position of least action, as the circuit is thereby relieved of the resistance of an idle coil. But no such coil should be short-circuited to cut it out. In the case where the coils are working in parallel, cutting out an idle coil increases the resistance, but may be advisable to prevent heating from waste currents traversing it from the active coils.

y. In the case of pole-armatures, the coils should be wound on the poles rather than on the middles of the projecting cores; since the variations in the induced magnetism are most effective at or near the poles. (See § *m*).

z. Since it is impossible to reduce the resistance of the armature coils to zero, it is impossible to prevent heat being developed in those coils during their rotation; hence it is advisable that the coils should be wound with air-spaces in some way between them, that they may be cooled by ventilation.

aa. The insulation of the armature coils should be insured with particular care, and should be carried out as far as possible with mica and asbestos, or other materials not liable to be melted, if the armature coils become heated.

(*To be continued.*)

WIMSHURST'S INFLUENCE MACHINE.

ON p. 153 we illustrated and described a multiplate electrical induction machine, devised and constructed by Mr. Jas. Wimshurst, of the Board of Trade. That gentleman has now added to his reputation as a scientific inventor by constructing a machine, the description of which we extract from an article in *Engineering*:—

This new machine consists of two circular discs of ordinary window-glass 14½in. in diameter, mounted upon a fixed horizontal spindle in such a way as to be rotated in opposite directions at a distance apart of not more than ¼in. Each disc is attached to the end of a hollow boss of wood, or of ebonite, upon which is turned a small pulley. This is driven by a cord or belt from a large pulley, of which there are two attached to a spindle below the machine, and which is rotated by a winch handle, the difference in the directions of rotation being obtained by the crossing of one of the belts.

Both discs are well varnished, and, attached by cement to the outer surface of each are twelve radial sector-shaped plates of thin brass disposed around the discs at equal angular distances apart, which play a very similar part in the action of the apparatus to the "carriers" of Nicholson's "revolving doubler," and those of the "Replenisher" of Sir William Thomson; but it would appear that they do more than this, and that they take the place also of the "inductors" in both those instruments—for there is nothing else in Mr. Wimshurst's apparatus to correspond with those parts—and it is probable that the carriers of the one disc act as inductors to the other.

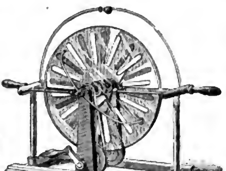
The two sectors, situated on the same diameter of each disc, are twice in each revolution momentarily placed in metallic connection with one another by a pair of fine wire brushes attached to the ends of a curved rod, supported at the middle of its length by one of the projecting ends of the fixed spindle upon which the discs rotate, the brass sector-shaped plates just grazing the tips of the brushes as they pass them.

The position of the two pairs of brushes with respect to the fixed collecting combs, and to one another, is variable, as each pair is capable of being rotated on the spindle through a certain angular distance; and there is, as in the case of the collecting commutator-brushes of dynamo-electric apparatus, one position of maximum efficiency. This position in the machine we are now describing appears to be when the brushes touch the discs on diameters situate about 45° from the collecting combs, and 90° from one another. To make this clear, let us suppose the twelve sector-shaped plates to be numbered round like the hours of a clock, from I. to XII., then opposite plates, such as XII. and VI., X. and IV., VIII. and II., if on the front disc, would be momentarily connected together when passing the diameter, joining a point mid-way between X. and XI. and IV. and V. on a clock-face; and, if on the back disc, they would be connected when passing between I. and II., and VII. and VIII.

The fixed conductors consist of two forks furnished with collecting combs directed towards one another and towards the two discs which rotate between them, the position of the two forks, which are supported on ebonite pillars, being along the horizontal diameter of the discs. To these collecting combs are attached the terminal electrodes whose distance apart can be varied by the two projecting ebonite handles shown in the illustration.

The presence of these collecting combs appears to play no part in the action of the apparatus except to convey the electric charge to what may be termed the external circuit, for the inductive action of the machine is quite as rapid and as powerful when both collectors are removed, and nothing is left but the two rotating discs and their respective contact or neutralising brushes, the whole apparatus bristling with electricity, and if viewed in the dark presenting a most beautiful appearance, being literally bathed with luminous brush discharges.

It is one peculiarity of this interesting machine that it is only with the greatest difficulty that the polarity of its electrodes can be reversed, and in this respect it has a very decided advantage over most of the induction machines. It is difficult to account satisfactorily for the exceptionally high efficiency of the apparatus, which is considerably more powerful than a Voss machine of equal size and of much greater weight (for in the first experimental machines which Mr. Wimshurst has constructed for himself the extreme lightness is most remarkable). With a machine of the size we have described, which is shown in the illustration, there is produced under ordinary atmospheric conditions, a powerful spark discharge between the electrodes when they are separated by a distance of 4½in., a pint size Leyden jar being in connection with each electrode, and these 4½in. discharges take place in regular succession at every two and a half turns of the handle. This remarkable efficiency may be partly due to the duplex action of the apparatus, both plates being active and contributing electricity to the collecting combs, the sector-shaped plates of brass acting as *inductors* when in their position of lowest efficiency as *carriers*, and as *carriers* when in the positions at which their inductive effect is at a minimum, and *vice versâ*, and as it follows from the construction of the instrument that the inductors of the one disc are at the position of highest efficiency when those of the other are at their lowest, and *vice versâ*, and as this applies with equal force to the sectors when considered as carriers, it also follows that the charging of the electrodes, and therefore the discharge between them, is by mutual compensation maintained constant. The machine is, moreover, perfectly self-exciting, requiring neither friction nor the spark from any outside electric exciter to start it. This is one of the most remarkable features of the apparatus, for under ordinary conditions the machine is working at its full power after the second or third revolution of the handle. We are inclined to think that this initial charge is obtained not so much as in Sir William Thomson's replenisher from a minute difference of electrical potential between two parts of the apparatus—for the insulation is hardly perfect enough to allow so minute a difference to be so enormously increased in so short a time—but rather from the frictional influence of the air, and that chiefly between the plates—that is to say, on the surfaces opposite to those to which the sectors are attached. Within this narrow space the air friction must be far greater than on the outside surface, on account of the two discs rotating in opposite directions. Whether, however, the initial charge be derived from air friction or not, its generation is a point of very great interest, and this is especially conspicuous in the remarkable experiment to which we have referred, in which both conductors are removed, and the most brilliant electrical effects are produced when the apparatus consists simply of two discs rotating in opposite directions, with no fixed conductors except the light conducting brushes.



From the above description and illustration it will be apparent that the apparatus can be constructed for a few shillings, and thus a very useful and highly instructive generator of static electricity is by Mr. Wimshurst's latest invention, placed within the reach of all. Having constructed several machines himself, Mr. Wimshurst is of the opinion that amateurs, possessing an average amount of skill, and having facilities for making the parts, can construct a machine of this kind for a very small sum, as the materials cost but little. If such a result can be obtained, Mr. Wimshurst will, besides having won the gratitude of the scientific world for having made a valuable contribution to the science of electricity, deserve the thanks of teachers and students for placing in their hands a much-needed instrument for the induction and production of electricity.

CONDUCTION OF SOUND IN FREE AIR.

THAT the intensity of sound heard in air decreases in the ratio of the square of the distance, has been accepted as an unquestionable dogma of physical and physiological acoustics, and a necessary postulate of the fundamental principles of dynamics. Recent experiments by Herr Vierordt, however (of which an account appears in *Der Naturforscher*), appear to cast some doubt on it.

Sounds and tones of various intensity may be produced, of course, by dropping weights on a plate that is capable of vibration. In calculation, one must not take (as was formerly done *à priori*) the *vis viva* of the falling body at the moment of striking the plate, and so the square of the velocity, as measure of the sound-intensity, but simply the velocity. This has been previously shown by experiments, both by Herr Vierordt and by Herr Oberbeck.

In the first of Herr Vierordt's experiments to be now considered, a sound-pendulum was used, which set in vibration a small vertical ivory plate; the intensity of the sound could always be determined in the simplest way from the angle of elevation of the pendulum. The ear of the observer was first placed at that distance from the source of sound at which, when the pendulum was raised only a few degrees, and let fall, he could just hear the sound. This was the case at 13·74m. (say, 45·8ft.) distance, and 5° elevation; and these values varied but little in different experiments on the same day or on different days. Then four distances were measured from the source of sound, which were as 1 : 2 : 3 : 4, and for each the angle of elevation, or intensity of sound, was measured, which was necessary to produce the sensation of sound.

The numbers obtained on two days of experiment proved that for production of just perceptible sensations, intensities are required which (approximately) increase in proportion to the distances of the ear from the source of sound.

To examine further the weakening of sound at very great distances, Herr Vierordt procured a larger pendulum apparatus giving stronger sounds, and made the experiments in the evening, in calm weather, and in an open place, where the possibility of reflection was excluded. The measured distances from the source were again as 1 : 2 : 3 : 4; and the nearest station was 54·96m. (say 183ft.) In a last series of experiments stronger sensations of sound were produced from a sound-pendulum standing near, and with these were compared the impressions from a second apparatus, which, for particular distances, required different angles of elevation to produce equality of sensation.

The values obtained in the last series show that for production of equally strong sensations at different distances of the ear from the source, intensities of sound increasing by about the same amounts are required. In this case, therefore, the result was the same as in the other; that is, from one distance to another the intensity of the sound is always diminished about equally.

Lastly, the same law was verified in large rooms, provided the experiment was made only with very weak sounds, so that disturbing reflections from the walls were avoided.

Herr Vierordt accordingly formulates the seemingly strange result that *the intensity of sound in free air decreases in the simple ratio of the distances from the source of sound.*

"To the objection that (as I am very well aware) my representations are absolutely in conflict with the laws of physics, and especially with all that it has hitherto been necessary to accept regarding the propagation of spherical waves, I must reply," says the author, "that I do not take my stand on theoretical grounds, but only and exclusively on facts acquired experimentally, which cannot be simply denied. My affirmation, also based only on experiment, that the ordinary measure of sound intensity is false, is also in direct contradiction to the theory accepted, as beyond doubt this contradiction will disappear, and the contradiction of theory arising from the facts of experiment just given will find a satisfactory explanation, if facts discovered by me first appear inexplicable or even impossible.

"I only remark further, that, as I have found in numerous experiments, which I will not here stay to describe, sound in its progress through media of invariable cross section is always weakened by unit length of the medium, about exactly the same absolute amount (depending on the aggregate form and the special nature of the medium). This highly unexpected law is confirmed in cylinders of wood, metal, ice, &c., in open troughs of uniform cross section, filled with water or other dropable liquids, as also, lastly, in air columns inclosed in pipes of uniform width. Sound is thus propagated according to quite different laws from, e.g., those of light."

To any one inclined to doubt this result, Herr Vierordt recommends a simple experiment. By dropping a ball from 6ctm. (say 2·4in.) and 0·57ctm. (say ·22in.) produce two different sounds, whose intensity in this case will be in the ratio of 4 : 1, and listen to them first at a distance of 1m. (say 3ft. 4in.), then at a distance of 2m. (say 6ft. 8in.). The most unpractised will perceive that the intensities are not weakened in the ratio of the squares. He who has convinced himself of this will then willingly accept also the positive statement that the sound intensity diminishes in the simple ratio of the distance from the sound source, and convince himself of its correctness by experiments.

Herr Vierordt suggests the possibility that the law of sound conduction arrived at by him through numerous experiments may depend on special objective properties of the sound vibrations, perhaps caused by friction of particles on each other, and requiring further investigation.

Der Naturforscher says that the contradiction here pointed out may find its explanation in the observation of Lord Rayleigh, that the intensity of air vibrations, as measured by a special apparatus, often stands in no relation to the simultaneous sensation of hearing.

A BRIEF HISTORY OF ELECTRICITY AND ELECTRIC LIGHTING.[*]

By W. J. LANCASTER, F.C.S., F.R.A.S.

HAVING thought that a brief history of electricity would be of interest to our members, I have searched through some scores of volumes, old and new, and present the following with the best wishes of this festive season. The first record I have to note relates to 4,500 years ago.

At this remote period of our earth's history, the Chinese were acquainted with the power possessed by loadstone, of attracting particles of iron. Whether they knew of attraction and repulsion we cannot tell, and nothing is recorded of any further knowledge of magnetism or electricity until some 2,000 years later, or 580 B.C., when Thales of Miletus, the founder of the Ionic philosophy, discovered that amber (electron), when rubbed, possessed the power of attracting particles of decayed leaves, pieces of straw, &c. Thales believed that amber was an animate body, and, in fact, regarded the world as a living being, and that everything was derived from water. Again, another period of over 2,000 years elapsed without any important fact being recorded; when, in A.D. 1576, Robert Norman discovered that when a nicely-poised needle was magnetised, the North end became apparently heavier, and the South pole had to be weighted to give again a true balance; hence the inclination of the magnetic-needle was discovered by Norman. Some twenty-four years later, in A.D. 1600, Dr. Gilbert, of Colchester, wrote a small work, entitled, "Physiologia nova de Magnett et de Tellure magno magnete," in which he describes some new experiments, proving that other bodies besides amber had similar properties under like conditions. Among such substances he enumerates glass, resin, spars, gems, stones, sulphur, &c., and he first gave the terms North and South Pole; also a theory accounting for terrestrial magnetism. Although Dr. Gilbert's work was received with enthusiasm, three-fourths of a century had nearly elapsed before anything worth recording took place; when, in 1672, Otto Guericke, in his work, "Experimentor nova Magdeburdica," announced his discovery of a machine consisting of a ball of sulphur, which, when rubbed by the hand, produced sparks of electricity. Three years later, in 1675, Sir Isaac Newton found that a glass globe was preferable to a ball of sulphur; and Sir Isaac also found that by rubbing a flat glass held a short distance above the table, small bodies on the table were lifted towards it. He also found that different materials used for rubbing produced different results; some causing a violent attraction, and others a weak attraction only. In the same year, 1675, Robert Boyle found that not only did the rubbed amber attract other bodies; but that when the amber was suspended, so as to move easily, the amber itself was also attracted by the body acted upon; in other words, that the attraction was mutual.

The 17th century closed without any further discovery being reported, and in 1729, Stephen Grey, a pensioner at the Charterhouse, after numerous experiments, found that bodies were either conductors or non-conductors of electricity, and he conducted a current through wet string, the first experiment, leading on to the establishing of telegraphs throughout the world. Four years later, in 1733, Dufay discovered that conductors were non-electrics; and that non-conductors were electrics. He also distinguished between positive and negative electricity. For several years after this period, attention was directed to the perfecting of the frictional electric machine, the most important additions being, in 1740, the prime conductor, by Boze, of Wittenberg, and the fixed rubber, by Winkler, of Leipsic. Just after this, in 1746, Muschenbrock, and his pupil Cuneus, of Leyden, were endeavouring to electrify a flask of water, which Cuneus held in one hand, while a chain from the machine dipped into the water. After the machine had been turned some time, Cuneus, in the act of removing the chain received a severe shock. This was the origin of the Leyden jar, and, as it was the first experiment proving that electricity could be stored, it may rank as the forerunner of all storage apparatus. One of the greatest discoveries about this time was that in 1749, of Franklin's, by which he obtained a parallel between lightning and electricity. After a considerable number of experiments with a large battery of Leyden jars he, in June, 1752, during a storm, flew a kite having metallic points; with this and a key attached to the lower end of the packthread, and from this a silk cord attached to a tree, he obtained a considerable number of sparks; not until, however, the rain had saturated the thread. From these experiments, Franklin invented the lightning-conductor. From Philadelphia we must travel to Pavia, where, in 1775, Volta invented the electrophorus, in 1782 he made the condenser, and in 1799 he made his famous voltaic-pile. While Volta was at work in experiments in frictional electricity, at the neighbouring town of Bologna, Galvani was making equally important experiments; but in an opposite direction. Thus, in 1780, Galvani discovered the contraction in a frog's leg, when the crural nerve was connected to a metallic support, and the electrical machine, worked at every spark he found a consequent contraction of the leg. In 1786 he obtained the same effect by the contact of two dissimilar metals, and after a great number of experiments, in 1791 he published a complete account of them, which led to a considerable amount of correspondence between Galvani and Volta; but the first to explain the true cause of the action in 1792 was Fabroni, of Florence, who enunciated the theory that chemical action was the sole cause. This theory was further confirmed in 1800-7, by Davy, who immediately had made a large number of cells, some 2,000 in all. A full and a most interesting account of these cells, and the then remarkable experiments and researches made with them, may be found in the "Bakerian Lectures," of Nov. 20, 1806, and Nov. 19th, 1807; in the latter one, Davy foreshadows his discovery in 1809 of the electric light, which he obtained from two pencils of charcoal, each 1in. long and ⅛in. in diameter; the spark obtained, when the points touched, was increased to an arc 4in. in length by the separation of the carbon points; afterwards an arc of 7in. was obtained in an exhausted receiver, and so intense was the heat that Davy tells us not only were the charcoal points consumed, but also the platinum wire to which they were attached was melted and fell down in large globules; since that time only 70 years have elapsed, and it will be quite impossible for me to chronicle one-tenth of the discoveries and inventions made in this period of time. I shall content myself by simply pointing out the most important of the discoveries connected with electric lighting, leaving it to my readers to study the subject if they wish to know something of that force which is destined to occupy an important place in the near future.

A discovery of the utmost importance was made in the latter part of the year 1819 by Oersted, the then secretary of the Royal Society of Copenhagen. He had, in 1813, published a work in which he hinted at a connection between magnetism and electricity, but it was six years later when he made the important discovery that a current of electricity passing through a wire over a magnetic needle caused the needle to deflect. The announcement of this experiment excited the greatest interest among all the philosophers of Europe, and in 1820 Arago invented the electro-magnet; Schweigger, of Halle, also invented the galvanometer, which Ampère first exhibited at a meeting of the Royal Academy of Sciences, and in the following year, 1821, Faraday discovered electro-magnetic rotation; a full account of his experiments are contained in the *Philosophical Transactions* for 1823; but the most important of the great discoveries of the noble Faraday was that in 1831, when he obtained electricity from the inductive action of terrestrial magnetism. In the year following, 1832, Pixii made the first magneto-electric machine, which was improved and added to in 1833 by Saxton, of Philadelphia, who made the bobbins to rotate in place of the rotating magnet of Pixii. Other improvements have been made; but one of the most important was that by Siemens, in 1854, of his armature, in which the wire was wound longitudinally instead of tranversely, as in the old machines. The first time the electric light was used in a public manner was in 1836, when it was used to illustrate the rising sun in "Le Prophète," at the Opera, in Paris. How different to the magnificent effect of the electric lighting in the present Opera House. Four years later, 1840, the first patent (No. 8644) was taken out by Henry Pinkus for electric lighting; a number of patents were granted year by year. In the year 1845, a patent was taken out by Starr and Peabody for an incandescent lamp, consisting of platinum wire; and in 1847, Foucault and Duboscq made the first regulator for an arc light; soon after this, Serrin made his famous regulator: this entirely superseded the former one of Foucault and Duboscq. In 1849, Professor Nollett, of Brussels, commenced a machine, which was not finished during his lifetime; but was afterwards completed by Berlioz and Melderen. This machine, called the Alliance, contained 48 compound magnets, and when the armature was rotated, a brilliant light was obtained; but this machine, although used at that time in several lighthouses in France, was soon replaced by smaller and more perfect machines. In 1854, Siemens made a great improvement in the armature, which I have before mentioned; then came the machines of Wilde, Holmes, Ladd, and others, and during a period of some 18 years but little was done to keep up the excitement of 1840-6; but in the year 1872 Gramme made his justly celebrated dynamo, which has yielded him fame, gold medals, and other rewards, and as a consequence of his success others followed, and some hundreds of dynamos have been made—some good, others bad—and among other inventions connected with electric lighting is that in the year 1876, by Jablochkoff, of the candle which bears his name; also in 1878 Edison introduced his platinum incandescent lamp; again, in the same year, Brush made his famous dynamo and arc lamps, and in 1881 Maxim made his incandescent lamp, using carbonised cardboard. Lane-Fox also made an incandescent lamp, using carbonised broom, Edison's using carbonised bamboo, and Swan, who uses carbonised parchment, and in the same year, amid considerable puffing, Faure's accumulator came on the scene, and remains almost as it was. But there are reasons why the accumulator should become a great success, and with the amount of brain energy devoted to it we shall no doubt, during 1883, have a more perfect accumulator. It has been impossible to mention even the names of the numerous systems of electric lighting, but I have to mention a system which has occupied considerable attention, and which has been most successful where adopted. I refer to the 1882 Crompton system of electric lighting, of which the Crompton Winfield Association are the proprietors. The association manufacture the Crompton electric arc lamps, Burgin dynamo machines, electric mains, electric lanterns, and all kinds of ornamental fittings for use in electric lighting. Beginning with the Bürgin dynamo, which is a recent introduction into England, I may state that although at first it was an excellent machine, still Mr. Crompton has so much improved its construction that it is now known as the Crompton-Bürgin machine. The current produced by it is a continuous one, equally applicable for either arc or incandescent lamps, and its current being, as I have stated, continuous, there is no danger of even the slightest accident or even death, as is the case with an alternating current. The dynamo consists essentially of a large pair of electro-magnets, forming the framework, having similar poles in close contact thus, N. to N. and S. to S. Between the N. and S. poles a space is bored out truly cylindrical, and is fitted with gun-metal covers, having central bosses, in which revolves a turned steel spindle, driven by a steam-engine. Upon this spindle are secured, side by side, but in moderately open order, a number of coils of insulated copper wire, so disposed that when revolving with the spindle, the rings of each coil cut through the lines of force of the electro-magnets, and induce a current of electricity, becoming more intense in proportion to the number of layers of wire in each coil, and also to the speed of rotation. The coils are built on radial arms from the spindle, as to bring them as nearly as possible to the inner surfaces of the pole-pieces of electro-magnets when rotating, so that the whole cylindrical space is lined with the coils. From each coil there are two free ends of wire, all of them being led out to one end of spindle; they are there connected to separate insulated strips forming the commutator; the current is collected from this commutator by a couple of metallic brushes diametrically opposite to each other; these convey the current first through the coils of wire on the large electro-magnets, called the field magnets, and thence to binding posts, from which a cable conveys the current to be used up, either as an illuminant, or as a source of power. For an arc light a regulator must be used, and for incandescent lighting either of the systems I have before mentioned is satisfactory. In the lighting of our own institute, the Crompton Winfield Association use Swan's lamps, of which there are over 40 in the circuit; these incandescent lamps are very satisfactory, and have an average life of 1,000 hours; some, however, have lasted longer than this. Of the fittings, I can only say that the beauty of Messrs. R. W. Winfield and Co.'s productions is well known, and they have, not only here, but in the Town Hall, Birmingham, the Mansion House, London, the New Law Courts, &c., &c., added lustre to a reputation already world-wide and unsurpassed. I have only to add that Messrs. Winfield and Co. will be happy to show at their own offices and show-rooms their contributions to practical electric lighting to anyone interested in the subject.

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[*] Submitted by the author at the Birmingham and Midland Institute Conversazione, January, 1883.

USEFUL AND SCIENTIFIC NOTES.

Patents in 1882.—The number of patents applied for during the year just expired shows a considerable increase over the applications of the year 1881. The steady rise in the business of the Patent Office may be best exhibited by taking the figures of the last few years, which are as follows:—1870, 3,405; 1871, 3,529; 1872, 3,970; 1873, 4,294; 1874, 4,492; 1875, 4,561; 1876, 5,069; 1877, 4,949; 1878, 5,343; 1879, 5,338; 1880, 5,517; 1881, 5,751; 1882, 6,241. As regards the applications of last year, no fewer than 1,531, or about 25 per cent., originated within the limits of the London postal district (because the majority of patent agents have their offices within those limits). The United States furnished 799, or very nearly 13 per cent. The number of applications from France reached 544, or something under 9 per cent., showing a slight falling off from the applications in 1881, which amounted to 552. On the other hand, Germany contributed 499, or about 8 per cent., as against 465 in the previous year.

Tempering Mill Bills.—The *American Miller* gives the following composition for tempering cast-steel mill bill:—"To three gallons of rain water add three ounces of spirits of nitre, three ounces of hartshorn, three ounces of white vitriol, three ounces of sal-ammoniac, three of alum, and six ounces of salt, with two handfuls of the parings of horse's hoof. The steel should be heated a dark cherry red. A large jug of this preparation should be kept corked tight so that it may not evaporate nor lose its strength." We imagine this recipe is rather old, as we have some recollection of it being specially recommended for tempering chisels to pick French burr stones.

During the year just closed there were reported 28 mining explosions, 16 of which were fatal, the number of deaths reaching 241, exactly the average for the past 32 years. Of 32 warnings issued, 19 were justified by subsequent events, 12 were followed within three days by the loss of 139 lives in 15 explosions, and 66 lives were lost on the fifth and sixth days after the issue of warnings. In each case these warnings denoted a continuance of dangerous changes.

Amongst lubricating oils, fine mineral oils stand first on the list of those which adhere well to metal surfaces, but are without perceptible molecular cohesion. Sperm oil stands second; neatsfoot third; and lard oil fourth.

SCIENTIFIC NEWS.

ELEMENTS of the great comet of 1882, computed by Prof. Frisby, of the U.S. Naval Observatory, bear, he says, a close resemblance to Comet I., B.C. 371; and he thinks the recent appearance may be possibly its third return, a very brilliant comet having been seen in full daylight, A.D. 363.

An abstract of the proceedings of the Liverpool Astronomical Society contains the substance of the papers read before the Society at its meeting last month—viz., the "Probable Variability of Beta Leonis," by Mr. J. E. Gore, F.R.A.S., in which the author concludes that the star is less brilliant than it was formerly; "Note on the Order of Discovery of the Details of the Great Comet," by T. E. Espin, B.A., F.R.A.S.; "Lunar Atmosphere," by W. H. Davies; and "Recent Observations on Jupiter," by W. F. Denning, F.R.A.S.

The Gresham Lectures will be read to the public, in English, at 6 p.m., in the theatre of Gresham College, Basinghall-street, in the following order:—Geometry (the Dean of Manchester), 16th, 17th, 18th, and 19th of January; Law (Dr. Abdy), 23rd, 24th, 25th, and 26th of January; Rhetoric (Mr. J. E. Nixon), 30th and 31st of January, and 1st and 2nd of February; Physic (Dr. Symes Thompson), 5th, 6th, 8th, and 9th of February; Music (Dr. Henry Wylde), 13th, 14th, 15th, and 16th of February; Divinity (the Dean of Chichester), 20th, 21st, 22nd, and 23rd of February; and Astronomy (Rev. E. Ledger), 27th and 28th of February, and 1st and 2nd of March.

A course of lectures on "Voltaic and Dynamic Electricity and Magnetism, and their Practical Applications," will be delivered on Monday afternoons, at King's College, by Prof. W. Grylls Adams, and a course of practical work will be carried on in the Wheatstone laboratory under his direction. The laboratory will be open every afternoon except Saturday. The lectures and work commence next Monday.

It is stated that several artists have combined to have their studios illuminated by incandescent lamps. The fact that combination is necessary looks as if there was not much probability of electric energy being sent out in storage batteries at so much per cell.

Mr. C. E. Stretton sends us an account of a visit he paid to the factory of Messrs. Corah, Sons, and Cooper to see the electric light installations. There are fourteen arc lamps of the Brush type, any of which can be switched out of the circuit, and eighteen Swan incandescent lamps for the offices and private rooms. By means of the electric light, colours can be readily distinguished, and thus work can be continued, without daylight, at Messrs. Corah's factory. Mr. Stretton thinks that electric light might be used with advantage at some of the large junctions and shunting yards, where many of the employés are injured in consequence of having to perform their dangerous duties in comparative darkness.

M. Gaston Planté has received the gold medal of the Société d'Encouragement, which was awarded at the annual meeting for 1882, for his work on the accumulation of electricity.

Messrs. Brown, Barnes, and Bell, of Bold-street, Liverpool, send us some specimens of "Photo-filigrane," a method of producing the effects of water-marking in the body of ordinary paper, by pressing it between specially hard rollers, temporarily engraved by photographic means. The process is the invention of Mr. W. B. Woodbury, and the effect is caused by the portions of the paper which are compressed by the design engraved on the rollers being rendered more transparent to transmitted light, and darker in colour by reflected light. Half-tones or gradations of light are thus reproduced. Amongst the samples are visiting cards, which held up to the light convey the impression that a photograph is buried in the substance of the paper, portrait and ornamental notepaper, and business stationery in which the specialité of the firm is indicated by the photo-filigrane watermarking. The process is believed to be specially useful for producing designs upon bills of exchange, cheques, &c. The cost of the process is said to be moderate.

The great value of the Westinghouse brake was exemplified once more the other day, when a down express was promptly stopped and prevented from running into the wreck of a coal train which had fouled the down line near Angel-road station, on the Great Eastern Railway. It appears that a signalman, finding that something was wrong with a coal train approaching him on the up line, had the presence of mind to block the down line by throwing up his home signal almost in the face of the driver of the down express, which had already passed the distant signal. Thanks to the power of the Westinghouse brake, and the fact that it is placed in the hands of the driver, the train was brought to a stand in 200 yards. What would have been the result if the driver had had to whistle for the brakes, can be easily imagined. It is satisfactory to learn that the coolness and promptitude of both driver and signalman have met with recognition and reward.

M. Blanchard has been elected President of the Académie des Sciences. Prof. Bunsen has been elected a foreign associate in the place of the late Dr. Wöhler. There are only eight foreign associates, and three of them are English—Prof. Owen, Sir G. B. Airy, and Sir W. Thomson.

Count Wilczek has been elected president of the Vienna Geographical Society, Dr. Von Hochstetter, who has held the post for many years, having been nominated honorary president for life.

Since 1870, the number of patents applied for every year has steadily increased, and for 1882 it reached the unprecedented number (for this country) of 6,241. About 13 per cent. came from the United States.

In the environs of Paris, from about four to seven miles, are numerous industrial works, warehouses, &c., the proprietors or managers of which have their homes or offices in Paris. At present there are only two means of communication open to the merchant—the use of the ordinary telegraph, if there be a telegraph office near the works, or a private telegraph wire to be fixed at his own expense. The latter is virtually impracticable on the score of cost, and there are hardly any private lines. The former method often involves long delays, so that one might as well send an employé to the works. To remedy this state of things, the General Councillors of the Suburban Cantons have proposed to the General Council of the Seine the establishment of telephonic communications between Paris and its environs. It is pointed out that this will not make a breach in the monopoly the State reserves in the creation of telephonic lines, that it will increase the resources of the Treasury by increasing the number of subscribers to the Société Générale des Telephones.

A new method of recognising blood-stains where they have been partly washed out or altered by decay, has been recommended by Signor Filippi. It depends on the iron in blood. The suspected parts of the tissue are macerated 24 hours in alcohol of 95 per cent. strength, to which one-twentieth of sulphuric acid has been added. The liquid is poured off, and made strongly alkaline by adding an alcoholic solution of ammonia; then it is heated to boiling in a water-bath, and filtered. On the filter remains a precipitate of sulphate of ammonia, which is washed with alcoholic ammoniacal liquid. The liquid is vapourised and the residue calcined. If hæmatin is present, red spots appear on the sides of the porcelain dish, and these dissolved in a drop of nitro-muriatic acid, give the well-known iron reactions with ferro- or sulpho-cyanide of potassium. It is advisable to make a testing experiment with a stainless part of the same tissue.

The obituary of 1882 contains many well-known names in Continental science. We may note the following:—Wöhler, Van Monckhoven, Wolf, Von Kobell, Reich, Zöllner, Bergsma, Reinhard, Reitlinger, Mauser, Schwann, von Burg, Schlegel, Decaisne, Hildebrand, Desor, Poitevin, Giffard, Leclanché, Plantamour, Marino Palmieri (see *Chemiker Zeitung*, 31 Dec.)

Attention is called, in *Stahl und Eisen*, to the great difference that prevails with regard to the value of a ton. In England, in the copper industry, one ton of ore is sold with 21cwt. = 2,352lb., but cast copper with 2,440lb.; one ton of coal = 2,240lb., and in Newcastle, 30 cwt.; in America, wholesale, 2,240lb., retail, 2,000lb. In the American iron trade there are no fewer than five different "tons" in use, with the several values of 2,000lb., 2,204·63lb., 2,210lb., 2,268lb., and 2,464lb.

The high conducting-power of certain solids for sound has been long applied (according to M. Gobin), for ascertaining the progress of gravels on the bed of the Rhone. If one is in a boat, it is sufficient to place one end of a cane in the water and apply the ear to the other; one then hears very distinctly the noise produced by the shock of pebbles carried along by the stream. The sound is described as crackling similar to that produced in frying: now and again more pronounced shocks are heard, on impact of large stones.

In a note to the Paris Academy accompanying his six admirable photographs of the comet, Mr. Gill, of Cape Town, says that, considering the distinctness with which small stars are indicated in two of these, he has no doubt that stellar maps might be produced by direct photography of the heavens.

It has been recently found by M. Brown-Sequard that carbonic acid, blown into the upper opening of the larynx, produces not only a local anæsthesia in that organ, but general anæsthesia; and that this loss of sensibility throughout the body depends, not on passage of carbonic acid into the blood, but on an influence exercised on the nerve-centres by irritation of the sensitive nerves of the larynx.

The International Exhibition in Vienna this year will continue from 1st August to 31st October. The 1st of March is the limit of date for applications. There is to be no jury, and no distribution of prizes; but scientific commissions will be appointed for electrotechnical experiments.

A Frankfort firm, M. S. Hess, have offered three prizes (of £25, £10, and £5 respectively) for the best designs for iron room-stoves. Designs to be sent in before 1 Feb., 1883.

M. Trouvé has recently brought forward some pretty designs for a mixed system of domestic lighting, in the form of ornamental candelabra, which have incandescence-lamps, as well as sockets for ordinary candles. Both candles and lamps may be lit together; but it may happen that the candlelight is desired without the lamps. Most batteries and accumulators are applicable for the lamps; but M. Trouvé has devised a battery of a very few elements, which may be placed at a distance, or in the body of the candelabra, and which acts regularly a great number of consecutive and even alternate hours; there is no waste when the lamps are unlit. The system is described in *Les Mondes*, 23 Dec.

In a recent paper to the German Electrotechnical Society, Herr Ludewig gave information as to the disturbances from earth currents in the telegraphic lines in November. (The paper appears in the Society's *Journal*.) In the discussion which followed, Dr. Aron expressed the idea that the action of thunderstorms on underground lines might be due to the fact that these and the aërial systems had common earth plates; and he suggested an experimental trial of lines wholly separated. Dr. Werner Siemens, considering the strong action of atmospheric and earth currents on telegraph working, thought the employment of the earth's conductivity prejudicial rather than useful, and asked whether those disturbances might not be wholly prevented by exclusive use of a metallic circuit. Dr. Brix recalled that in 1858, in North America, the earth currents during aurora had been utilised for telegraphy, and Dr. Siemens mentioned having carried on long telegraph conversations with officials at Juterbog during aurora in 1849 (a dial telegraph was used, and the galvanometer showed deflections such as would have been produced with 8 Daniell cells; there was, of course, much irregularity). Herr Elsasser thought the weaker effect of earth currents in the aërial lines of Austria might be due to the less perfect insulation of those lines. It was stated that in further endeavours to elucidate the subject of earth currents, the Society might count on the active assistance of the telegraph authorities; but Herr Meissner (of the Post-office) could not agree with Dr. Siemens' view as to utilisation of the earth's conductivity for telegraph working, for a better and less expensive return-connection could not be desired.

It has been recently pointed out by Herr Stefan that, if a hollow iron sphere be magnetised by external forces, it acts, in its interior, with force opposite to those outside. The resultant effect depends on the thickness of the metal. A magnet in the interior is thus partly screened by the iron wall round it from the action of magnets outside; and, conversely, the latter are much less affected by the interior magnets than if those were in a free state. An iron sphere behaves towards magnetic forces like a hollow sphere of good conducting material towards electric. This screening action has found an important application in the Gramme machine, and Herr Stefan also demonstrates it in lecture-experiments with iron cylinders and iron rings.

From a careful re-examination of 120 years' records of sunspots, M. Wolf, of Zurich, comes to these three conclusions:—(1) There is a period of 10 years; (2) there is a second period of 11 years 4 months; (3) there is not a period of 12 years imputable to the action of Jupiter. Notwithstanding the great difference of the two periods, the interval from a minimum to the following maximum is the same for both—viz., 4½ years. After 170 years, the maxima and minima are reproduced in the same order and with the same numerical values.

VEGETARIAN RECIPES.

(From the *Dietetic Reformer*.)

Lemon Pudding, baked.—Materials: bread crumbs, 5oz.; milk, one pint,; butter, 1oz.; one lemon; pounded sugar, 2oz.; two eggs. Method: bring the milk to boil; stir in the butter; pour this hot over the bread crumbs. Add sugar, and three finely-minced lemon-peels. Beat the eggs, and add them very gently. Put a plain paste round the dish, and bake for three-quarters of an hour. Cost about 7d.; will serve three or four persons.

The Ribblesdale Pudding.—Ingredients: three eggs; three large apples (good cooking ones must be chosen); bread crumbs, ¼lb.; sugar, 3oz.; currants, 3oz. (must be well washed and dried); grated nutmeg to taste; half a lemon. Method: pare, cut, and mince the apples into small pieces, and mix with the other dried ingredients, beat up the eggs, and blend the mixture with them; then beat well for ten minutes; put into a well-buttered mould, tie down with a cloth, and boil two hours. Serve with sweet sauce.

A Dinner for Two.—Thicken a pint of milk with flour (or cornflour), and simmer well with a little finely-chopped onion. Salt and bruised peppercorns to taste. Presently add a tablespoonful of chopped parsley. Boil two eggs hard—they should be put into cold water, and kept in three minutes, gently cooling after they come to a boil—shell them and lay them, cut neatly in half lengthwise, whites uppermost, on a hot dish, on buttered toast, or not, as preferred, and pour the thickened milk, &c., over them, boiling. Vegetables, as desired, as an accompaniment.

Pease-brose—a delicious Breakfast for a Halfpenny.—Put two tablespoonfuls of the finest pea-flour into a moderately-sized basin, upon which pour boiling water sufficient to allow of its being stirred into a thick paste; rapid and thorough stirring is essential. This should be eaten warm, with syrup or raw sugar. The cost will not exceed a halfpenny; but some prefer to eat it with milk, which, of course, is more expensive. Edinburgh pea-flour is considered the best, the price of which is 2½d. per lb., or 2d. per lb. in larger quantities. This is a favourite dish throughout Scotland, where is is generally designated "pease-brose." The flavour is peculiarly pleasant and aromatic, and as a light and nourishing breakfast it cannot be surpassed.

Appliances for Soot Prevention.—A Berlin engineer, Herr Albert Petzold, has devised an appliance for preventing the escape of soot into the atmosphere. It consists of two hollow cylinders, made of sheet iron, arranged one underneath the other, but with space between them rather greater than the diameter. They are placed, either in the chimney, or in a chamber above the fire-grate, and in communication with the chimney. The upper cylinder rest on a plate closing the chamber, except inside the cylinder, so that the air around this latter is in repose. A band of sheet brass is wound spirally inside the two cylinders, thus giving the smoke a rotatory motion, and causing the particles of soot and ash to pass out at the space between the two cylinders, owing to the centrifugal force, and fall down in the chamber outside the lower cylinder, to be removed at intervals by a door.

Lubricating Composition.—Mr. H. Montgomerie, of Cleadon, Durham, has patented (2154, 1882) a lubricating composition which is a mixture of plumbago (powder) 25 parts; lime water, 12½ parts; gallipoli oil, 12½ parts; flowers of sulphur, 10 parts; and tallow, 40 parts; or if not required solid, equal parts of plumbago, gallipoli oil, and lime water.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE SEA-LEVEL.

[20927.]—WE are accustomed to speak of the height of mountains *above the level of the sea*, but few persons know the true scientific definition of this, and the processes by which this level have been determined exactly in each port, notwithstanding the incessant variations induced in it by the phenomena of tides. We consider it interesting, then (says *La Nature*), to make known the exact definition of the term, keeping apart all considerations that are foreign to it, and taking for our guide the instructions published by the *Annuaire du Bureau des Longitudes*.

It is known that the height of the tides varies with the relative positions of the earth, the moon, and the sun, and that the greatest are produced about the time of syzygies. A formula given by Laplace in his "Mécanique Céleste," enables us to calculate the heights of all the great tides at each syzygies, that is, at each new moon and at each full moon. The greatest of our great tides are produced at equinoxes; and in our ocean ports these great tides follow by one day and a half the new and the full moon.

Dividing by 2 the mean height of the total tide at the moment of equinoctial syzygies, we have a certain number to which is given the name of *unit of height*. In each port, the unit of height is deduced from a great number of observations of high and low equinoctial waters. At Brest, for example, the mean of these observations has given 6·42 metres for the difference between high and low waters; the unit of height at Brest is, then, 3·21m.; that is, the quantity by which the sea rises or sinks relatively to the mean level which would have occurred without the action of the sun and the moon. It is this mean level which, at Brest, is the *sea-level*. We may, then, *en resumé*, define the sea-level in the following way:—

The *sea-level*, in a given port, is the mean level between the high and low equinoctial waters a day and a half after the corresponding syzygies, when the levels of these high and low waters have been determined after a great number of observations.

This level is designated by the name of *mean level*. The height of any tide above the mean level in a given port is calculated, by multiplying the height of the tide at the epoch given, deduced from the formula of Laplace, by the corresponding unit of height for that part.

The height of the tide is, in general, greater or smaller than the unit of height, as previously defined.

When heights are calculated from barometric observations, the sea level is defined by the formula of Laplace—a very complicated formula, into which enter coefficients which give account of all the elements of the question, height of the barometer at the two stations, temperatures of the barometer, and of the air, &c. Use is made of this formula with the help of calculated tables, published by the *Annuaire du Bureau des Longitudes*, in which those who are interested in the question will find ample information and complete details relative to the application of Laplace's formula.

A. B. M.

THE BLACK DROP.

[20928.]—PERMIT me to draw your readers' attention to a very simple method of producing a good imitation of the phenomenon called the black drop, seen at the transit of Venus. The experiment may be made either by gas or daylight. Turn the left side of the face towards the light, and close the left eye; then glance off the edge of the nose with the right eye, at some object in the window or more distant, and then slowly move a finger across, and very close to the eye, in the direction of the nose, when the ligature will commence to grow, and will finally cover the object looked at. This experiment fails when attempted through a pinhole. By careful observation in performing this experiment, the performer will notice that besides the sharp outline of the nose there is a shadowy image also visible. It is to the extent of this shadowy image the ligature grows. The pin-hole removes the secondary image by confining the light to a limited area of the pupil. Most probably the black drop in a transit would be also removed by making the observation through a pinhole instead of by the whole pupil. If so, the cause of the phenomenon is obvious, and the explanation simple. **H. Gornall.**

REFLECTORS v. REFRACTORS.

[20929.]—"PRISMATIQUE" says mirrors rapidly deteriorate. I have had one fifty years with the mirrors untarnished. He says the Gregorian is difficult to adjust. I would undertake, in the one I had, to have it taken to pieces and put it together, and in adjustment in five minutes; but this was not required, nothing being necessary but to remove the cap, and start observing. As to the Newtonian, I will undertake to start level and get a 6in. Newtonian in working order before "Prismatique" can arrange a 3in. refractor. If he had tried a diagonal on a refractor, and compared with a Newtonian, he would have known there was no comparison betwixt the comfort of one and the other. The deterioration of the film is largely imaginary. With but little care it lasts years. Lastly, what can "Prismatique" know about them to write of "the continual cleaning for resilvering deteriorating the glass surface?" It sounds as if he thought they required cleaning and silvering every week.

E. Holmes.

[20930.]—I CANNOT read the letter (20901) of "Prismatique," so condemnatory to both ancient and modern reflection, without asserting that my experience is totally different to his. I have now in my possession Gregorian reflectors by Short, Adams, Ramsden, Cuthbert, Lassell, Bond, and others that are as bright and good as when first made, as far as I can see, and though often used, have never given me the least trouble by getting out of adjustment. A Ramsden of 4in. aperture is always in my bed-room, and frequently used, and although made so long ago, the metals appear as good as ever, and its adjustment always perfect.

The silver-on-glass I have also found very far from requiring the constant renewal imputed to it. My 15in. I silvered 16 years ago, and I have had it in constant use ever since, and it is now in so fair a condition that I do not think it necessary to resilver it. This I have preserved by putting a sheet of glass on the face of the mirror, and then covering both by a tin cover when I have finished using it.

As to the deterioration of the glass surface by continual cleaning—when resilvering, I clean the surface by pouring on it strong nitric acid and washing it off again, but never rub it or in any way cause it to be worn away; so that I do not see why a good mirror, carefully used, should not last for an indefinite time, as the coat of silver preserves it from the effect of the atmosphere, which must affect the refractor and eventually ruin it. That the Newtonian requires adjustment at times I admit when a wooden tube is made use of; but if the tube is made of metal, I do not see why the adjustment should not be as permanent as in the Gregorian, but I have had no experience with metal-tube Newtonians.

As to the use of the zenith-diagonal in the refractor: the cost of light in that instrument is too great to allow of its being lost by the reflection; and even with that, the position, when viewing objects of great altitude, is by no means pleasant. In fact, no instrument is so convenient to use as the Newtonian reflector on alt-azimuth stand.

Philip Vallance.

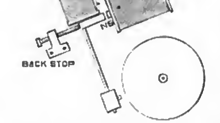
AMERICAN SIDEREAL CLOCKS.

[20931.]—A RELIABLE sidereal clock at a reasonable price, such as amateurs require, seems to be still a desideratum. When we see what excellent mean-time keepers the Americans turn out for a trifling sum (years ago I bought a clock for 4s. 3d. that sometimes did not vary over a minute in the month, but this, I think, must be a very exceptional case), there seems no good reason why our instrument-makers should ask the sums they do for their cheapest astronomical clocks. As the demand for sidereal time-keepers must always be rather limited, of course we cannot expect that they can be made by the quantity, and consequently as cheaply as the ordinary American clock; but still I think if our enterprising Transatlantic friends who are in the clock business would take this matter in hand, they could get up a reliable observatory clock of good quality at a sufficiently cheap rate to be a boon to the amateur astronomer, while they, at the same time, might have a very fair profit on the transaction. It seems useless to look for aid in this matter from our own manufacturers, so I suppose we must turn to that same America from whom we have already received so many useful lessons. I sincerely hope that this may meet the eye of some one on that side of the water who is both able and willing to go into the matter.

Edward M. Richards.

SIMPLE METHOD FOR OBTAINING AN INCREASE OF POWER FROM AN ELECTRO-MAGNET.

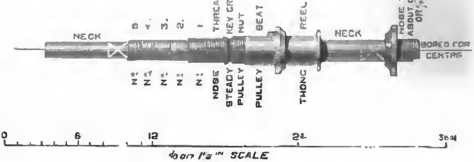
[20932.]—THE accompanying diagram requires no explanation. This plan seems to me preferable to that of making the armature a permanent magnet. All necessity for a spring is removed by adjusting the armature at a suitable inclination. The diagram represents my plan as applied to an electric bell; but of course it can be adapted to other apparatus. **Edward M. Nelson.**



SCREW-CHASING TRAVERSING MANDRELS.

[20933.]—"O. J. L.'s" article on the old-fashioned traversing mandrel in the "E. M." of the 29th Dec., is the most practical and to the point I have read lately. As to his description and praise of the French traversing mandrel, I can fully endorse him, having myself (while an articled pupil to an old French engineering firm, now extinct) worked constantly for more than a year of my time at one of 8in. centre, ·28 centim. The headstock of this lathe was, as "O. J. L." describes, mostly of wood—in this case hard pollard oak, well and firmly mortised, tenoned and bolted together, the straps over the heads for setting up the collars and the before-mentioned bolts alone being of iron, and the mandrel was certainly not less than 30in. long, if not more. I learned the following particulars respecting it from the foreman, who had been in the service of the firm more than 40 years, and under whose directions the lathe was constructed a few years before my pupilage. The mandrel was forged in the shop from the best "Berri" charcoal iron (fer au bois de Berri), faggotted and twisted and swaged till nearly cold. It was then rough turned and annealed; the nose and pattern-threads were next cut on the only screw-cutting lathe in the shop (they were not to be found in many shops 47 years ago); the threads were decimal according to the French metrical system, and were a specialty of the firm. The mandrel was again annealed, and the necks and belt cylinder for the pole-strap or thong finished off. The mandrel was next thoroughly and deeply casehardened (trempé au paquet), and afterwards trued between centres, with a lead block and mallet, after which the necks were carefully lapped by a lead wheel, dressed with powdered or crushed white sapphire dust, mounted and traversing on a slide-rest, and the whole mandrel was then polished in the usual way. The two four-speed pulleys (interchangeable and of different diameters) were held on the mandrel by a stud, previously screwed into mandrel, and hove up with a tight-fitting nut; I, however, never saw but one (the largest four-speed 9in. diam.) used. The collars, or bearings, were of white metal, an alloy of tin and antimony, for both back and front, and were rather more than 1½ diameters in length, the diameter of the front neck being about 1⅞in. (·0485 mil), and having about (as near as I can remember) 3in. traverse. The guide-keys, of mountain ash (Cormier), and wedge were arranged precisely as "O. J. L." describes, but the steady key and *the* wedge (only one) were of hard-hammered brass, and worked between well-fitted metal checks; in addition, the front or projecting handle of each guide-key was loaded, so that it always dropped clear of its corresponding screw on mandrel until wedged up, which operation necessarily released the steady-key, which also dropped clear. All the woodturning for the shop was done in this lathe, as well as all the brasswork, and I have myself often turned up wooden, built-up driving pulleys, then much used, quite 3ft. diam. ·950c. For chasing, a pole and strap, or thong, wound round the barrel of the mandrel, and attached to a treadle, was used (the lathe generally was driven from a countershaft as usual); and I consider this method, or an equivalent in the shape of a coil or rubber spring, to be preferable to partially swaging the wheel, as the latter may, by accident, pass over the top centre, and so strip the threads, either of the work or of the guide key. The work in this establishment was principally for shawl dressers, calenderers, and paper-mill machinery, involving a large amount of screwed brasswork, and it was to insure uniformity in their work and to facilitate repairs that the firm determined on and adopted their special set of threads; these were all numbered 1 to 5, and also on a brass plate *over* the key mortise holes. I may here mention that the latter were all boxed in to keep out dust and dirt, the box of course being provided with a hinged cover for oiling and cleaning. The head-stock formed part and parcel of a heavy oak frame sunk well into the floor of the shop; the bed was also of oak, the ways being about 12in. deep by 4in. on top, and about 12ft. long. They were well braced together by distance pieces, and also firmly fixed to heavy timbers sunk in the floor; the top of the ways were faced with flat iron and filed up tolerably true. The poppet head was of cast-iron, and like most French work of that date, of bad design, although the workmanship was very fair. Between the head-stock and long bed was a gap for large work, which was bridged over by an oak frame for ordinary work, and held in place by mortise wedges. I cannot speak too highly of the performance of this lathe, its smooth and steady action, and as I found, the ease and celerity with which the chasing of any sized work could be performed; and although it had been some five or six years in constant use, and often with very heavy work on it, the necks, when I worked at it, showed no sign of wear, as was proved by the easy sliding motion of the traverse; nor do I remember even setting up the bearings. I have since often substituted white metal for brass steps in lathes, and always with good results, and, even for coned mandrels I prefer it to steel, as, by its use, in this case, I have never yet found the two to set fast, although a very common occurrence with steel if they run at all dry.

I see no difficulty in adapting this kind of mandrel to our present iron-bed lathes, without unduly lengthening the bed, simply by making the head-



stock a box or shell casting, and allowing about one-half to overhang; of course, it would both look and be better to seat the entire head, but I see no reason why the headstock and bed should not be cast in one—aye, and planed up at one chucking (after the bottom cut has been taken off); the steps would then, of necessity, be in true axial line with bed. Our American cousins, who are up to all labour-saving dodges, have long since adopted this plan with great success. Our readers have only to visit C. Churchill's showroom, where they will see the reality. In conclusion, I would advise any, and many of the readers of the "E.M." when they have an opportunity of visiting Paris, not to neglect seeing the Conservatoire des Arts et Métiers in the Rue St. Martin, where there is a very fine collection of old lathes, from the 16th century down, mostly ornamental; some with rose-engines, elliptical, eccentric, and even geared geometric chucks, all with slide-rests more or less primitive, and all driven from overhead. Amongst them is a very fine engine-lathe, "Tour à Guillocher," made by a Strasburg mechanic, for King Louis XVI. All these have traversing mandrels, mostly running in tin or white-metal steps. By the way, the Strasburgers have always been noted mechanics, as may be proved by inspecting old wheel-lock firearms, and also the steel cross-bows. "Stutzer" of the 14th and 15th centuries, and, I believe, the founder of the present firm of Holtzapffel, was also a Strasburger. Anyone inspecting the collection above mentioned, must be struck with the paucity of invention, and want of improvement displayed in our own present ornamental lathes; for, with the exception of "Ibbotson's," the cycloidal, and the straight-line chucks, and the compound drilling-frames, *all* may be seen in various forms on the above lathes, and I very much wonder that the late C. Holtzapffel did not make greater capital of them in his work. Another curiosity in the collection is a dead-centre slide-lathe by the celebrated Vaucanson. It is a large rectangular cage of square iron bars, two bottom ones of which are filed up true, and on these run the saddle and tool-post or box, and actuated by a leading-screw, geared. This is another illustration that there is nothing new under the sun, and that many so-called new inventions are only reproductions of ideas and contrivances worked out by mechanics who were in advance of their age.

Mechanicus.

SIZE OF FLAT IN NEWTONIAN TELESCOPE.

[20934.]—THE question raised afresh by Mr. Westlake is one of considerable practical interest, which ought to be fully worked out.

The minimum size would apparently be that required to intercept the *whole* of the cone of rays proceeding towards the focal point when the telescope is being directed to the largest object required to be viewed, the term "large" being of course used in reference to angular diameter.

This may be assumed to be the sun, and if we take as an example a mirror 10¼in. diameter and 10ft. focus, the focal image would be somewhat less than 1¼in. diameter. If we decide that this image is to be sent to a point 12in. from the axis of the body, the flat would require to be 2in. in its minor axis. It would not require the eyepiece-fitting to project so far from the side of tube as this distance, because the cone of rays proceeding from the flat would be converged to a much nearer point by the action of the field-lens; but allowing for convenient manipulation, the distance named would seem about the right position.

I cannot agree with Mr. P. Vallance's remark that we might equally reasonably "take a larger object," because the Newtonian telescope is not ordinarily used for terrestrial objects, while his suggestion to cover the whole of the flat except the size of a pea would proportionately reduce the light (but not the size) of the image to that of a mirror giving an equivalently small cone of rays. If, therefore, Mr. Vallance uses a 2in. flat for his 17¼in. mirror of 9ft. 3in. focus, he will lose the full effect of his mirror as regards brilliancy, and virtually reduce it to one of much less diameter. It is quite true that the argument may be pushed to an absurd extreme, as Mr. Vallance suggests; but the answer is that *in practice* no one would wish to employ "a very small mirror of very long focus."

Is the sliding plate carrying both flat and eyepiece *as steady and free from shake* as the usual plan of making the eyepiece alone moveable?

A. S. L.

[20935.]—IN reply to "Faber" (20899), I named the doing away of the flat altogether as a theoretical advantage. I do not expect to see it adopted. With the flat close to the edge of the tube, or even outside, without enumerating other difficulties of this construction, the observer's head would obstruct more light than the flat, besides the extraordinary inconvenience of the position.

Mr. Vallance's 1⅜in. flat (20900) for his 15in. mirror is very small, and is, I should think, too extreme to get the best out of his mirror. There ought to be a margin outside the cone of rays of at least ⅛in. all round—mine is $\frac{3}{16}$in., which I think none too much. I might use a smaller flat than my 1⅝in. by moving the flat and eyepiece farther up the tube and from the focus, in the way he suggests. This would, however, be attended with inconvenience in other ways. The eye-tube must be so very short, that it would necessitate a separate slide for the lower powers, particularly for 70 or 80 Kellner, which I use a great deal, and which would be more trouble than the extra advantage of a slightly smaller flat. In Mr. Vallance's 17¼in. mirror, I see that the diameter of cone of rays will be 1⅜in. at 11¼in. from the focus, and 1⅜in. at 10⅜in. The latter would allow $\frac{3}{16}$in. all round the mirror, and taking the diameter of the tube to be 18¼in., it would bring the focus only 1⅜in. outside the tube, and the former 2in. This makes the eyepiece exceedingly short.

I cannot approve of his plan of a sliding tube for eyepiece, with flat attached to arm. This plan is altogether incompatible with the perfection of adjustment which I get with fixed eye-tube, and spot and pinhole method of adjustment. In the first place, the positions of the flat and eye-tube should each be capable of separate adjustment, which his plan is not. As pointed out by Rev. N. S. Godfrey, the flat should be in the centre of the large tube, and is easily fixed there by the present mode—viz., by adjusting the mirror in the usual way, viz., with full mirror, making shadow of flat central, and then putting in, say, a 6¼in. stop. If still central, it is all right; if not, the three-watch-spring plan, with screws, allows of its being adjusted till it is central in all positions. I am quite aware that the optical adjustment is not affected by this, provided it is not sufficiently out of the centre to interfere with the cylinder of rays falling on the mirror; but everything is made out of truth by it, and for the flat to be anywhere but in the centre of the tube is imperfect, and ought to be inadmissible. Nothing can be simpler and more complete than the present flat-mount method of fixing and adjustment, and it certainly obstructs less light than the other. The expense, if any more, is but trifling, and is not, I think, a consideration when it is more perfect.

Again, by the sliding plan, the eye-tube piece may be true, or may not; the fixed can be adjusted with slots in the large tube and the screws which fasten it on, till the axis of the cone of rays passes through the axis of the eye draw-tube, which is tested by the pinholes at both ends of the draw-tube, and the image of the flat being seen central in the farther pinhole, with a ring of light all round at all focusses and rotation of tube. This would seem quite impossible with the sliding plan, which at the best is only a haphazard adjustment, in all probability not perfect, and with no means of making it so.

"Prismatique" (20901) apparently holds a brief (not financial, of course) in favour of refractors. I have heard of such a thing as a green growth between the lenses of an o.g., and the advice is then, "Let it alone." I should like to show him my contrivances with Mr. Calver's new method of transverse adjustment of flat, which is more delicate and certain than the usual one, and which never moves after it is set, and I think he would see the "infinite bother" of doing it grow somewhat less than he imagines. I have not touched my adjustments for weeks, though they are perfected when required in a minute or two, *by day*, and without opening my house. My mirror, to all appearances, is as good as the day it was put in, eighteen months ago, and is not likely to want silvering for years, the "continual cleaning" for which purpose will be somewhat deferred. Suppose I had a 10 or 12¼in. o.g. properly mounted, what would it cost? And should I see Jupiter, Saturn, the Moon, nebulæ, or clusters any better—or the infinite beauty of the coloured doubles—than I do now at a tithe of the expense? Query!

Fordingbridge. **T. Westlake.**

TELESCOPE MATTERS.

[20936.]—IN answer to Mr. Crickett (49502), I use exactly the same proportions of ingredients as Mr. Brashear gives in Vol. XXXI., p. 327, which is in the number for January 11, 1880; but I add to the silvering solution (at the time of silvering, of course), double the amount of reducing solution he recommends, and not double the amount of sugar to the reducing solution, as someone understood. The reducing solution is all the better for being made some days, or even weeks, before using. From ¼in. to ¾in. between the surface of the speculum and the bottom of the vessel is enough.

I would here give a word of explanation to my experiments on the ease with which the surface of a glass speculum may be got out of shape and spoiled, and which experiments are referred to by "Prismatique" (20901). Now these experiments were made with rouge, and I mentioned them to deter all possessors of glass specula from using any polishing material in cleaning off the silver previous to resilvering; and to add weight to what I have already written on this subject, I will mention further that in my investigations into the exact effect of each motion, and quantity of motion, and variation of the conditions and combinations of the motions, I have been omitting one motion or condition after another, and working the surface until I find the conditions have left their ultimate result on the face of the speculum. This I carefully study under the shadow test. By this means I become completely master of the effect of each motion and condition, and can then reason out the effect of any combination of motions and conditions, or find out beforehand the best motions and conditions to produce the required truth of figure. All these experiments I hope to describe in their proper place. Now what I wish to here call the attention of the possessor of glass specula or any other specula to, is the fact that I find from five to eight minutes working, with 30 to 40 revolutions of the handle per minute, will so alter the shape of the figure by leaving deep marks, that it will take me from 1½ to 2 hours work to get them out, with from 50 to 60 revolutions of the handle per minute, so that five minutes' injudicious work *with rouge* may utterly spoil any speculum. But the possessor of a good glass speculum need not be alarmed on this account: the glass surface is just as permanent as the glass surface of an object-glass, provided he keeps all polishing materials away from it when he is cleaning it for resilvering. Let him dissolve off the silver with nitric acid, being as careful to clean the edge as the face, rinse with water, then clean well the edge with potash water (1 to 12 of water), rinse again with water, then pour on the face a little of the potash water, and gently rub with a bit of flannel; let it stand some time, then wash off with water, and at once insert in water until required to silver. This treatment will not alter the surface, but will keep it good for generations, or, as we say, for ever.

The edge of the speculum ought to be as clean as the face, or we get marks on the face near its edge, and the deeper the speculum is in the silvering solution, the better the edge of the face will be. I find good rain-water for the process as good practically as distilled water. Mr. Brashear has mentioned this before. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

OPTICAL MATTERS.

[20937.]—I AM sorry your correspondent "Bow" (letter 20871) did not preserve some abstracts of the papers mentioned by him. It is a great pity that such researches should lie buried in volumes out of almost everybody's reach. The early volumes of the *Cam. Phil. Trans.* and of the *Transactions* of the Royal and Royal Astronomical Societies contain many things that would be especially interesting now that we have such a band of earnest workers in optical matters. With regard to Airy's papers named by "Bow," and Littrow's, in Vols. III. and IV. *Trans.* and *Mem. R. A. S.*, if anyone desires to help in the work, but is unable or unwilling to face the task of reduction, if he will give his address, and send the books to me carriage paid, I am quite willing to give the time and trouble necessary to make a précis of the articles, and send it to these columns for the good of all. I cannot do more.

In reply to Mr. Wassell (letter 20867): I do not require "tracing diagrams" for my own use. If such diagrams could be reproduced and reduced, I thought they might prove serviceable to his elucidations of the action of different varieties of stroke. The question put to me in letter 20898 by "L. L. L." is a practical one, which I am quite unable to answer. In such a matter, I do not think the most elaborate calculations can yield anything like so good a result as could be furnished by a clever practical man at once. I trust some correspondent will take the hint given by Mr. Calver, and invite Dr. Royston Pigott to contribute a little to the literature of the reflector.

With regard to the optical glass mentioned by me in a former letter, I may say, in answer to "Prismatique," that if by "brand" he means the "number" of the glass, Mr. Caplatzi can readily give this. He tells me that the numbers on his flint glass slabs are 1181, 1204, 1206, 1209, 1213. These are Feil's numbers; but what they mean I do not know, as I can find no reference to them in his price-list. They are printed in large black figures *on* the glass, not impressed *in* it. I have procured a few pieces from Mr. Caplatzi, and have tried, in a rough way, to ascertain their approximate specific gravity. Two of these are plates 2¾in. square, polished on two edges, so that you can see through them. They are numbered respectively 1181 and 1204, and I believe their specific gravities are about 3·000 and 3·400. The third is a crown glass disc, rounded out of a square plate; it is numbered 200 (probably this originally was 1200), and its specific gravity seems to be about 2·625. Two more are moulded or pressed discs. These have a circular form, with smooth edges; the crown lens is equi-convex, and of specific gravity about 2·500. One surface is very smooth, and, so far as I can see, there are no marks or numbers on the glass. The flint lens has one flat and one very shallow concave side: its specific gravity is about 3·500. There is a number or mark impressed in the glass, which seems to be 42. I hope our friend "Prismatique" will kindly give some little explanation of the "brands" or marks usually met with on optical glass. Mr. Caplatzi sells his glass very cheap, and I feel certain the amateur object-glass grinder will desire to make his first attempt upon glass that from its low cost he is not afraid of spoiling.

Orderic Vital.

GRINDING AND POLISHING SPECULA.

[20938.]—PREMISING that I am very glad my previous letter has proved useful to Mr. Wassell, and thanking him for his courteous references to it, I proceed to refer to certain points in his letter on page 387.

As regards Herschel's mirrors, particulars are wanting, except as to a few; and as far as I can learn, only two are now known to exist: one at Stonyhurst College, and another in private hands, the owner of which, however, informed me that the speculum was hopelessly injured.

I have within the last few days come across an illustration of Herschel's "forty-foot" telescope, with its timber framework; but the accompanying description is very meagre. There is, however, one remark that is worth quoting—viz., "We believe it has been little used, it being found that the great mirror *bent under its own weight*, and distorted the image."

I have heard, or read somewhere, that the same defect exists in the Foucault mirror of the large reflector at the Paris Observatory, notwithstanding a system of cushioning and packing-up at the back of it. The goodness (or badness) of the old specula is a matter of much difficulty to decide, because possessors of such of them as still exist seem unwilling to have them tested and compared with modern ones. Certainly, the accounts given of them by contemporaries are very remarkable, to say the least. For instance, we find a little Cassegrain mentioned as being only 3in. in diameter and 6in. focus, yet fitted up with three convex small mirrors, and magnifying *from 75 to 400 times!* The maker (Watson) in referring to it, says (and his remark is interesting in connection with what "Orderic Vital" has written), "The making of this telescope discovered to me that the curve of the large mirror most proper for the Gregorian is not so for the Cassegrain, which requires a different figure; I therefore made another large metal, and gave it such a figure as, combined with the convex small mirror, gave distinct vision." From this it would seem that the large mirror was corrected to suit the small one, and not *vice versâ*. A Tulley Gregorian of 30in. focus and $5\frac{3}{10}$in. aperture is also said to have shown a printed paper "better than a very fine achromatic" of 5ft. focus and $3\frac{1}{3}$in. aperture. One would certainly suppose that in *these* two cases, at all events, the mirrors must have been most accurately figured; and many similar accounts are to be found in confirmation. Cannot Mr. P. Vallance kindly help to clear up the difficulty, with his fine (probably unrivalled) collection of old and modern specula.

As to the method (suggested both by "Orderic Vital" and myself) of tracing the action of the polisher, I proposed to Mr. Wassell to use different-coloured chalks for the separate zones of facets, so as to distinguish the effect of each zone: and a still more complete method would be to put *a separate chalk-pencil through each facet*, all those in any given zone being the same colour. By the extent of the shading, or depth of tint, an idea would be obtained of the *total* effects of the *whole system* of facets; and I yet hope Mr. Wassell will tell us something of what he obtains by this mode of making the polisher register its own action. I may add that the method of polishing convex small specula by a series of graduated rings had also occurred to me; but I understand the difficulty is not merely in working, *but in testing* these small surfaces. I have proposed grinding and testing them *as lenses*, and then silvering them; but I am not aware whether my suggestion has yet been tried.

L. L. L.

THE SLIDE-RULE.

[20939.]—READERS interested in this subject will please notice letter 20922 before 20919. Alter the example given in former as $\sqrt{\left(\frac{17 \times 23}{13 \times 19}\right)^2}$ = about 1·56 to $\sqrt[3]{\left(\frac{17 \times 23}{13 \times 19}\right)^2}$ = about 1·36, and consider, that although an instrument prepared with uninverted and inverted logarithmic lines on a slide placed between two sets of similar uninverted fixed lines, as I think "Gamma Sigma" means, serves for obtaining the contact in cubic inches when length, breadth, and depth given in inches, yet it is not calculated for giving the result in cubic feet or yards, from dimensions in inches, which a double slide instrument is. And again, if I understand aright, the "computing telegraph," referred to by "Gamma Sigma," as necessarily confined to the circumferential logarithmic lines of circles of moderate diameter, then this instrument is inferior to a spiral one, which gives results with greater accuracy to four places of figures than the ordinary straight or circular instrument will give to three, giving for, say—$\frac{98{\cdot}4 \times 7{\cdot}532}{8{\cdot}917}$, the answer slightly in excess of 83·10, while, really, it is under 83·12.

Thomas Dixon.

Buttershaw, January 8th.

STANDARD WIRE GAUGE.

[20940.]—LAST month one of your correspondents promised to give us the decimal numbers of the proposed standard wire gauge. I, for one, shall be glad if he will do so at his earliest convenience.

In 1880 I proposed the following, as approximating as near as possible to the gauges then in use:—·500 ·480 ·460 ·440 ·420 ·400 ·380 ·360 ·340 ·320 ·300 — ·290 ·280 ·270 ·260 ·250 ·240 ·230 ·220 ·210 ·200 — ·195 ·190 ·185 ·180 ·175 ·170 ·165 ·160 ·155 ·150 ·145 ·140 ·135 ·130 ·125 ·120 ·115 ·110 ·105 ·100 — ·0975 ·095 ·0925 ·090 ·0875 ·085 ·0825 ·080 ·0775 ·075 ·0725 ·070 ·0675 ·065 ·060 ·0575 ·055 ·0525 ·050 ·0475 ·045 ·0425 ·040 ·0375 ·035 ·0325 ·030 — ·02875 ·02750 ·02625 ·025 ·02375 ·0225 ·02125 ·020.

In deciding upon a decimal gauge, it must be taken into consideration that the wiredrawer cannot supply large quantities of wire all drawn perfectly true to one decimal number—he will require a little allowance above and below that number. For instance, Siemens Bros., in their specifications for cable wire, allow 2 per cent. above and below the number named: thus, if they required a thousand tons of ·100, they would receive all between ·098 and ·102—that is, they would reject all thinner than ·098 and any thicker than ·102.

This variation for large quantities of wire is found in practice to be quite sufficient; for needle-wire and piano-wire about 1 per cent. is the usual allowance.

If we get a gauge made from Sir Jos. Whitworth's patterns to the above decimal numbers, the thinnest allowed would pass the gauge easily, and the thickest allowed would only "go tight" through the gauge "nick."

If the "nicks" or "slots" of the gauge were made V-shaped, the wiredrawer could work to such a gauge with pleasure, as he would "set" nearly into ·095, and "run out" tight to ·100, and so of all other numbers.

I would suggest doing away with the old numbers altogether (as they are only misleading) and use the decimal numbers only. Anyone can quote prices to any definite decimal number; but if you ask a quotation, say, for No. 13, one will say it is ·095, another that it is ·100, and they will never agree to call them otherwise.

Lestar.

A VIOLIN WITHOUT A SOUNDPOST—EXTRAORDINARY VIOLINS.

[20941.]—"FIDDLER" has now for some time past, fought against the use of a soundpost in a violin, because he has "found it a delusion and a snare," and thinks it may be left out without detriment to the sound of the violin. I think he has not made himself quite clear in this controversy, for he knows as well, and perhaps better than, many of of our readers, that the soundpost is indispensable in the modern violin. But if he constructs a violin of a totally different form, I admit that it is possible to leave the soundpost out, and possibly gain the same result, or, as he says, a better result. However, his arguing that harps, pianos, and such instruments answer their purpose without a soundpost, is not quite to the point. In those instruments the string is plucked or struck, and then left to vibrate; while in the violin it has to do that by the bow. I think in one of "Fiddler's" letters some years ago, in "ours," he stated that a violin which had a sustaining sound when plucked, was as a rule deficient under the bow. I accept this to be theoretically correct, although I cannot say that I have practical experience in this respect. Now one moment's consideration will make it clear, that there is a great and fundamental difference between the piano and a violin. In the violin the breast and back, or in fact the whole case, bears the tension of the strings. If we take away the soundpost, rapid passages get muddled, because the breast and back are free, and their vibration cannot be stopped by the finger; but if the soundpost is put between them, they are more perfectly under the control of the player. A pianoforte is an acoustical savage, and cannot be compared with that perfect instrument the violin. I must put the responsibility on "Fiddler" for doing so, who often points to the piano as doing very well without a soundpost. But the fact is that no such perfection of stopping the sound in a piano is possible, and in many cases not even required. As proof of this assertion, I may state that a lady when buying a piano of mine said to her mother "Oh, ma, this piano cuts my music all to pieces;" yet the dampers did not act to my satisfaction, and no piano can do it, especially the treble, which has no dampers at all, and rings like a musical box. The tension of the strings in a piano is on an iron frame, and consequently the sounding-board is left free comparatively. I do not envy "Fiddler" for trying to find a form for a violin in order to do away with the soundpost. I leave the form and general construction as it is, because I make sure it is perfect, and try to improve the material of the breast. I will now state the composition of the wood of two breasts I have made, and the result thereof. In manufacturing pianos I find that straight grain of the wood for the soundboard is of great importance, especially for power of tone. Thinking that it might have the same effect on the violin, I bend, instead of curving, the wood for the breast. For that purpose I made a plaster of Paris form of a good shaped breast, I then made strips of mahogany veneers, about a card-board thickness thick, and as wide as the breast should be thick when finished, and also a number of soft pine wood, a full $\frac{1}{16}$in. thick and the same width. These strips I bent edgeways in the form, and glued them together alternately. When finished the breast had the form and thickness I required. The result is a fine-toned violin, but I consider it a failure, because it is not louder than others. Thinking that the surfaces of a soundboard are mainly instrumental in transmitting the vibration to the air, while the inner portion of the wood might be considered dead matter, I glued between two $\frac{1}{8}$in. thick plates of Swiss pine, an equal thickness of cork-wood, and the result was that that piece of board produced a greater quantity of sound under the tuning-fork, than a natural piece of Swiss pine of the same size. But when bent and glued in the plaster of Paris form it was less in quantity of tone—hence a failure. I have therefore come to the conclusion that bending the wood for a soundboard is no good. I have now made another piece of wood for a breast, and will report its result when finished.

J. H. Schucht.

[20942.]—IN the first part of his letter (20887, p. 388), "Fiddler" credits me with some extraordinary theories, which he proceeds to demolish triumphantly; but as I have not started any theory whatever, further reply to that portion is unnecessary. As regards his letter generally, "Fiddler" appears to mistake the point at issue—which is not whether he can make a violin on above plan of better tone and power than one of ordinary construction made by an "amateur or a tinker." The question is whether the *principle* "Fiddler" advocates is superior; in which case he should at least be able to compete with the best made modern instruments.

Captain Cuttle.

[20943.]—I HAVE seen a record of the Trumpet Violin, mentioned by "Fiddler," which was, I believe, exhibited at Munich in 1854, by its inventor, Ferd. Hell; and was also patented in this country by W. E. Newton in the same year. The tone of both violin and trumpet are stated to have been good; but I do not think this is the direction in which progress may be anticipated; and the trumpet, which was coiled up inside the instrument, with the bell end towards the button, could hardly be fixed by an ordinary amateur. With regard to the 30s. fiddles, I do not think that any one who knows what a *violin* is would expect one to be made and sold at a lower price than, say, £5 10s. I know that a really useful and satisfactory modern instrument can be purchased at this figure; and am of opinion that no violin, however good, is intrinsically worth more than £30. This, of course, is dreadfully heterodox; but I have been led to the belief by seeing so many high-priced and avowedly genuine old violins which, in tone and appearance, were not worth one-twentieth of their fancy price. However, I still have a strong leaning in favour of the model upon which the old makers worked; but am not so bigoted as to expect it can never be improved on, and would like much to test "Fiddler's" new violin, did not my remoteness from London prevent my having an opportunity of doing so.

Will "Fiddler" tell us if all his violins turn out equally good?

War.

MEDICAL QUERIES AND REPLIES.

[20944.]—I READ the ENGLISH MECHANIC every week, and have done so for some time, and am astonished at the medical queries put to Dr. Edmunds. I often write out answers on paper for my amusement, but in many cases I can see no answer, since the query is put in such a way that it may be one of many complaints or none of them. I am very often astonished how Dr. Edmunds can manage to answer such a curious mixture, from bad feet up to sick headache. It ought to make one careful in his queries, since many contradictory answers can be, or are often given to a question.

To one skilled in the causation of disease, reading over these queries at once reveals many of the conditions of a patient's life. Thus, if a person complains of being too fat, it at once informs me that he eats too much of the kind of food that he takes, and may possibly, not certainly, drink beer. The cure would at once be to lessen the amount of food. If a person complained of constipation it argues too little vegetable food, and that he eats white bread; the rational cure then for constipation is wholemeal bread, vegetables, and fruit. Bilious attacks inform me of persons eating too much rich food, such as fat meat, eggs, cheese, or fried oily fish. The way to prevent such attacks is to avoid these rich foods, or, if taken, to be taken sparingly. In the same way pain in lower part of stomach very often means some indigestible food irritating the intestines, such as pork, veal, goose, turkey, ducks, or such like, the cure being a purge to carry off the food which has given rise to the complaint; in same way a vomit cures a bilious attack quicker than anything else, since it relieves the stomach of offending materials. Heavy, drowsy feeling in the morn, when one should be up, and no desire for breakfast when up, points very frequently to heavy suppers not long before retiring; in some it points to over-feeding, since they do not deposit the fat in their tissues as many do. Stoutness is as much a disease as is gout or rheumatism, and can only be cured by abstinence. Indigestion, with its many troubles, means either too much food or food too rapidly swallowed; too much fluid at meal times or alcoholic habits. It may also mean indigestible food or want of exercise. The cure is limiting amount of food so that it causes no pain, to be eaten slowly, and not to take too much liquid at meal times, such as beer, wine, spirits, tea, coffee, or even water; to eat easily digested foods and take regular exercise. Rheumatism or gout certainly means alcoholic habits and much good living as a rule. Some unfortunate total abstainer may have it from his father, but I never knew a vegetarian with it. Coughs, cold, bronchitis, pleurisy, and inflammation of the lungs point out that the patients have lived under bad conditions, but that the chief bad habit was a habit of not getting sufficient fresh air. The prevention of such complaints is to accustom ourselves to be in the open fresh air for a regular period each day, and even to sleep with our windows open 1in. or more. I am writing now for healthy persons, and not those troubled with chronic bronchitis; but even these may gain benefit if the change is done gradually. In warm rooms, the bronchial tubes become lined with a delicate lining, which is destroyed by cold air. But if we live much in the cold air, this membrane becomes harder and does not inflame easily.

The ordinary expression of persons living much indoors is, "I cannot put my nose out of doors without getting a cold." I quite agree with them; but if they made it a practice to go out for a daily walk, or sleep with windows open a little, such colds would be rare. Let anyone go from the cold air into the rooms of many of the poor in London; he will be almost choked by the stench of the room, for all the openings are blocked up, and no fresh air can get in. The room is also warm, but at what expense to the occupants? In the first place, the air they breathe is very impure, and so productive of much disease; in the second place, it is hot, and so destructive to the healthy lining of the breathing tubes, since it causes it to be tender, and almost sure to be destroyed by cold air, giving rise to coughs and colds. So we might go on showing the cause of most complaints. If we can find the cause, we can easily prevent the disease by removing the cause.

This brings me to speak of the very great lack of common education on the question of health. Everyone ought to be taught general physiology at school, or else as soon as he can after leaving it. Our health is in our own hands, and we either keep ourselves well, or ruin ourselves early, the same as a man making a fortune. There are regular rules of health, and if we follow them we are well, but if we do not we must suffer. It does not matter whether we know them or not, if we transgress them we must suffer, as the physical laws of nature with regard to man are like all other laws—immutable.

Disease may be said to be due to three causes: 1st, my own fault; 2nd, my neighbour's fault; and, lastly, to what are called accidents.

If I eat too much, and am bilious, it is my fault. If my neighbour's drain runs into my well and gives me typhoid fever, it is his fault. If I am hurt in an accident, or struck by lightning, then the disease or injury is due to causes over which I have no control. Let querists thus see if they can lessen the query columns, as most of the queries keep coming uppermost like the spokes of a wheel. Let them try and live in a proper manner, and disease will become less common.

January 5. **T. R. Allinson, L.R.C.P., &c.**

LEGAL REPLIES.

[20945.]—APPOINTMENT OF NEW TRUSTEES (49048).—It would be necessary to see the deed itself before answering so complicated a question; and also to know when and in what order the husband and trustees died. Probably the deed provided for the appointment of new trustees; but if not, it is likely then an application would, under the circumstances, have to be made to the Court of Chancery for such an appointment, and so the querist had better consult a solicitor.

EASEMENTS OF AIR AND EAVES (49057).—I can find no authority for holding that an easement in eaves can be acquired by prescription. The law only acknowledges certain kinds of easements, and does not allow new ones to be created. The eaves are therefore simply an encroachment, and, after notice, the neighbour could probably cut them down. But if the window has been used for light and air for twenty years, it has become an ancient light by prescription, and cannot legally be stopped up by the neighbour; so that the querist may probably be able to keep both.

WILL—PROPERTY (49064).—This question answers itself; for how can a woman who has only a life interest in property leave that property by her will after her death? In other words, the wife has the property for life, and when she dies it goes to B. and C. These, therefore, take a vested remainder which cannot possibly be affected by their mother's will. In truth, she has nothing to leave by will, and her being sole executrix to her husband can give her no such power.

TITLE—ADVERSE POSSESSION—STATUTE OF LIMITATIONS (49065).—Possession, to operate as a bar to an action under the Statute of Limitations, need not be specially adverse. Any possession will do except under a written acknowledgment. Here there has been 16 years' possession, and so the right of action is barred. The suit in a county court would be rather against the claimant or otherwise. If the will were proved at Bath, it would be in the Bristol Registry; but it may have been proved in London. The querist can only find out its length by searching at either or both places for the will itself.

MARRIED WOMEN'S PROPERTY ACT, 1882 (48080).—There is nothing in the new Act specifically affecting the husband's liability to support his wife. But for the future a married woman having property of her own will be deemed to contract so as to bind that property, and thus wives can be made to pay their own debts and to support themselves. The very first principle of the Act is to take away the whole of the husband's control over the wife's property, and as this seems to surprise the querist, he had better read my shilling handy-book on the Act before asking more questions.

ADMINISTRATION (49084).—The best way is to get the proper form of receipt from the authorities; but an ordinary stamped receipt would be sufficient. The administrator will have to send in a residuary account, showing how he has disposed of the estate, and the only discharge I know of is by a deed of release signed by all the legatees.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

RATE OF A DOUBLE THREE-LEGGED "DENISON" GRAVITY TURRET-CLOCK.

[20946.]—SOME months since I contributed a paragraph to the "E.M.," in which I stated that Messrs. E. Howard and Company, of Boston, Mass., were making many excellent gravity clocks, and spoke of the one in the City Hall, New Haven, Conn., as one of theirs. Our horological amateurs will be glad to see its rating, March 1, 1882, up to June 1, 1882.

Week ending.	Clock Error.	Deviation from *Mean* Weekly Rate.
	secs.	secs.
March 8	Gained 2·42	0·81
" 15	" 1·24	0·37
" 22	" 1·74	0·13
" 29	" 1·22	0·39
April 4	" 1·32	0·29
" 11	" 3·22	1·61 [Severe storm Ap. 8-9]
" 18	" 1·43	0·18
" 25	" 1·81	0·20
May 2	" 1·94	0·33
" 9	" 1·59	0·02
" 16	" 1·15	0·46
" 23	" 1·27	0·34
" 30	" 0·62	0·99

The clock was set back on four occasions, by holding 'scape-wheel fast; but the swing of the pendulum was not interfered with.

Roi ne Puis, Souza je Suis.

SCREWDRIVERS.

[20947.]—MANY a carpenter and cabinetmaker, not to mention scores of others who use screws in their work, will be glad to know that a screwdriver ground one side perfectly flat, as in a chisel, will do its work firmer, cleaner, and better in every respect than with the old method of grinding. It takes a better grip of the slot, and does not rime the edges off as the old shape does. Let anyone try to turn a screw home with a ¼inch chisel, and they will catch my meaning in an instant.

Ouvrier.

TIDES.

[20948.]—ACCORDING to the attraction theory, as advocated by Sir W. Thomson at the meeting of the British Association in Southampton, the moon raises the water in the ocean every twelve hours; but it is only once in 24 hours that she stands over an ocean, consequently, while at the meridian she must be drawing to her the water that is above, and, at the same time, repelling from her that which is below. Nor is this the only difficulty: the water, which the moon is said to raise, does not actually rise until three hours after the moon has passed the meridian. This delay, it is said, arises from the fact that the water takes three hours to feel and follow the attractive force. There might be something in that if the moon had gained the meridian at a bound; but she herself has taken six hours to climb from the horizon to the meridian: surely the water has had time enough to feel her force and obey her attraction. We see how rapidly it can appear along the coasts, although one wave has to impel another. But in the case of attraction where the moon would act at once on every particle of water, there would scarcely be friction enough to occasion a minute's pause. Again, when once the moon has begun to draw the water, why does she not draw it right up to herself?—especially as "the attractive force increases as the square of the distance diminishes."

The fact that temperature, and other physical causes, interrupt the uniform flow of the tide indicates that it has nothing to do with attraction, but is an effect of atmospheric compression and agitation—as, indeed, storms are nothing else. The ebb and flow of the barometer proves likewise that it proceeds from atmospheric pressure.

An upward attraction would act alike on great waters and on small. A downward pressure on lakes and inland seas is checked by the surrounding shores. On the oceans this compression of the atmosphere becomes perceptible; thus the opposite coasts of Europe and America have high or low water at the same time. If the water were raised by the moon's attraction it could not be high water on such distant shores at one and the same time: it would be flood beneath the moon, and ebb on the distant shores. But, in point of fact, the water rises both before and behind the moon, because in the middle, under the moon, it is depressed.

As our distance from the sun increases, and the compression of the atmosphere diminishes, the tides ought also to decrease. And such is the fact. According to Pythias and Pliny (lib. 2, cap. 97), the coast near London, at low water, was laid bare for nine miles round. Carden and Olaus Magnus relate that at a Swedish promontory, Nasus, in the Baltic, the tide ebbed and flowed every six hours with such tearing vehemence that ships were swallowed up on its approach. In the Gulf of Venice the flood covered many thousand paces (of five feet) in a very short time (Procopius "De Bello Gothico," lib. 1); Riccoli, in the 17th century, found it covered only 200 paces. Mariners knew no danger equal to Scylla and Charibdis in the Straits of Messina, which even Aristotle reckons among the wonders of the world. Pliny says that with the tide you might have sailed from Italy to Utica (in Africa) in three days. In former times, the tides in the Red Sea so rose and sank with the flood and ebb that ancient authors thought they could explain the passage of the Israelites without a miracle.

Southampton, Dec. 27th. **G. Schutze.**

[20949.]—THE explanation usually given as to the cause of the tides is, as it appears to me, usually defective. That the sun and moon are the primary cause there cannot be any doubt; but how do they act? Not by *drawing away* the water from the earth's centre, nor the earth's centre from the water. It is an impossibility, for the earth's attraction on its component parts, whether fluid or solid is much greater than that which is exerted upon them by the sun and moon, and a smaller force cannot exceed a greater.

Now the water of the ocean is attracted towards the earth by a given gravitating force, and which would hold the water at a constant height, if no other force operated upon it; but the moon (the sun may be omitted for the sake of brevity) in passing over any portion of the water, exerts *her* gravitating influence also, thereby *lessening* the earth's gravitation to that extent, so that the water under the moon is attracted towards the earth by the *difference* of the two forces during that period. What, then, is the result? The density of the water being consequently less, there are two other forces which immediately act upon it—namely, centrifugal force and the pressure of the circumadjacent water, and these continue to act until the balance, which has been disturbed, is restored in accordance with hydrostatic laws.

The tide on the opposite side of the earth is a necessary consequence of the primary tide.

The earth passes on, and the water which had been disturbed by the moon's gravitation resumes gradually its former density; but as it does not immediately resume its former level, it affects the axial equilibrium.

Now the axis of rotation in a body, whose motion is entirely free and unrestricted, must take such a position as will establish an equilibrium about it, and therefore if the earth's equilibrium be affected from any cause, the axis of rotation accommodates itself to the change: thus the secondary tide is raised. The axis of rotation shifts, the radial line is thereby lengthened, and the centrifugal force augmented, and the surrounding water presses on and continues to flow until an equilibrium is again established about the axial line. **W. B. P.**

DIRECT-ACTION TRICYCLES.

[20950.]—WINTER is the time in which to discuss tricycling matters. During the summer evenings, every enthusiastic tricyclist is, or desires to be, "upon the road"; but during the dark and dirty nights of winter he cogitates over his summer experiences, and makes up his mind as to what he will do when that delightful season again returns.

In the great majority of three-wheelers, the parts which cause most trouble are those which transmit the power from the feet to the wheels—in other words, the chain, or the cog-wheels, which connect the treadles with the axles of the machine. All chains stretch more or less; after a few weeks' work they begin to rattle and work loose; they require continual adjusting, and the adjustment does not last long; perhaps they slip off, or catch, and the result is that the rider finds himself on his back in the mud. The cogs of cog-wheels have a charming habit of snapping off, and their side-shake, with a continual rattle, is very disagreeable.

When I, a middle-aged man, with some knowledge of mechanism, resolved, a year or two ago, to go in for tricycling, I carefully considered the points of most of the tricycles then in the market; and my attention was drawn (by a letter of "Sunlight's" in the ENGLISH MECHANIC) to a tricycle which was devoid of either chains or cogs, and in which perfect simplicity of action appeared to have been attained. The result was that I invested in a Coventry "Royal National" of this description, and the object of this letter is to give some account of its performance. The machine is very light, not weighing more than 65lb.; it is a rear-steerer, with 36in. wheels, double band-brake, applied to a drum fitted to each wheel, and provided with Bown's ball-bearings to all wheels. The main new feature in its construction is that the machine is driven direct by means of a cranked axle, no cogs or chain of any description being employed. To allow of this, it is true that the seat is placed, necessarily, some 3in. or 4in. higher than in most tricycles, but I have not found this any disadvantage; with me the machine has proved perfectly safe. To test the friction, I tried this "direct-action" tricycle with a dynamometer on a level smooth road. A weight of one pound made it move readily; with a rider in the seat, a tractive force of four pounds was sufficient. The speed that could be got up was great; indeed, I never personally attempted to find its limits, as I am a somewhat careful rider; but I could always, with little exertion, ride a mile in six minutes. The merits of the machine are, however, most conspicuous in hill-climbing. When my boys, much stronger riders than myself, rode this direct-action National, they reported that they were able to pass every other machine, both tricycles and bicycles, on steep ascents.

I should be glad to hear of the experience of any of your readers who may know of other direct-action tricycles. I may add that by the substitution of a saddle for the ordinary seat, I found an immense increase in power and in speed to be attainable.

A Fellow of the Geological Society.

SQUARING THE CIRCLE.

[20951.]—IN replying to a query on the subject of dividing circles, this subject attracted my attention, as it was necessary to find a geometrical method of finding the value of π, the ratio of the circumference to the diameter.

The problem, as is well known, cannot be solved accurately; and as it has attracted as much attention as perpetual motion, the tri-section of an angle, and other difficult questions, it may be interesting to ascertain how nearly we can solve the problem by geometry. I would like to ascertain also, whether the following method has ever been surpassed in point of accuracy.

Draw a circle of any radius, and draw two diameters horizontal and vertical, and to save a diagram place the letters N, S, E, W, in the positions found on the compass; produce the horizontal diameter E W to the left, and mark off on it a point three-quarters of the radius measuring from W outwards, join W N, and produce it beyond N: from E draw a perpendicular to the diameter meeting W N produced in a point P, then E P will be *very nearly* $= \pi r / 2$; and the rectangle contained between this line and the diameter will be the area of the circle very nearly; the area so found will be in excess of the true value by a fraction represented by area ÷ 2620. **M. I. C. E.**

THE LINK-MOTION.

[20952.]—IN my description of the chart of curves of the link-motion, given at page 383, I pointed out that the vertical line $d = l = 10$ was remarkable as showing the places of a series of circles, the general equation of which was

$$x^2 + y^2 - n^2l^2 = 0$$

at points on this line for which $r = n\,l$, n being an integer, or a fraction, and also that along with these circles there was a system of leminscates, whose general equation was—

$$(x^2 + y^2)^2 - n^2l^2\,(x^2 + y^2) + 4\,l^2\,y^2 = 0.$$

Now, this is the equation to two distinct classes of curves, both of which are well known to mathematicians. For if n is any number greater than 2, the equation becomes that of the locus of the intersection of the tangent of an ellipse with a perpendicular to it, passing through the centre. The semi-axis of the ellipse being respectively $n\,l$ and $l\,\sqrt{n^2 - 4}$, and the eccentricity $e = 2/n$. The figure 15 has been taken for the point $r = 26$, and an ellipse has been inscribed touching the curve at the extremities of the major and minor axes. All the curves from $n = 2$ to $n = \sqrt{8}$ resemble this in form, with an undulation at the extremity of the minor axis: but for values of n greater than $\sqrt{8}$, the undulation disappears, and the common tangent at the extremity of the minor axis lies above both the curves. The curves are then a species of oval between the ellipse and the circle.

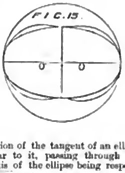


FIG. 15.

Again, when n is less than 2, the equation becomes the solution of the corresponding problem for the locus of the intersection of the tangent, and a perpendicular to it through the centre of an hyperbola, the semi-axis being $n\,l$ and $l\,\sqrt{4 - n^2}$.

Fig. 16 shows the form of the curve taken at the point $r = 12$. The hyperbolas to this curve have been drawn with semi-axes 12 and 16.

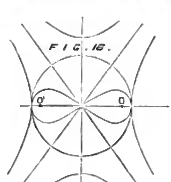


FIG. 16.

And again, when $n = \sqrt{2}$ we have the equation to the lemniscata of Bernoulli, the equation being then—

$$(x^2 + y^2)^2 = 2l^2\,(x^2 - y^2).$$

Or in polar co-ordinates—

$$\rho^2 = 2\,l^2 \cos.\,2\theta.$$

The place of this well-known curve on the chart, (see page 383), is at h, the intersection of the hyperbola A F, and the ellipse A M B. Its being on the latter curve shows that its branches are at right angles to one another. **Milverton.**

GERMANY produced, in 1881, 2,914,009 tons of pig iron, 560,222 tons of castings, 1,421,792 tons of wrought-iron and steel, and 894,425 tons of cast steel.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48076.]—**Emigration to South Africa.**—Railway and Post Office officials are, it is generally understood, much underpaid. In the "Eastern Province," English is mostly spoken along the coast districts, and Dutch in the inland districts; generally, Dutch (or what goes by the name of Dutch) is the predominating language. Get "The Cape and South Africa" by John Noble, London: Longmans, Green, and Co. My advice to "J. A. F." is, if you have employment don't come to South Africa at present: everything is in a very depressed state, and new-comers find a difficulty in getting employment. I was told by a gentleman a few days ago that at Port Elizabeth there are scores of young men looking out for any kind of berth to get some sort of a living. I hope some of our readers in other parts of South Africa will notice the query; I am 250 miles inland. Shall be glad to give any other information.—BLIKNEUS, Cape of Good Hope.

[48596.]—**Harmonium Reeds.**—Mr. Fryer, "as a player of this instrument of some years' experience," must "candidly and honestly" contradict the statement that if the reeds are of good metal hard blowing will not injure them. If Mr. F. really thinks so, he is quite justified in saying so; but he must expect his opinion to be criticised. I am quite prepared to admit that if you blow "too hard" you will ruin anything; but I am quite certain that even Hercules himself would be unable to ruin good reeds in a properly-constructed harmonium by means of hard blowing. Perhaps Mr. F. will now kindly say why hard blowing should be expected to injure reeds which were made to be blown? and if he would also at the same time calculate the pressure which 'Arry sometimes puts on to his concertina reeds we should be able to arrive at an idea of what "too hard" may really mean. I have some recollection that Signor Regondi and Mr. Case used to brutally ill-treat (from the Fryerian point of view) their concertina reeds, and I have also heard harmonium players put extreme force upon the reeds in their instruments, but I never knew hard blowing injure good reeds. I suppose that reeds, like other things, give out in time, and then require renewal; but, in any case, it can hardly be said that they have been injured by hard blowing. It is rather from the continuous vibration over a long period—just as iron girders are weakened after a time by the effects set up by vibration. I should like to know what is considered "an undue force of air," because it must be remembered that it is only when the expression stop is used that any pressure more than is due to the springs can be put on, and then only such pressure as the feeders will stand. As one ounce of fact is worth a whole dictionary of words, I have tested a harmonium I made ten years ago. C in the staff I found to be dead true with a tuning-fork giving the Philharmonic pitch, and the 4ft. and 8ft. C's were just as they were left years ago. If I add that this instrument has been used for practice by my children, and that its bellows, thanks to their vigorous pumping, has had to be mended more than once, I shall have said enough: but I may add, the reeds are not supposed to be of best quality, though they have proved themselves excellent.—HENRI ETIENNE.

[48665.]—**Water.**—Would "H. B. G.," page 303, kindly work out his calculation more fully. I cannot see how 8,446,464 cubic inches are calculated, and how 4,888 cubic feet equals 782 gallons.—SCREW.

[48689.]—**Lathe Bed.**—I see on p. 364 a reply which is likely to mislead the party wishing to know how to make pattern of lathe-bed to mould properly. "E. P.," of Liverpool, says the moulder will ram up the pattern in the sand, face downwards, which is correct. Now, I should like to know how he is going to lift out the sand in the middle of pattern after top box is lifted, which has a joint, as shown in his sketch; if he was going to do it in that way he would simply have to lift the sand from the middle of pattern, and the top altogether, which course must be followed in heavy foundation-plates. "E. P." goes the hardest way to work altogether; he should simply screw the parts together, so that the moulder can take out screws where required. Place the pattern in the bed, ram up a middle, then the pudding inside the pattern, then make a joint and ram up a top, lift top, draw out sides, and ribs, which has a little taper, letting the middle and inside of pattern stop behind, then lift middle, and draw out the faces sideways; there would be no staying of the pudding with the top box, as the moulders term it, and would be moulded in half the time. Hope this will prove of some use.—W. J., Pattern-maker, St. Austell.

[48713.]—**Organ in Small Room.**—I really could not advise you to make a four-stop organ according to the plans you propose. It would be a very costly affair to do properly, and take an experienced person to make. It is a difficult matter for a practical organ-builder to finish such cramped-up instruments satisfactorily, so what must it be for an amateur? The tall bellows, with rings on each corner of the ribs, would be an absolute failure. The chest might be put close to the floor, and this would entail short keys, which are not at all advisable. Your large wood pipes are most probably cracked, or cut up too high at the mouth; if the first, glue them up; if the second, you can't very well alter them. If the large metal pipes give a false note first (commonly designated as being "fifthy"), you give them too much wind—try less. I'm afraid you cannot make much out of your gamba; but the safest way, if you have any respect for the stop, is to let some voicer have it under hand. You cannot alter any of your stops from what they are, and so improve them; you might complete their ruin by doing so. The last portion of your query—viz., "Clear, full, round tone, with power, being required," is what is not, even among the best and most experienced organ-builders, often obtained, with the best of material and workmanship at hand. This being the case, how can the amateur expect to obtain the same, with no experience, and nothing but old materials to work upon, which have perhaps been hacked about by various tuners? If only amateurs knew the difficulty to voice a stop properly, and with a right appreciation of the tone required, and to be obtained, and how to obtain it, they would not propound such queries. It certainly is a laudable object for anyone to try and improve what he has, but in such cases impossibilities are often asked. I am sorry to give "Beta" such a disappointing answer; but I should not feel justified in doing otherwise. I should not like to advise "Beta" to proceed with his proposed alterations, full well knowing what the result would be. If you do alter your organ, let it go up to the top of the room, or nearly so, and put the bellows under the keys, and the soundboard above, when all the pipes, with a little management, may be got in comfortably, by a little mitring and conveying. If you decide to do this, I will try to help you, but cannot do so with such a plan as you think of. When amateurs make organ-pipes, they ought to get professional voicers to voice them, and so save a world of trouble and annoyance. If "Beta" makes any pipes, let him get them voiced; it will pay in the end, and even then, if they are not quite satisfactory, be must put up with it (for if such illustrious organ-builder's work as the Albert Hall organ has been before now styled "an American steam devil," and not "tone," which, with experienced voicers, surely should not be the case), and not complain.—URANIUM.

[48723.]—**Washing.**—I do not know whether steam laundries are under the Factory Act; should imagine so. At any rate, your correspondent can easily ascertain by applying at the Factory Department, Home Office, where also he should give information. I should like to be able to answer the second question: Why do modern flannels shrink so, and how can it be avoided? Will some of your readers help?—S. M.

[48724.]—**Worm-Eaten Furniture.**—Washing with a solution of corrosive sublimate is said to be effective; but I should prefer rubbing tallow into the holes, and warming the furniture—oil is death to insects. Repeat the dose once or twice; then fill up with plaster, and polish over or varnish.—T. P.

[48729.]—**Oysters.**—"The question is not an easy one to answer." This I wrote three weeks ago; and my short answer, "Ploni Almoni" says, is rather more curious than the question, and his answer seems to me to be even more curious than mine. No physiologist would admit that the ciliary motion of ciliated epithelial cells was an evidence of life being present. It is, however, evidence of life having been. I have had portions of the trachea of the lower animals removed after pithing and pinned down, and placed in a humid atmosphere, in which the ciliary motion has kept up for hours. Again, "Ploni Almoni" is altogether in error in supposing that mere circulation is indicative of life. I have had frogs pithed, and kept up their circulation for a long time. This, then, is no evidence of life. It is difficult to say in a word what life is; but "unconscious life," as far as regards the animal kingdom, is not life to me. The moment consciousness is destroyed, the animal ceases to live. This is my idea of life. I have, like many others, produced apparent life in dead animals, and have really startled myself by the near approach to real life in experiments I made some years ago. I should be pleased to read an answer on this oyster question from men of the calibre of Drs. Carpenter and Michael Foster.—W. J. LANCASTER.

[48730.]—**Canaries.**—By "greenhouse" presumably is meant conservatory, which is liable to be treated to great variations of heat and cold; that would be sufficient to account for it. The canaries would live in an equable temperature much hotter than any dwelling-room, but they will not stand extreme changes. Even in the house it is advisable to remove them from proximity to the window when frost is about. But if it is really a greenhouse, they would not take much harm if the temperature never falls below 45°, and the cages are removed to the body of the house for the night. As the aviary is a tolerably large one, cannot you heat it; or is it damp from which the birds suffer? Canaries would scarcely thrive in a greenhouse suited to ferns.—S. M.

[48734.]—**Electricity.**—There is no difference in the electricities you mention. Put it thus:—Twenty tons of bricks have to be carried up to the top of a building; one man commences the task. What a time it takes him to finish the task. Ten men start on it, and by helping each other get the work done in one-twentieth the time. This is a counterpart to your cells. In the nine cells you get more so-called intensity. I have no doubt the water you use contains sufficient salts to keep cells going.—W. J. LANCASTER.

[48752.]—**Tea.**—I must tell Mr. Prettijohn that barley is better to make imitation coffee than wheat, as it has somewhat of a bitter taste, which makes it more like coffee. It is to be hoped that all temperance people, as they are called, are not like those to whom "F.R.C.S." refers. I should not think of taking the pledge, though for many years I have been almost a teetotaler; but tea with sugar and milk I do not like. Years ago I was travelling abroad, and not being able to get milk I drank the tea without either, and have continued it since, and having hard work to do I never found anything better to drink than tea or coffee. I never drink now anything where the water has not been boiled, so when I make my tea I pour out what I want, and afterwards add some more water so as to give me a glassful at supper and leave a glass and a half or so for dinner next day. Now, I by no means think a moderate quantity of beer or wine will do much injury; but I am quite sure that most are more comfortable without them, especially where fatiguing work is done. Look at numbers who have, for instance, to travel long distances. They go and drink brandy-and-water, beer, or wine, with the idea that they will keep the cold out, and help to keep them from feeling the fatigue. Many get to their journey's end tired out, with headaches, &c., whereas, if you keep to tea or coffee, nothing of the kind is felt. There is a great deal too much talked and thought about eating and drinking in the present day, and I am often amused and something more when I read various articles in the MECHANIC. Good things were given to us to eat and drink, and I don't believe a word about this or that being unwholesome. The truth is, that most who suffer from indigestion do so from taking too much, not chewing it sufficiently, and not allowing a sufficient time between meals. The advice of a clever physician now dead was: Don't think so much about what you shall eat; but don't give your stomach more to do than it can. If you find a meal disagree with you take less, till you find that your stomach can digest it. A very true piece of advice.—EDWARD THOS. SCOTT.

[48762.]—**Jerk in Railway Trains.**—Assuming the righting of the carriage to be the only cause of the jerk, the best position will unquestionably be the centre seat.—E. G. M.

[48768.]—**Gilding on Leather.**—Have you tried glair—white of egg beaten to a froth and allowed to stand?—T. P.

[48783.]—**Graphic Methods.**—If this querist can refer to Vol. XXXIII. of the "E. M.," he will find, under the head of "Reviews," "Graphical Determination of Forces in Engineering Structures," by Jas. B. Chalmers (Macmillan). I have never seen the book myself; but, doubtless, it may suit. And now to the subject. It is a conventional mode of calculating forces by graphical representations; it dispenses, to a certain extent, with trigonometrical and abstruse mathematical investigations. I may add that, however carefully the drawing be made, the result will be less accurate than one determined algebraically, &c.,—i.e., it will not be mathematically correct, though sufficiently approximate for most practical purposes. As an example, we will apply the method to a problem—say, two forces of 6lb. and 10lb. act at a point, and at an angle of 70° with one another. Required the magnitude of their resultant. Let 1in. represent 1lb. (conventional). First draw any line 6in. long, to represent 6lb., and at one extremity of this another 10in. long, and at the required angle with the former; then the length of the line (in inches) joining their extremities, gives the number of pounds in the resultant. To solve the above mathematically, some knowledge of trigonometry is required. Lines are used, because they are capable of performing the double function—viz., representing not only the magnitude, but also the direction of resultant forces. Again, they can be used to represent positive and negative pressures: thus taking one drawn downwards to represent a force of compression; one drawn in the opposite direction would indicate tension. If there is anything you do not understand, write again.—NUNQUAM NON PARATUS.

[48797.]—**Gelatine Enamel.**—Are you sure it is gelatine—not varnish? If it is really gelatine, I believe it is spread in thin film on glass plate, and the show-card pressed down upon it. After carefully moving, the edges are trimmed.—SEC. T. L.

[48807.]—**Neuralgia, &c.**—"X + Y" suggests that I should give my experience concerning neuralgia, &c. I should have done so in my reply to "Gamma," instead of offering to write to him, but for the fact that anything relating to medical electricity is generally regarded as mere quackery; but whether quackery or not, I have reason to be grateful to it. I have always been subject to neuralgia, and doctors and dentists (while I went to them in hopes of relief) agreed that I should be so whilst I remained in this world; but the doctor's quinine, &c., did me no good, and wherever the dentist took out a tooth there the neuralgia settled in its most rampant form. I was then induced to try galvanism, and from that time (eight years ago) I have been able to keep the complaint in check. If ever neuralgia comes on, I know for certain that half an hour or thereabouts with the battery will take it away; but it is important that the right kind of apparatus should be employed. If "X + Y" or "Gamma" should use any kind of coil, he must not expect to get rid of his neuralgia; but rather to have it intensified. But if he will use such an apparatus as I will describe, I am quite sure that his neuralgia—however long he may have had it—will disappear after one or two applications of about half an hour each; and most likely after the first. And a curious thing about the matter is that the greater the pain the more quickly it is removed: for while a "nagging" pain will resist for perhaps an hour, a maddening pain will probably give way in ten minutes or a quarter of an hour. I do not know why it is so, but I do know that such is the case. It is absolutely necessary that the current should be a primary one, and that penetrating power should be obtained by having a large number of cells. Take about 60 inkwells or small tumblers, or any glass vessels that can be got—the smaller the better—and range them in a box. Then get a similar number of pieces of zinc about 1¼in. long, and the same number of pieces of copper about 2¼in. long—zinc and copper each to be ¼in. wide. Solder the pieces of zinc to the pieces of copper, and bend into the shape of a U. Cover the zinc with mercury by placing it in sulphuric acid-and-water (1 in 12) till clean, when the mercury can be easily rubbed on with a brush. Vinegar forms a good exciting liquid for the battery, or sulphuric acid-and-water (about 1 in 25) may be used; but care must be taken not to make it too strong, or the great quantity of electricity generated will become painful to the skin. The zinc and copper couples should then be placed in the jars, the copper in one jar and the zinc in its neighbour. It is best to hang the couples on some kind of rack, so that they may be readily raised or lowered. When the couples are ranged in the jars, one end of the series will contain copper only, and the other end only zinc. In the jar containing the copper put a piece of zinc and connect it with a binding-screw, and in the jar containing the zinc place a piece of copper, and connect that with another binding-screw. To each of these screws attach a metallic cord, or length of copper wire, with a piece of brass tube having a wooden handle and a piece of sponge in the other end of it. The battery is then ready for use, and in applying it for neuralgia, the sponge (which should be thoroughly saturated with water) that is connected with the zinc ending should be applied to the place where the pain is, much in the same way that a painter uses a paint-brush; and the sponge that is connected with the copper ending should be held still against the other side of the face in such a way that the current from the opposite sponge is sure to be attracted through the affected part. It is sometimes necessary to put the sponge connected with the copper inside the mouth, in order to cause the current to run just through the painful part, and this is easily done by using a small piece of sponge, about the size of a nut, attached to a piece of copper wire, which would be used instead of the brass handle. The depth to which the couples should be plunged into the liquid must be regulated by the feelings of the patient. Just so much current should be generated as will cause the place to which the sponge from the copper is applied to feel a comfortable warmth, and the place to which the sponge from the zinc is applied to feel the sensation of being scrubbed with a hard brush; and if the current cannot be reduced to that, the fault will be in the liquid being too strong. It is specially important that this matter of strength of liquid should be carefully attended to, as an excessive current would not only prevent a cure, but is very painful, and likely to make an ugly sore. For rheumatism, wire brushes should be used. These brushes may consist of two bunches of fine copper wires, which should be attached to the cords instead of the brass handles. These brushes should be rolled up in pieces of flannel saturated with water, the one from the zinc being held or tied to the afflicted part, and that from the copper applied to such part as the operator believes would cause the current to pass right through the part to be operated on. Care must be taken that the pads are not left too long without an examination, or the skin may be broken, and a sore will be the result. For nervous debility, the current should be applied to the spine, and it will be found that a much stronger current can be borne there than in other parts. The sponge or pad from the copper ending should be held still, and that from the zinc passed up and down the spine, until it shows a distinct redness. I do not pretend to enumerate all the complaints that may be expected to give way to the application of galvanism, but any person may easily tell for himself where galvanism is likely to be of good by roughly dividing complaints into two classes—those that originate in the blood, and those that originate in the nervous system. Where the blood is the cause of the disorder, galvanism would do no good; but wherever a complaint can be traced to the nerves, galvanism may be expected to effect a cure, and no case is more likely to be cured than that which has baffled the efforts of the medical man.—W. S. W.

[48818.]—**The Weather.**—Mr. Colby is quite right in wishing for information that shall be of service in the determining of the causes of our climate. Many others have wished for the same information, and although volumes have been written, we are a long, long way off knowing much about the causes. You read through year after year the work done by the Meteorological Society, and you are but little the wiser. Plenty of tables of the height of the barometer, pressure of wind, temperature, and rainfall; but the causes—oh the causes! you are left to find them out yourself. We want observing stations not only inland and around the coast, but at a number of points some hundreds of miles from our coast line. To know what we have is simple, to know from whence it came is difficult.—W. J. LANCASTER.

[48818.]—**The Weather.**—Allow me to thank "Nun. Dor." for his information; but my difficulty is not as to "rainfall," *per se*, but water (potentially rain) held in suspense overhead as vapour, cloud, &c., causing gloom and dampness, and watery vapour impregnated with solid matter, called fog, also causing gloom, with more or less dampness. The record of "sunshine" in London this last month will well illustrate my inquiry. The "rainfall" in England, I believe, is quite moderate. I have seen heavy rains in S. America—and all parts, with some exceptions, have "rain"—but my observation of S. America, Malta, Italy, &c., has shown me that, as a rule, rain follows closely on clouds, and the rain once down, the sun shines, as distinguished from our climate, where "cloudiness" is the main feature, and "rain" proper only occasionally, and intermittent, and also variable in form—mist, or drizzle, or damp fog—and "sunshine" an exceptional feature. I have observed also frost and ice in many parts (*e.g.*, in Germany), accompanied with bright "sunshine." This is not common with us: generally "gloom." The pervading, and almost permanent, dampness and the sunlessness are not accounted for by any theories that I have met with in my reading as yet. But I am of opinion that a considerable amount of gloom oppressing our large towns is preventible by human agency, and I take this at least to be a practical question.—E. R. COLBY.

[48831.]—**Electro-Magnet.**—You need not have bobbins on so small a magnet. Get a small paraffin candle and some thick blotting-paper, cut the candle up into pieces and put on a plate in the oven, when quite liquid dip strips of blotting-paper, about 1¼in. square, into it, then drain them, and when cold bend two of them round each leg of the magnet; the iron must, of course, be bent into the horseshoe form, then wind some No. 20 cotton-covered wire round each leg in opposite directions until each coil is ⅜in. diameter. With this electro-magnet you will be able to pick up 14lb. easily.—W. J. LANCASTER.

[48835.]—**Fusible Plugs.**—Although these plugs are recommended by one of the boiler insurance companies, I believe they are a delusion and a snare, for certainly, after a time, they do not melt when they ought, and sometimes they melt so frequently that they are replaced by an iron plug. I look upon them as a makeshift—an excuse for an evasion of a duty that ought to be rigidly attended to.—T. P.

[48838.]—**Coil-Making.**—You do not say whether the core is a single piece of iron or made up of thin iron wires. Of course you know everything depends upon the rapidity of make and break of primary circuit. I am afraid your core is at fault. It would have been well also to have had paraffined paper between core and primary. Still, the paper you have, if perfectly dry, would not spoil the coil. You would have done better with stronger insulation between primary and secondary than one or two layers of foreign note. Begin with core first; then if you cannot succeed in improving matters, you had better unwind secondary, and well insulate from primary, and insulate between all the layers of secondary.—W. J. LANCASTER.

[48849.]—**Rack and Pinion.**—The simplest way you can do this is to cut two pieces of wood about 10in. long and ¼in. square; then put pinion wire between them, and move upper one backwards and forwards under pressure. You will then get an exact fac-simile of what rack must be to work smoothly.—W. J. LANCASTER.

[48856.]—**Electric Light for Small Room.**—Wait a little longer, then you will be able to have a successful method of lighting at a small cost. At present the expense is in the driving power. What we all want is a one-horse gas engine for £20. Of course I shall be told this is preposterous, but it must come, and it will come. There is an immense field for anyone who will make such an engine. Batteries are too troublesome, apart from expense.—W. J. LANCASTER.

[48862.]—**Chilblains.**—When a youngster, I always got rid of chilblains by rubbing them with snow; and, failing that, with urine. Certainly, I never had them bad, and have never experienced any trouble since I was a youngster. I can remember, though, that the snow was an infallible remedy; and I have a distinct recollection of taking off my boots and socks and running about in it on one occasion. If my memory does not deceive me, that was a perfect cure; but I never had broken chilblains, so, perhaps, have no experience worth mentioning.—S. M.

[48865.]—**Animal Charcoal.**—I can't think that anyone has suffered more from indigestion than I have. Don't spend any more money on advertised remedies; I found them almost worthless. Take 1lb. of genuine wheatmeal; then mix one teaspoonful of tartaric acid with one tablespoonful of carbonate of soda; sprinkle this into the wheatmeal, and then a teaspoonful of salt. Mix all thoroughly, and pour in sufficient water or milk to form a soft dough. Put it into a flat dish (not a tin), well greased, and bake, straight off, in a quick oven, 1½ hour. This loaf costs 3d., and did me as much good as a 4s. 6d. bottle of the best medicine I ever tried. Slice thin, and use only a little butter at first; but keep to this bread as strictly as possible or convenient, and I promise you better spirits, health, weight, strength, and appearance. Always make your own loaves, and a small one at a time. At first you may think it insipid, but keep to it, and you will like it better than the white fancy stuff. The homœopathic pilules nux vomica, taken as directed for indigestion, will help the cure, but may be done without. The wheatmeal bread sold is more palatable, but not your kind.—OLD ROBIN.

[48866.]—**Astronomical Apparatus.**—Begin with a small telescope and a star atlas. Proctor's is good, and Webb's "Celestial Objects"; then go carefully to work, make a note of anything worth recording, and you will have hours of pleasure. But if you begin with a large instrument you are at once disappointed, because you expect too much. I have known many a student disappointed with a large telescope, from the simple reason that he was not educated to its use, and nothing gives a better astronomical education than the use of a small instrument first, then larger and larger.—W. J. LANCASTER.

[48880.]—**Working Models by Electricity.** You can readily make a motor to drive your models. I have given drawings in some back volumes of the kind of engine to suit you. You would have to use a Bunsen or Grove cell if you want to work them any length of time. I should have thought a cheap, strong clock movement would have been best for your purpose.—W. J. LANCASTER.

[48882.]—**Organ Tuning.**—Tuning horns are made of brass, or wood; I prefer brass. They are generally six in number, shaped like cones—in fact, they are hollow brass cones. The largest three are simple separate cones, and the remaining three are double, a cone at each end of a small handle: one end for outside use of cone, the other end for inside use. May be obtained in London. To use: if the pipe wants sharpening, insert the pointed end, and gently press open the pipe top; if flattening, use the hollow end, and cone in the top of pipe.—URANIUM.

[48904.]—**Magneto-Electric Machine.**—It is a difficult thing to describe the connections, &c., of the bobbins in a magneto-electric machine. The simplest way for you to do is to borrow a machine and remove the covering on bobbins. You will at once see through the method of construction. If you cannot borrow one, I will tell you how to proceed and succeed.—W. J. LANCASTER.

[48905.]—**Rewiring Grand Piano.**—The sizes given were quite correct. The hint as to measuring between the bridges was only for your future guidance.—W. H. DAVIES.

[48908.]—**Electrical Thermometer.**—You can place the thermometer wherever you please, but it should be near where a fire is likely to take place. If you place them near a ceiling, the fire would have obtained a firm hold on the building before the alarm would ring. The iron rust on porous cell will not hurt; you can easily scour it off with a little fine sand.—W. J. LANCASTER.

[48910.]—**Storm-Glass.**—No, it is not entirely due to temperature; a great deal is due to varying electrical action and to moisture.—W. J. LANCASTER.

[48911.]—**Self-Registering Thermometer.**—The self-registering minimum should not be laid down too flat; incline it sufficiently to prevent the breakage of column; the index will then go back with less capillary action, and you will consequently keep the column continuous.—W. J. LANCASTER.

[48921.]—**Street-Lamp Reflector.**—You can do what you wish by having a solar gas-burner in lamp and two paraboloids joined at their centres—one will collect on one side and the other on opposite side; but you will get the light all collected in these two directions; by having the burner outside the focus of each paraboloid you will obtain a diverging beam on each side, and so light up more of the road.—W. J. LANCASTER.

[48929.]—**Conductivity.**—Galvanised iron is better for outdoor work than copper; the copper, unless well protected, would go directly. Of course, the resistance of the copper wire is very much less than the iron; but this is not of much moment in a telegraphic circuit.—W. J. LANCASTER.

[48930.]—**Rendering Wood Fireproof.**—Some years since, experiments were made by Professor Pepper, with a view of rendering articles fireproof by the use of chemical solutions. The following were the results:—Treated with alum the article soon yielded, and burst into flames; with borax, it lasted longer; with tungstate of soda, longer still; with phosphate of ammonia, it resisted best of all.—S.

[48930.]—**Rendering Wood Fireproof.**—Wood can be rendered practically fireproof by first drying it thoroughly and then coating it with common whitewash. If the wood is not thoroughly dry, the coat of whitewash shells off, but it is a very difficult matter to burn wood which has been plastered over with whiting or even limewash.—E. R. M.

[48936.]—**Organ at the Temple Church.**—In the specification of this organ, kindly given by "Dia-Pantos" on p. 392, I notice that in the pedal department there is a twelfth of 5⅓ft. pitch, and a fifteenth of 4ft. pitch. Will any of your readers explain what is the special value of registers of that pitch in a "pedal organ," as it is a bit of a puzzle to me?—S. M.

[48941.]—**White Background for Photo.**—You can obtain a white background with a light slate background; but very few photos look well with a white background. The best background for amateurs to use is a medium slate shade, or a revolving one with several shades, or a capital arrangement used by Mons. Letaille, of Birmingham. He has a curtain of differing shades; this can be rolled up or down until a suitable shade is obtained, then, even while the plate is being exposed the curtains may be rolled, and a pretty effect, very soft, is obtained.—W. J. LANCASTER.

[48942.]—**Needle Telegraph Inst.**—Have a small fork to slide down or lift up from the back easily, so that, as needle passes zero, the fork will prevent it oscillating. Of course, this would only be used after the current had ceased. As you say, weighting will only make the needle less sensitive, and give it a pendulum motion.—W. J. LANCASTER.

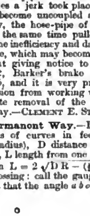
[48947.]—**Rainband Spectroscope.**—I have never yet met with anyone more fortunate with the rainband than you. I know many who have used the spectroscope for the purpose, and I have used it many times, but with but little success. I am afraid the rainband will dissolve into nothingness.—W. J. LANCASTER.

[48963.]—**Sciatica.**—"Anona" complains of cold feet. Let him wear horsehair soles, and he will find much warmth and comfort from them. They keep the feet warm and dry in the winter and cool in the summer—at least, that is my experience. I fear he will get no permanent relief from the sciatica till the warm weather sets in.—C. TOWNLEY.

[48963.]—**Sciatica.**—This is a form of rheumatism. I know it is contrary to the advice of most and the treatment generally used. I am not going to enter upon this subject, though I think the usual way of treating rheumatic affections is only weakening, and, if relief is given at the time, the parts are more easily affected again. I would not advise anyone to try the plan I mention, in case they should think themselves worse afterwards. But in my own case, and that of others, I find bathing the part with cold water very effectual, well rubbing after. I should not mention this had I not experience of its good.—EDWARD THOMAS SCOTT.

[48964.]—**Brake Failures.**—I have read with much interest the details of brake failures given by Mr. Jackson (page 412). I may, however, mention that the hydraulic brake which failed at Harlington was Barker's, not Clarke's. Clarke's hydraulic brake was, some years ago, removed from the only train to which it was ever fitted, and is now an extinct system. Barker's hydraulic brake (system No. 2) has been used upon the Midland Railway, as shown in the table given on p. 210 of the present volume; during the year 1882 the one "fitted train" which remained was stationed at St. Alban's, and worked trips to Bedford and St. Pancras. On the 11th of December, 1882, this train, drawn by Engine No. 132, left Bedford at 6.50 p.m. for London; when the hydraulic brake was required to stop at Harlington it failed to act, as the water in the pipes was frozen. In stopping with hand brakes a jerk took place, which caused the vehicles to become uncoupled and hang by the side chains only, the hose-pipe of the continuous brake being at the same time pulled apart. This failure shows the inefficiency and danger of a non-automatic brake, which may become useless at any moment without giving notice to the driver. In November last, Barker's brake was taken off engine No. 135, and it is very probable that the present suspension from working will be followed by the complete removal of the brake from the Midland Railway.—CLEMENT E. STRETTON.

[48974.]—**Permanent Way.**—In the diagram, let R be radius of curves in feet (both curves having same radius), D distance from centre to centre of roads, L length from one of the points to the other; then $L = 2\sqrt{DR - (\frac{1}{2}D)^2}$. Now for the angle of crossing: call the gauge between rails g; it is evident that the angle abo is the angle required, ab being a tangent to the curve at the point b; bc is the semichord, and will be equal to $\sqrt{(2R - g)g}$. The trigonometrical tangent of the angle abc is semichord ÷ (Radius − g), from which the angle may be found from a table of tangents; or, if no tables are handy, draw a right-angled triangle, the two sides containing the right angle being drawn (to any scale) equal to the semichord and radius − g respectively; then the angle opposite the semichord is the required angle abc.—M.I.C.E



[48991.]—**Equatorial.**—"E. R." asks how to adjust an equatorial without circles. Assuming that he only wants to know how to place it in position, his task is not difficult. Whatever form it may be, an equatorial must have two motions; by the first the telescope is raised to the altitude of the star, and by the next, made to follow the star in its course. Now, all that is necessary is, to make the axis on which the telescope turns in following the star, point straight to the North star. The telescope will then swing on an axis parallel with the earth's axis, and a star in the field can be followed in its course. This is all that can be done without circles.—W. G. T.

[48993.]—**Yellow and Red Timber.**—I was greatly surprised to see the answer to this query on p. 392, and still more so to see it signed "Timber Merchant." I have been all my life perfectly well acquainted with yellow and red pine: they are perfectly distinct kinds of timber, quite different, and very easily distinguished from each other and I never knew a house carpenter or contractor, or—I won't say timber merchant, for I believe many of them know very little of the details of their business—but say foreman in a timber-yard, who did not know them as perfectly distinct, and used for quite different purposes. Yellow pine was formerly much commoner and more used than it is now; it was also cheaper than red pine, whereas it is now very much dearer. It is very large timber, with a most beautifully clean, close, and straight grain of a light yellow colour, which darkened considerably by exposure to the air. It was very much used in panels in consequence of its cleanness, little liability to warp, split, or shrink, and the great breadth to which it could be got; and also for mouldings, carvings, and for gilding, &c. Of all pines it is the easiest and nicest to work, and is particularly well adapted for carving out the hull of a model yacht. It has now got very scarce and dear. The very extensive substitution of varnished for painted work, and the introduction of pitch-pine in house-fittings has also, as well as its high price and scarcity, very much put it out of use, except for mouldings, carvings for gilding, and some other special uses. It was never used for framing, roofing, joists, or bearing timber of any kind, being neither nearly as strong nor as durable as red pine. This latter was and is very much used for all those purposes; it can be got with a very nice clean grain, though it is much more fibry and stringy than yellow pine, and does not work so very nicely and cleanly. It is almost invariably used for window-sashes and frames, for which it is admirably adapted, from its strength and durability, as well as for all sorts of framing, and for roofing and bearing beams. It is much more easily seasoned and less liable to warp than pitch-pine, which, together with the less cost of sawing it, makes it much better adapted for framing, particularly for light framing, than the latter, which, however, has latterly taken its place to a considerable extent for some purposes, particularly in varnished work, in consequence of its more ornamental appearance and figuring of the grain. Yellow pine is very light, red much heavier, and pitch-pine heavier than either. Yellow has also the least smell of turpentine, and pitch-pine the greatest. Both yellow and red pine, properly so called, come from America, neither ever from the Baltic, though some Baltic timber (Memel and Dantsic) is very like American red pine, and may be, and is, used for similar purposes; but yellow pine is totally different and distinct, and very easily distinguished from any other kind of timber. It is now scarce, and not in common use—hence the puzzle about it; but anyone who wants it, and knows it when he sees it, can get it if he knows where to look for it; and for many special purposes there is no timber like it. By the way, I think a specially-selected piece of it ought to be admirably adapted for fiddle-making: it is close, straight-grained, and light, easily seasoned, little affected by atmospheric changes, not much loaded with resin, and works most beautifully. By the way, in the trade which has sprung up of late years to so great an extent with Norway in prepared flooring, there is a distinction made of yellow and red boards; but they are not the timber known as yellow and red pine, and are very inferior timber. "Timber Merchant" may be engaged in this trade, and that may account for the way in which he has answered the query.—G. J. H.

[49001.]—**Clock-Chain.**—Size of pulley and number of pins is only required to make a chain. Rule: If 6 pins, the pulleys should measure over with callipers, exact size, as length of 3 links; if 7 pins, 3½ links; if 8 pins, 4 links. This is a correct way. There is another rule, but this is the simplest. Links should be nearly as wide as the pulley body to prevent wrong running. If old pulleys are worn much, no new chain will fit, and will be troublesome in jumping. Re-turn them and re-pin (if worn) before measuring. Links must not touch the bottom of pulleys. That may be filed away by taking them apart. A new chain may be had for 1s. I prefer to make my own, although a long job in these "go-ahead times."—E. COUNSELL, Faringdon.

[49005.]—**Wine and Spirits.**—I *have* read and *have* marked, but have neither learned nor inwardly digested, as Dr. Edmunds suggests, Dr. Allinson's letter on "Drinks." Dr. Allinson says: "Tea and meat ought not to be taken at the same meal, as the tannin of the tea is said to form leather with the gelatine of meat." I would like either him or Dr. Edmunds to say (1) upon what authority that statement is founded? (2) What are the chemical changes which cause and accompany the transformation? and (3) (and more especially) What are the means whereby, in the numberless cases in which tea-dinners are taken, the persons of average or good health who take them digest the leather? Dr. Edmunds says, in reply to my query as to why so many medical men recommend the drinking of light wine during meals, that it is because they didn't know any better. If this be true, a very large percentage of the members of the medical profession must be wofully far behind the advance of science. In putting the question, I was thinking of the urgent advice of a gentleman now medical officer of health for one of the most important towns in the kingdom, and whose knowledge of his profession probably equals Dr. Edmunds' own; and of the words of a Professor in one of the most important of the Scotch schools of medicine. If the action of alcohol when taken to relieve indigestion be simply "narcotic," how comes it that recovery is frequently delayed so long as none be taken, and is immediate and complete as soon as it is taken? Dr. Edmunds says that "the wise person will avoid indigestion." Does anyone seek it?—HOUSEKEEPER.

[49005.]—**Wine and Spirits.**—In the interests of the temperance cause, it is to be regretted that in reply to the question put by "Housekeeper," "Why do so many medical men recommend the drinking of light wine during meals?" the answer should be given, "Because they don't know any better." I have studied the temperance question long and deeply—have studied it, I believe, impartially. The result is that I am, in ordinary practice, a teetotaller. Perhaps a few observations, the outcome of much thought and experiment (as well as reading, attending lectures, and discussion of the subject), may be appreciated by many of our readers. Firstly, teetotallers do their cause a deal of harm by asserting too much. Taken in large quantities, alcoholic stimulants are universally acknowledged to work serious harm; but there is not a particle of evidence to show that the lighter beers and wines do the healthy person any harm whatever. But then the healthy person does not require them; therefore, I think it his duty to abstain. With many persons, however, who suffer from exhaustion, over-work, indigestion, and various other complaints, they are often of the greatest value. Scientific opinion, practice, and the researches of experimentalists, form together such an overwhelming mass of evidence, that medical men as a body are compelled to acknowledge the fact; and the sooner my teetotal brethren acknowledge it, the better will it be for the cause, for it disgusts a thinking man to be told a thing is no good when he has practically proved the contrary again and again. It is in the fact that a glass of ale makes the exhausted man feel a different being, that one of the greatest dangers lies. He is tempted to go on working, and if he does, he soon wants a glass or two more, which, if he takes, a reaction follows. Secondly, teetotallers generally confound the effect of alcohol with that of wine or beer. Now, they are similar only in a degree. This anyone can easily test for himself. A little pure alcohol, taken diluted with water, has nothing like the refreshing effect that the same quantity has when taken combined with ale. Yet none of the teetotal beers possess the slightest value that I can find; consequently, ale and wine owe much of their virtue to their particular formation. On the other hand, they frequently disorder the stomach, which I never found pure alcohol do, nor will it leave any taint on the breath. Thirdly, teetotallers, even eminent men in the medical profession, confound the effect of a small dose of alcohol with that of a large one. I cannot conclude this reply without urging on moderate drinkers the necessity of being perfectly sure that they require a stimulant; and further, that though a small quantity probably does them no harm, their taking it may do someone else harm; and that though science has failed to prove that any evil results to themselves from taking "a little," it has abundantly proved that, on an average, about three-quarters of a pint of ordinary ale is as much as it is safe for a man to drink in a day.—DANDIE DINMONT.

[49015.] — **Engine Side-Rods.** — If "Engine Cleaner" were to think a moment, he would see that the connecting-rods and side-rods, as regards their circular motion, never stop. When there is a change in the direction of a reciprocating motion, as with a piston, there must be a momentary stop at the exact point where the the backward begins and the forward ends. The reason that a connecting-rod does not stop, is because when the rod and piston are in a direct line, theoretically the crank-pin is moving through a point in a direction from which the piston can derive no motion. This part of the stroke corresponds to the change of motion in the piston. You must remember the stoppage in the piston seems to be of much longer duration than it really is. The connecting and side-rods stop as regards their reciprocating motion, but not their circular motion.—ANON.

[49016.]—**L.N.W.R. Engines.**—Achilles 1005, and Lucifer 1004, have cylinders 16in. by 22in., and are shed 8. North Star 934, Vampire 885, and Atlas 2150, have cylinders 16in. by 20in. North Star and Vampire are shed 14, and Atlas 10. Whitworth, Red Gauntlet, The Nile, Dalton, and several others have lately had their funnels shortened and broadened. Cygnet, Lily, Waverley, Erebus, Soult, and several others of the "Lady of the Lake" class, now have cabs and plain splashers. I hope such alterations as these will continue to take place, as they greatly improve the appearance of such engines as the above.—PROMETHEUS.

[49022.]—**Bottle Jack.**—After well cleaning the jack (this is best done with benzoline, and a small painter's brush, cost about three pence), put it together, with the exception of small regulating wheel at bottom (which is fixed in position by the brass lug and screw), get the silk line quite free from any twist, turn the quadrant-shaped wheel so that the small wheel when in its place will catch it in the centre; screw the lug fast, and wind up the jack; after every click see how many you can count before the weight stops to return the other way. You should be able to count an equal number each way, or the jack will not be in going order. To regulate it, clasp the jack in left hand, hold the quadrant wheel between second finger and thumb firmly, partly unscrew the lug, sufficient to get the regulating wheel out of the teeth of quadrant wheel, and shift the last named wheel one tooth *from* the side you count the lowest number; push the regulating wheel into the teeth of the other, and screw fast again and test. Be care ul to hold tight all the time, or the spring will drive the wheel out of your fingers. You will soon see how to do it—your spring will no doubt do again.—FRANK SMITH.

[49024.]—**Stains or Dyes for Wood.**—I have very little personal experience in staining wood, but I have found Stephen's stains very good and permanent, and it will certainly take an awful amount of rubbing to get them out when once fairly in. Logwood decoction, applied hot, will certainly dye the wood, and, probably, if dosed with alum solution subsequently, will produce the colour required by your correspondent; but I think he would get better results from bichromate of potash, or the permanganate used in two or three dressings. A weak solution of sulphuric acid might also answer the purpose of the querist; but I know that these "chemical stains" are considered much of a trade secret, and so possibly he will not get much useful advice.—S. M.

[49028.]—**Intrinsic Equation.**—Would "M." kindly explain how the algebraic equation is obtained from the differential equation, if the process is not too long. Previous to my seeing this reply I had solved the problem by means of this differential equation, by supposing the required equation to be $y = A + Bx + Cx^2 + \&c.$; then differentiating twice, and by equating like coefficients in the two series on both sides of the original equation, I obtained a series giving the value of y. I supposed the dog and man to be going at the same pace, so as to simplify the arithmetic work; the equation is—

$$y = \frac{x^2}{2a}\left\{1 + \frac{3x}{2\cdot 3a} + \frac{7x^2}{2\cdot 3\cdot 4a^2} + \frac{23x^3}{2\cdot 3\cdot 4\cdot 5a^3} + \&c.\right\}$$

the general term being $nC + (n - 1) / \underline{|n + 2}$, where C is the coefficient of the term preceding the term we are dealing with. This series is converging, but when x approaches a in value, it is not very rapidly converging. I have tested the curve by drawing it from this equation, and find that the equation is correct: still I should like to know how the exact equation is obtained; the exact value of y, as obtained from the equation in "M.'s" reply, will be the limiting value of a series such as I have found when the number of terms is infinite. Is "M.'s" equation found from a series, or in a more direct manner.—M.I.C.E.

[49030.]—**Locomotives.**—The coal consumption of express engines varies with the work they have to do. If you want only a general reply, you may take the coal consumption as from 23 to 30lb. per mile; but it is obvious that the coal bill with the same locomotive and train will vary considerably if the run is on a fairly level track, or on one where stiff gradients abound. Probably with some engines on the Great Northern and Midland the coal consumption will run up to 35lb. per mile, whereas, with same engines and load on more level lines, it would be nearer 20lb.—ESSAR.

[49031.]—**Specific Gravity.**—The rule is a very simple one. The difference between the gravity of the required mixture, and the gravities of the liquids employed in preparing it, give the inverse proportions required. An example will make this clearer. Suppose ammonia of sp. gr. 880 is required to be reduced to 990 with water (sp.gr. 1,000). Then $\frac{1{,}000 - 990}{990 - 880} = \frac{10 \text{ pts. ammonia}}{110 \text{ pts. water.}}$ The reasoning is as follows—1 part of water is 10 *above* the vol., and 1 part of ammonia 110 *below* the vol. of the required mixture; therefore eleven times as much water as ammonia is required to bring the mixture to a sp. gr. of 990.—NO SIG.

[49031.]—**Specific Gravity.**—Assuming that the volume of the liquid compound is equal to the sum of the volumes of the constituent fluids (an assumption not always strictly true), then universally—

$$S + Z(x - 1) = yx$$

where S = the specific gravity of liquid
Z = the specific gravity of added liquid
X = total volume of mixture as compared with volume of original liquid
Y = required specific gravity.

Example:—I wish to add water of specific gravity = 1 to ammonia of specific gravily = ·96, so that the mixture shall have a specific gravity = ·98. How much water must I add? Substituting, the general equation becomes—

$$\cdot 96 + 1(x - 1) = \cdot 98x$$
$$\text{whence } x = 2$$

That is, there must be twice the original quantity in volume.

$$\begin{aligned} \text{Proof:—1 volume water} &= 1{\cdot}00 \\ \text{1 volume ammonia} &= \ \ {\cdot}96 \\ \hline \therefore \text{2 volumes mixture} &= 1{\cdot}96 \\ \text{or 1 volume mixture} &= \ \ {\cdot}98 \end{aligned}$$

The same result can nearly be obtained by alligation.—MITCHELL, Westgate-road, Newcastle-on-Tyne.

[49034.]—**Electrophorus.**—Try either of the following:—(1) 2 parts shellac, 1 part Venice turpentine; or (2) 4 parts beeswax, 4 parts Venice turpentine. Melt together, then add 40 parts shellac, slowly. Why not use a piece of ebonite sheet? You will find it much better, for the resinous plates are always cracking.—J. R. E.

[49034.]—**Electrophorus.**—You might make your electrophorous solely from shellac and Venice turpentine in the following proportions:—Five parts of lac to one of turpentine. You could make one with guttapercha or vulcanised indiarubber, but I think the shellac one would answer your purpose. I should not put any tallow in it. I cannot inform you why books on electricity do not give exact composition.—J. W. BOND.

[49047.]—**Solder for Iron and Brass.**—If the metals are not to be subjected to extreme heat after they are soldered together, the following method will prove successful if carried out as explained below. First make the iron clean and bright; then afterwards tin it by means of a little tin solder and a small portion of clean rosin as a flux. This proceeding will require some degree of patience and time before it will be properly accomplished. The iron should be kept as warm as possible during the process of tinning. When this is done, clean the piece of brass as bright and free from any dirt as possible; then afterwards tin it over with the same solder, using rosin as a flux. Now, if convenient, place the two pieces of metal to be united in a vice; place a small portion of solder between, with a little rosin. Use the blowpipe. As the solder gets gradually hotter between the two pieces of metal, the vice should be drawn tighter so as to insure a close joint. When set, the joint will be firm and strong. I once fastened a piece of brass to a piece of cast-iron in this way, and found it both strong and durable. If this method fails, it is only because it has not been properly done.—G. FRYER.

[49050.]—**Pumps.**—We have double-acting pumps running—8in. chamber, 7in. suction, and delivery-pipes.—BRAKESMAN.

[49051.]—**Permanent Magnets.**—Bessemer steel is not fit for the purpose, nor any cast steel. Good shear steel is employed, and the best is steel containing about 3 per cent. of tungsten; this is a French steel, used for all high-power magnets now; it is needlessly costly, however, at present—I suppose, because it is only produced at the one works.—SIGMA.

[49059.]—**Electric-Light Machines.**—I think it is an error to bring the poles so close together, and that any expected gain will be neutralised by introducing local actions or magnetic short circuits. But I should not attach much importance to the action mentioned by "Electric"; I do not think that the direct action on the wire is of any particular moment in this form; it is entirely the magnetic charge of the iron core which is effective. Whatever effect might be produced by the wire itself cutting the lines of force is almost always neutralised, because the two sides are generally in opposite fields.—SIGMA.

[49061.]—**L. and N. W. R. Engines.**—311, Ida, was built by Mr. Trevilhick. I do not quite understand what "An Inquirer" means by the "technical" name for a certain class of engine. Achilles, 1005, and Lucifer, 1004, have cylinders 16in. diameter, and are stationed at Rugby; North Star, 934, Vampire, 885, and Atlas, 2150, have cylinders 16in., 934 and 885 being stationed at Stafford and 2150 at Birmingham.—THUNDERBOLT.

[49068.]—**Induction Coil.**—Probably Mr. Lancaster can give more particulars than I can; but I will give the querist valuable advice which he will not like—and that is to give his cotton-covered wire away, if he has no other use for it. It is pure folly to use it in a coil from which good results are to be expected: it will require about a mile of wire per inch of spark, density of spark depending on size; if two sizes are used, the fine should be inside. Tin the broken ends of wire in a gas-flame with rosin for flux, then twist them carefully over each other and melt the solder in the flame, or with a thick wire, as a soldering-iron, held in the flame. Two layers of paper will give good insulation, if paraffined before use; the wire also should be baked and paraffined. I should do this after the winding.—SIGMA.

[49081.]—**To Poultry Breeders.**—When setting, reject the largest eggs.—DANDIE DINMONT.

[49083.]—**L. and S.W. Railway Goods Engines.**—Anglia, 226; Scotia, 221; Hibernia, 225; Cambria, 222; Medea, 54; Montrose, 151; Giraffe, 22; Bison, 49; Stonehenge, 16.—RICHMOND.

[49085.]—**Starr-Bowkett Society.**—I suppose "S. B. B. S." really means that the white and blue balls (representing units and tens) are numbered 0 to 9 (not 1 to 10). If there are 299 members, and three red (hundred) balls—viz., 0 to 2, the probability of any particular red ball being drawn is $\frac{1}{3}$ (i.e., 2 to 1 against it); similarly the probability of any particular blue or white ball being drawn is in each case $\frac{1}{10}$ (i.e., 9 to 1 against). The union of these probabilities—viz., $\frac{1}{3} \times \frac{1}{10} \times \frac{1}{10} = \frac{1}{300}$, makes it 299 to 1 against any particular number being indicated by the three drawings. Thus the odds against all numbers from 0 to 299 are equal. If 0 (represented by 0, 0, 0) is drawn, I suppose it will be over again, and this sort of thing will constantly happen in later drawings when a number of allotments have been made, whenever numbers which have occurred at previous drawings are repeated; this is certainly a disadvantage of the system.—VOLTAMETER.

[49089.]—**Pronunciation of Hebrew.**—"Nun Lamed" should get "Heads of Hebrew Grammar," by the late Dr. Tregelles (Bagster), where he will find all the help available in the absence of a teacher. Kamets is pronounced as *a* in father, and in general the Italian vowel scale is to be used: *a* = *ah*; *e* = *eh*, or *ay*; *i* = *ee* (or *i* in pique); *u* = *oo* (Tregelles, p. 5.) "Hebrew Reading Lessons, with Analysis" (Bagster), is also an excellent little book for a beginner.—G. J. W.

[49092.]—**Constant Battery.**—This is one of the unanswerable questions, because it is not complete. The answer depends on the external resistance—that is to say, upon the rate of current to be maintained. The Daniell is the only cell to be called constant; but the nitric-acid cells are fairly constant for some hours if of sufficient size for the work, where large currents are wanted. If a small current is required, the manganese cells will answer, provided they are of sufficient size to furnish the required current when the polarisation limit is reached. Such a question covers the whole ground of current electricity, and no one can give a definite answer.—SIGMA.

[49097.]—**Indian, Australian, and New Zealand Mounted Police.**—I am sorry to inform "Non. Com." that the mounted force in New Zealand is taken from the foot police, and as the mounted are very few compared with the foot, promotion is very slow indeed: therefore, "Non. Com." would first have to join the foot, and take his chance. And from what I know of the Australian police, it is about the same. It may be good information for "Non. Com." to inform him that there are always a lot of good men ready to join the forces when any vacancy occurs; therefore, to get an appointment here seems almost impossible.—AN EX-MEMBER OF THE NEW ZEALAND FORCE.

[49099.]—**Lathe.**—Your wheels are too deep in gear, which should be scarcely on the pitch-line. I have been altering a lathe I am working (a 15in. centre one) for the same fault, which you can remedy by drilling a fresh hole in your back gear spindle, so that it will gear properly, and you will find it answer well. Certainly you will not get so much power from a gut band as a flat belt—not by twice as much, for the simple reason that you will get more grip on your cone pulley from a strap than gut.—FITTER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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48721. Platform Scales, p. 304.
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QUERIES.

[49107.]—**To Mr. Wetherfield.**—Will Mr. Wetherfield kindly advise as to the following?—In October last I exhibited at the Horners' Company's exhibition at the Mansion House, three rare and valuable horn vases. I delivered them to the clerk of the Company, and one of the assistants, who also was one of the three judges, and, as I afterwards learned, was a retail dealer in horn goods. This individual, though they were entered under a business card, and for competition only, induced me to fix a value upon them, though in consequence of their rarity they were not for sale. He then, without, of course, my knowledge or consent, removed them from the exhibition under the excuse of showing them to his wife. Three weeks after the exhibition was over, he sent me a cheque for the nominal value fixed upon them, instead of returning them. Pray tell me what remedy I may have for this breach of faith in removing them from the Exhibition, and my almost certain loss of a prize, as well of my loss of time and expense. Can I sue for a fair recompense in the County Court? If so, whom?—the master of the Company, the assistant, or the clerk, the last two being those who receceived the goods into the Exhibition.—George Stoyland, Essex Horn Works, Sheffield, Yorks.

[49108.]—**Voss Induction Machine.**—Will "Sigma" or Mr. Molison be kind enough to answer me a few particulars respecting the above machine?—(1) I have found the greatest difficulty in making the hole in the large glass plate, which, I understand, should be about 3in. dia. In fact, it took a whole day to file it to that size. Is there not a quicker way than filing? (2) What should be the size of the two Leyden jars? I wish to hang them from the two brass rods that reach from the conductor to the discharging balls which are mounted on two glass pillars, the latter of which stand 9in. high—the same height as conductor. Also, what distance should they be from glass plate, from pillars, and also how high above base board or stand? (3) How are the pieces of brass that hold the bent arms, that connect the paper shields with the front plate, fastened to the fixed plate? Do they clip round the plate, or are they only fastened to the back by some kind of cement?—A Constant Reader.

[49109.]—**Legal.**—To Mr. Wetherfield.—Will you kindly give me your valuable opinion on the following?—I am the second son of a large family. I happen to find out that my eldest brother was not born in wedlock. He is married, with a family of two sons. I also am married, and have one son. There will be some property on the death of our parents. Am I and my son the rightful heirs, and are my brother and his family illegitimate? He married in our family name, and is unaware of the unfortunate discovery.—C. Edwards, Belfast.

[49110.]—**Sulphate of Magnesium and Glycerine.**—To two quarts of water I put 1½lb. of glycerine $C_3H_5(OH)_3$, and afterwards add 1½ handfuls of magnesium sulphate $MgSO_4$. What is the chemical change? What are the qualities of the new compound? What effect would it have on raw silk, if sponged over with it?—D. W.

[49111.]—**"Alexandra" Steamer.**—Could any of the readers of the "E. M." kindly give me the dimensions of the *Alexandra*, which runs on the Thames, and also dimensions of her engines, which, I believe, are on the diagonal principle?—E. Witney.

[49112.]—**Crest.**—Is a younger son at liberty to take his father's crest and use it as his own, or does the eldest son alone succeed to it?—E. R.

[49113.]—**Minima of Algol.**—I should be obliged for a list of those to be visible during the night hours?—More Light.

[49114.]—**Link-Motion as an Expansion Gear.**—While watching drivers starting locomotives, I have frequently noticed that at first, while the regulator is but slightly open, they work the link at full throw. When the train gets well under weigh, the link is run up (with the consequence of reduced travel to the valve); but simultaneously the steam is turned on fully at the regulator. I have been told this latter process is to work the steam expansively. Now suppose the following conditions: (1) Regulator partly open with link at full throw. (2) Regulator fully open with link at reduced throw. For a given quantity of work, is less steam used in the second case? And if so, is it because it is cut off earlier in the stroke? Also is reduction of the travel of the valve, when accompanied by the turning on of more steam, tantamount to shifting the eccentrics with reference to the crank, while the travel of the valve and supply of steam remain unaltered? I hope I make my meaning clear?—More Light.

[49115.]—**Gasometers.**—Could any of your practical correspondents kindly inform me what size a pair of gasometers should be to hold 6ft. of gas (one for hydrogen, the other for oxygen), what they should be made of, and their probable cost? They are to be used for the oxy-hydrogen limelight.—Richard S. Robson.

[49116.]—**Celluloid Collars.**—Is there any means of removing the strong camphor smell which the collars and cuffs made of celluloid possess? This seems to be their greatest objection?—Brickwall.

[49117.]—**Thermometer.**—Is there any way of preventing the liquid in the self-registering thermometers from separating into pieces, which it continually does?—Brickwall.

[49118.]—**Brick Bridges for Boiler.**—What is the best proportion of brick bridges, that is, length and height, for a boiler 8ft. × 7ft., with two internal tubes 2ft. 8in. in diam.?—T. W.

[49119.]—**To "Jack of All Trades."**—I have a very small pump fixed to the sink in the scullery, which works with a cone-shaped leather sucker screwed down at edges, and draws water by turning inside-out at each stroke of the handle. When these suckers wear out, I find great difficulty in getting a new one. They are pressed out of a round piece of leather. If "Jack of All Trades," or any one else, can tell me how to make them it will save me much trouble and expense.—Countryman.

[49120.]—**Cleaning Violin Bow.**—Will some one kindly put me up to cleaning my violin bow?—Frank Smith.

[49121.]—**Hairsprings.**—Will "Alfojoe" kindly say in adjusting the hairspring of a watch, which is best—that the impact of the spring be equal each side of the curb-pins, or should it be greater on one pin than the other? If so, which—inner or outer pin? I have asked several watchmakers (or sellers): some say one way, some the other. My watch is a first-class Waltham lever, with very stout hairspring.—Ouvrier.

[49122.]—**"Set" of Dog-Cart Axle.**—Since being at the coachbuilder's my trap is very heavy to draw. The axle has always had a "crank" of 9in. to keep the body low. How can I test the "set" of the axle myself, to discover error, as coachbuilder declares his work perfect?—No Name.

[49123.]—**Electricity in Horse-Training.**—Can any of your readers kindly inform me what effect an electric shock on the "bit" would have on a horse fretful and anxious at starting?—No Name.

[49124.]—**Wheel-Gearing.**—At the shop where I was apprenticed there was very little wheelwork done, and none by apprentices. Having left that shop, I am at a disadvantage to most journeymen in that one particular. Will some practical reader kindly give me the name of a book devoted to wheelmaking? Any information would be appreciated. Perhaps "Pattern-Maker" could help me?—Young Pattern-Maker.

[49125.]—**To Mr. Wetherfield.**—Will you kindly inform me if a mother who is of independent means is compelled to support her son, an apprentice, until he is out of his time? His apprenticeship ends April 4th, 1883; but he comes of age on the 17th of the present month, and his mother refuses to continue his remittance after that date.—An Anxious Enquirer.

[49126.]—**Huyghenian Eyepieces.**—I shall be very glad if some practical subscriber will help me out of a difficulty:—I took it into my head I would like to try and construct one of the above eyepieces; at least, put one together. So I sent to a London dealer and asked him to forward me lens necessary to construct a Huyghenian eyepiece to magnify 80 times, my object-glass being 3in. focal length. I, after waiting a week, received a parcel with a piece of brass tube and two lens plano-convex of an equal dia., and 1in. focal length. The tube was about 3in. long. I have tried to fix them to suit by placing the plane sides to the eye, but cannot succeed. Is it right that both should be of one focal length? I think I saw on a catalogue a few years ago that the ratio should be as three to one, or if the focal length of one was ¾in., the other should be ¼in. Perhaps some contributor will help me out of the difficulty?—Dorey.

[49127.]—**Twist-Drills.**—What is the best way to sharpen these?—Farmer.

[49128.]—**Screwing.**—What is the proper form of tool for cutting female square threads? A sketch of tool would oblige.—Farmer.

[49129.]—**Promissory Note.**—To Mr. Wetherfield.—Will you oblige with reply to the following?—A father makes a will, leaving his property equally between his two children. Some time afterwards he advanced a sum of several hundred pounds to the husband of one of his children on a promissory note, with interest. One payment only of interest has ever been paid, and that was some 14 years ago. No application for payment of interest has been made for many years, and it is understood that the sum lent is to be returned by the amount of the promissory note being deducted from the borrower's share of the father's property when the time shall arrive for it to be divided. Does the promissory note stand good to secure this payment?—John White.

[49130.]—**To "Fellow-Workman" or "Alfojoe."**—I had an old verge by Mr. Frodsham, London, 1719, brought to me the other day to be regulated. It was going 15 minutes fast per day. On trying the regulator, I found it inoperative, and so I took off cock and lengthened the hairspring a little, and then it went 15 minutes slow. I did this several times, and in one of them I happened to lift the balance and verge a little, and the watch ran down. On trying to wind it up after the cock was on, I found that it could not be done, as it just ran down again immediately. On looking at it, I see that the escape-wheel seems loose. Can you inform me what is wrong with the watch, and how to repair it?—Scotus.

[49131.]—**Steel Wire Rusting.**—Can any of your readers tell me of a ready plan of coating steel wire so as to prevent it rusting?—some plan free from grease, as it would require not to soil paper; and as the wire is tempered, the method must not require so much heat as would soften the wire.—Constant Reader.

[49132.]—**Silver.**—Can somebody help me? I have some silver which is impure. There is a great deal of good silver, but I am not certain what has alloyed it. I think there may be lead, and tin, and brass—any or all. How am I to test for them and purify the silver? If I throw down the chloride, and wash it to dissolve the chloride of lead, and then melt the chloride of silver in a clean crucible with borax, will any of the other metals, if there are any, remain?—Anon.

[49133.]—**Machine for Edging Paper-Hangings.**—Can any reader of the "E. M." inform me if such a machine has yet been invented? Shall be glad of any information.—Paper-Hanger.

[49134.]—**Angle for Lathe Mandrel.**—Will "J. K. P.," "O. J. L.," or other reader, kindly say what angle is best for a lathe mandrel intended to run in hardened steel collars? Also if the two cones are better one way or reversed? If they are both one way, I would have the back one sliding on one or two feathers, and adjusted independent of the front one. Or are reversed cones considered to run lighter? My reason for asking these questions is simply to find, if possible, the best angle and the best practice, having made three 5in. and 6in. centre lathes with Mr. Northcott's irregular mechanism considerably developed and augmented. Also an arrangement for an extremely long nut on guide screw? Being a quadruple screw of inch pitch, the rake of thread was too severe to admit of half-nuts being used. A description of arrangement I shall be most happy to send.—Harry Grosvenor.

[49135.]—**Elastic Moulding.**—Will any one be kind enough to state what is the composition of elastic moulding? I am desirous of taking plaster casts of some objects very much undercut, and am recommended to take the negatives in elastic moulding.—S. S.

[49136.]—**New Brighton Goods Engines.**—I should be glad to obtain the dimensions of the new splendid goods engines 421 class. I notice that there is a different arrangement of air-pump on the right-hand side of these engines which I should like to understand. The piston-rod is continued through the lower cylinder into another very small cylinder, and I should like to know whether this is anything to do with the reversing gear, as I understand that they are reversed by power, not by hand.—J. Jackson.

[49137.]—**Chronodeik.**—On p. 231, Vol. XXXII., of English Mechanic, is an illustration and description of this instrument. Can any of the numerous readers of "ours" tell me if this instrument has been made for sale?—Bliknaus, Cape of Good Hope.

[49138.]—**Organ Building.**—It is intended to build a six-stop organ for a schoolroom (accommodation 250) to be placed on a platform 7ft. 6in. from back to front, raised 2ft. from the floor. In order to save taking up so much of the depth (from back to front) of this platform, could not the 2ft. space between floor and platform be utilised for bellows, and so reduce depth of organ below claviers to, say, 2ft.?—Before proceeding further, I should be much obliged if one of our practical organ-builders would say if this is possible without much increase of cost?—Kunst Macht Gunst.

[49139.]—**Glazed Tiles.**—I want to cut some of the above. I shall be glad if any reader will kindly tell me how to do it. Also best manner of fixing same to wall.—Tiler.

[49140.]—**Model Cutter Yacht.**—To "Robinson Crusoe."—I am much obliged to you for your answer, a few weeks back, to my questions on the above, and should be still more so if you would answer the following: Having got all my frames up, what wood am I to use for the planking. You suggest English oak, "if she is to be left bright," but as she will be painted, what shall I use instead? I have had unperforated Venetian blind laths recommended. Would they do, do you think, or could you tell me what would be better, where to get it, and what would be the probable cost; and, then, how am I to fit the planks together so as to make her watertight?—G. F. L.

[49141.]—**Electric Motor.**—To "H. B. T. S."—Can you inform me what power could be obtained from a double ring motor, such as described by you, the outer ring being 6in. in diameter and 6in. long? I would be glad to know the correct resistances for field magnets and armature, and the current in ampères necessary to obtain best results from it. A motor giving from 1 to 1½ horse-power would be useful to me. Should I be infringing any one's patent rights in making such a motor?—McIntosh.

[49142.]—**Legal.**—Will some one kindly tell me if an amateur who has recently patented a new process can sell his prepared china plates without being liable to duty or license?—China.

[49143.]—**Printing and Lacquering on Tin.**—Can anyone tell me where I can get a few gross of tin box lids printed and lacquered? I should also like to know how it is done. I make the boxes and stamp the lids, which are 3in. dia., and I want to print name in black with gold ground or gold letters with black ground.—A Young Tinner.

[49144.]—**To Mr. Wetherfield.**—Will you kindly oblige by informing me upon the following:—A. marries B., and before A. dies he leaves all to B. with the understanding that all property shall be turned into money and equally divided at the death of B. Now, can the next of kin to A. demand the reading of the will, which was refused at both funerals of A. and B., with the evasive excuse that it was not customary, and how a will should be legally signed. This may also oblige others. It is now past the time appointed that all interested should be called together.—Heir.

[49145.]—**Sulphur Moulds.**—In what proportions, and how are sulphur and guttapercha combined in making moulds for casting in plaster? The combination does away with the brittleness of the sulphur mould.—G. Hirst.

[49146.]—**Lime-Light Apparatus.**—Will anyone who has used the patent oxygen apparatus, which does not require the use of bags, kindly give me any information as to the mode of working, and whether it is as safe and gives as good a light as the ordinary way of working with gas from bags at a high pressure? I should like to know where it can be bought, and the price.—Lantern.

[49147.]—**Ammonia.**—If I burn organic material containing 8 per cent. ammonia, and condense the gas in water, I should be glad to know what quantity of this material must be consumed to make one ton ammonium sulphate from the watery solution thus formed?—New Year.

[49148.]—**Bevelled Edged Photo. Mounts.**—In making these bevelled and gilded edged photo. mounts for my own use, I can never get the edges quite straight. I believe it is usually book-finishers who work them. Perhaps some one in that line would give us a few hints about the proper tools, &c. I suppose the fault lies in my not having a proper cutter for the bevelling. The way I have been doing them is to put about a dozen between two boards, the first card being flush with one of the boards, and each card about a 1-16in. further back than the one below it, and on the last card I put the other board, and tighten the whole up with two thumb cramps. I then use an ordinary hand-plane to plane them all the same bevel. The plane does not cut well from end to end, and in cutting across the edges it leaves them uneven. I would also be glad of some information about the gilding and burnishing.—Country Photo.

[49149.]—**L.B. and S.C. Engines.**—Will some kind reader give me the numbers of the following:—Midhurst, Three Bridges, Lewes, Bottolphs, Bayswater, Cheapside, Gatfield, Essex, Gieta, Rheims, Stockholm, Dijon, Navarre, Ancona, Auvergne, Brisbane, Barfleur, Munich, Rouen, Havre, Toulouse, Toulon, Montpellier, Lark, Lisbon, Louviers, Niort, and Bayonne? Also the names of numbers 146, 158, 94, 39, 56, 217, 250, 238, 267, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, and 162, formerly London?—RICHMOND.

[49150.]—**Sampling Benzoline, &c.**—Will some one oblige by giving me an easy method of ascertaining the amount of benzoline in samples of paraffin?—R. M. HANDS.

[49151.]—**Brittle Brass.**—I read an article in a popular periodical some years since stating that chains for gasaliers were to be had made of copper, which did not absorb the sulphur thrown off by the gas (and so become brittle like the ordinary brass chains) and cause accidents from the falling of the gasalier through the chains breaking. I have made many unsuccessful inquiries for copper chains for this purpose. Can any of the readers of the "E. M." oblige by informing me if they can be met with in London?—E. T. JOY.

[49152.]—**The Planet Mercury.**—I had an excellent view of the planet Mercury last May through a home-made telescope, in consequence of directions given in the "E. M.," how to find his position. Could your correspondent, L. T. Fleming, who gave this information last spring, again favour us with its precise position in respect to some easily recognised celestial object, and so enable some of your readers, including myself, to have another sight of this very interesting planet, which is so difficult to be seen by non-professional observers?—E. T. JOY.

[49153.]—**Skeleton Skulls.**—I intend to make a collection of the skulls of English fauna, and want directions how to prepare them. I am told there is no book on the subject.—R. G.

[49154.]—**Harp.**—Can any of our readers tell me the construction of the harp? What I want to know is, how are the strings fastened to the soundboard—are they fastened to the upper or lower board? Also are all the strings in a single row, and are they all an equal distance apart? Also, how many are gut and how many wire, and what is the difference in English and Irish harps, as I much want to make one, and have not the chance of seeing one. I should be very glad to have the above queries answered by some correspondent.—ENGLISH HARP.

[49155.]—**To "F. R. A. S."**—Will this ever-obliging correspondent kindly answer the following query? Does the moon participate in the motion resulting from nutation; and further, is the centre of motion or apex of the double cone described by the axis of rotation, coincident with the centre of the earth, its centre of gravity, or the centre of gravity of the earth and moon?—and yet further—Does the inclination of the orbit of the moon with the Ecliptic vary on account of precession?—W. A. H.

[49156.]—**S. E. R. Engines**—Will some one kindly give me dimensions of the following passengers, such as 35, 83, 227, and passenger tanks, 27, 144, 214, 239, 301?—C. H.

[49157.]—**Roller Skates.**—Wishing to make a pair of roller skates, I desire to know how to go about it. Are all the wheels to be of the same diameter? Are any of the wheels made to revolve in different directions, or should they be fixed so as to move in one direction? Any information as to the proper position of the wheels or rollers will be thankfully received. I can manage all the other portions.—G. FRYER.

[49158.]—**Traversing Mandrels.**—To "O. J. L."—In your article on "Screw Mania," you seem to hint that a mandrel, of the French pattern you describe, is likely to be soon made for sale. Being in want of just such tool, I should be glad to know if there is any probability of getting one at a reasonable price—I mean merely the mandrel and collars. I know where to get the kind as used by the Tunbridge turners; but, though the article is of first-class make, the price is more than I care to give, and in addition, I think the French pattern is preferable.—NEMO.

[49159.]—**Astronomical.**—To "F. R. A. S.—In letter 20724 in the "E. M." for Nov. 17th, mention is made of a "Report of observations at the Observatory of Dr. Von Konkoly, at O'Gyalla in Hungary." Will your courteous correspondent say if it can be bought?—J. H. L.

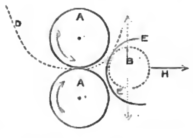
[59160.]—**Legal.**—Will Mr. Wetherfield kindly advise on the following. I am a tradesman. A family contracted a debt with me to the amount of £30. On pressing for a settlement I found that the income is derived from the wife, the furniture also is hers. The husband gave me a bill at three months, which was dishonoured, and I find it is no earthly use to prosecute him. Since that time I have had two instalments from *her*, one of £5 and one of £2, but cannot get any more. Can I press the wife for the debt under these circumstances?—ANXIOUS.

[59161.]—**Legal.**—To Mr. Wetherfield. A landlord induces a tenant to sign an agreement 33 years ago, to the effect that, provided tenant pays £1 a year more rent, he will withdraw his notice to quit, and let him remain tenant so long as he pleases to stop. Landlord now gives 6 months' notice to quit. Can the tenant recover the added rent, paid since agreement legally ceased, from his landlord; as well as revert to original rent since receiving notice to quit?—INQUIRER.

[59162.]—**Horehound Beer.**—Some horehound beer I made about a month ago has gone sour. How can that be prevented? Can I put malt in and sell it as a non-intoxicating drink? What is the most approved method of making horehound beer?—J. S.

[59163.]—**Transmission of Power of Electricity.**—What would be the first cost of apparatus for conveying from 5 to 6 h.-p. by electricity, a distance of about 600 yards, and what would be the annual cost of maintaining the electrical plant? If cost is not too great, a farmer proposes using electricity for conveying power to his thrashing machine.—I.

[59164.]—**Metal Bending Rollers.**—Will someone please enlighten me on the following? I have an old wringing or mangling machine, which I intend to convert into a sheet metal bender. The sketch will, I think, be explicit enough, A A are the two rollers which are connected at the other end by means of cogs not shown, the dotted circle B is the extra roller, which I intend to put and work up and down as the dotted arrows show. The dotted line D is the sheet to be bent; but a friend has advised me to do away with the cogs and impart the driving power to the bottom roller A only, make the back roller B to move in the direction of arrow H, and vice versa, putting the sheet in as the line E E shows making the pressure of sheet work the top roller A, also B. Which will be the best way to do it?—THOMAS HARDING.



[49165.]—**Engine.**—My cylinder is 2½in. bore and 5in. stroke; how many revolutions should it go per minute, with steam about 25lb. for to exert half horse-power? How much heating surface should boiler have, and what should grate-area be? Would a copper boiler one eighth thick be strong enough to work at 40lb. safely?—if not, how much?—WILLIAM WARNER.

[49166.]—**Zither.**—Will Mr. T. W. Kirby, or "Dispart" kindly give me a few hints how to put the frame of zither together, the best wood to use, and how I will get the scale and shape of top bridge and dimensions of same? T. H. HARPER.

[49167.]—**To "Fiddler."**—Some 18 months ago, you mentioned that you were going to make a Violoncello on the same plan as your new violin. If successful, will you oblige me with the requisite measurement. Did you not find the slope awkward to play by throwing the strings so far away from the player?—EAST ANGLIAN.

[49168.]—**Legal.**—A. having given B. credit six months ago, to the amount of £50, partly money lent and goods supplied, B. now finds himself insolvent and not able to pay his creditors all round, more than 3s. in the pound out of his estate. No money in hand, but a fair stock of goods and furniture. B. is quite willing to give A. preference to any other creditor, and feels anxious to see him paid in full if it can be done by the agency of any legal document. Would a promissory note signed by B. hold good against the bankruptcy, which must shortly take place, or what is the best security B. can legally give A., which will secure A. £50 in full out of the estate?—HENRY WILLIAMS.

[49169.]—**Silver Niello Work.**—Can any reader give me any information about niello work?—How the black appearance is produced on the silver, and by what means, &c.?—H. REGENT.

[49170.]—**The Great Comet.**—To "F.R.A.S."—It appears the great comet was first seen at the Cape on the 8th September in close proximity to the sun (apparently to fall into it), and again on the 17th September (when it was said to be in its perihelion) it was seen close to the sun. If its perihelion distance was only about equal to the sun's diameter, would it not pass from perihilion to 90° ($\sqrt{1^3} : \sqrt{p^3} :: 109{\cdot}6 : t$) in a few hours, and in nine days be far away from the sun? Since leaving the sun in September, it has continued to retrograde in long., and is now in opposition to the sun, and, I presume, in the direction of its major axis. Its perihelion long. would be in the opposite direction, or about 280° instead of = 55°, as stated in the elements. If its perihelion long. was 55°, would it not be travelling in a different direction to what it is? Your kind explaration will oblige an astronomical tyro.—C. A. B.

[49171.]—**Model Locomotive Boiler.**—I shall be obliged to any reader for some practical instruction in the making of a copper tubular locomotive boiler to be brazed together, showing the method of brazing in the tubes and the inside firebox: it being difficult to get at the tubes in the firebox ends. Having failed many times to accomplish this, I asked a coppersmith to braze a boiler together. He hesitated, saying soft solder would answer quite as well if the proper height of water in boiler was kept up. This being so, what advantage has the brazed boiler over the solder? Will the seams in a brazed boiler stand fire, in case the water gets low—the top of firebox not being covered with water?—W. R.

[49172.]—**Ethoxo Limelight.**—Will some one who has had practical experience with the above give some particulars? I wrote Mr. Fisher some time ago, but had my letter returned through the dead-letter office. Will some one say whether it is within reach of an amateur to make one? If so, will they give particulars how to proceed?—J. C. ETHOXO.

[49173.]—**Fan Mounting.**—How should the leaf of a fan be folded to secure the exact evenness of the folds, and what is the best cement to fasten silk to sticks?—AMATEUR.

[49174.]—**Sluggish Liver.**—To DR. EDMUNDS.—Can anything be done for a sluggish liver? I suffer agonies! Not a week passes but what I have to endure and fight against fits of depression, lasting sometimes for hours, sometimes for days. In my case, life is really not worth having, for even in my gayest moods (and they are but few) I am in constant fear of a relapse into low spirits. Sleep is my only consolation; but unfortunately for me, I cannot be always asleep. I might add that I am 22 years of age. I have very little trouble to contend with outside my liver. I indulge freely in muscular exercise, and live soberly and temperately. If Dr. Edmunds can hold out any hope of improvement, I will at once give further particulars. Or, if he desires it, put myself in communication with him.—1883.

[49175.]—**Typhoid Fever.**—(1) If after a case of the above, and the patient recovers, is the person liable to an attack again—more so than one who has never suffered from such illness? (2) After such illness, is there any one part of the body left weak, or subject to weakness? (3) If chalybeate waters are beneficial or not? and if so, in what way?—B. W.

[49176.]—**Dynamo-Machine.**—Will any of your readers help me in the following?—I have constructed a small dynamo-machine of the Bürgin type, having an armature 6in. long, and 3¼in. diam., consisting of four rings of six sections each. Each section is wound with 6ft. of No. 20 cotton-covered (upon a core of soft-iron wire), and is joined up in series to the succeeding section of the next ring which follows it at 1-24th of a revolution. The field-magnets are of very soft iron, and are wound with a total of 8lb. of No. 16 c.c. When a circuit from three Bunsens is passed round the field-magnets, and the armature is revolved by means of a lathe about 1,500 per minute, a current is obtained from it (the armature) equal to one or two Bunsens; but when the machine is deprived of outside battery power, and the current from the armature passed round the magnets in the usual way, no perceptible result can be obtained, even after running for 20 minutes at 1,500 revolutions. I shall be greatly obliged if some one will kindly point out the fault, and also say what might be reasonably expected from such a machine.—S. S.

[49177.]—**Sharpening and Setting Hand-Saws.**—To "JACK OF ALL TRADES."—As a young amateur who doesn't understand clearly your invaluable notes on this subject, may I ask you to reply to the following?—In sharpening, what are the different angles at which the handle of file should be to point of saw for rip, cross-cut, tenon, and dovetail? In setting, what is the best plan or method for the different saws mentioned? How I can gauge the proper amount of set to be given, and if there are any rules by which I can work in setting saws for soft and hard woods—such as pine and oak? As the saw is the only tool I use that I can't properly sharpen, I am desirous to understand thoroughly the subject, as it is of such importance to every wood-working amateur, and especially to the querist, who is—A YOUNG ONE.

[49178.]—**Velocity of Electricity.**—Could any reader give me the velocity of electricity, light, and sound, as the velocity of electricity is given in one book on electricity as 174,800 miles per second; in another as 288,000 miles? The conductor might make the difference, though I think it must be a misprint.—HIBERNIA.

[49179.]—**Glass Sweating During Frost.**—Can any of your correspondents give receipt to prevent glass of shop-window from sweating during time of frost?—DOWN.

[49180.]—**Cards for Automatic Musical Instruments.**—How is the cardboard prepared for the pianista? It is a very firm yet rather soft homogeneous card. I find ordinary cardboard flakes and becomes torn. Having a quantity to prepare, I should much like to know the best way of doing so.—PIANISTA.

[49181.]—**Laboratory Table.**—How can I stain and polish a deal table for a laboratory to resemble walnut or mahogany, so that it will not be affected by caustic alkalies and acids?—D. B.

[49182.]—**Liquid or Size Glue.**—Can any reader give information of a cheap way of making above in large quantities suitable for paper boxes?—W. THOMAS.

[49183.]—**Show-Cases.**—I should be glad if any reader can tell me how the composition is made, and how put on the ends and sides of small show-case that hold the glass together?—W. THOMAS.

[49184.]—**Examination.**—Would any kind reader give a list of books, such as would suffice to pass (granted they being well known) the examination of the C. S. Commissioners in Political Economy, Jurisprudence, Mental and Moral Science, Logic and English Language and Literature, all in Class I. Clerkship?—NOLENS.

[49185.]—**Legal.**—To MR. WETHERFIELD.—Will you kindly answer this? Fifteen years last Michaelmas I hired a house at £34 per annum, paying quarterly. Landlady died: property sold; commenced with new landlord at Michaelmas, 1878, at same rent; June, 1879, rent rose £6; paid first quarter increased rent at Michaelmas. At what time of the year ought my tenancy to expire on notice to quit from landlord, and may I remove any fixtures I have put up? There is no agreement between us.—AN EIGHT YEARS' SUBSCRIBER.

[49186.]—**Loss of Goods at Sea.**—The wreck of the *City of Brussels* suggests to me a pertinent question, which, perhaps, Mr. Wetherfield or some of your obliging correspondents can answer. Who loses the goods that thus go to the bottom of the sea? What is the custom, or is there any law? Suppose, for instance, I had ordered goods from America which were sent by the ill-fated vessel, who loses—the sender or the person who ordered them to be sent? Suppose they were sent on credit; as they were not received, should I have to pay? And if I had sent cash with order, would that have been filled by the shipping of the goods, and should I have to be at the loss of my money? I suppose there is a custom—can any reader tell me what it is?—T. J. P.

[49187.]—**Piano Frames.**—Would any reader give me sketch and dimensions to make pattern for casting of iron frame for 7-octave cottage pianoforte?—BRAKESMAN.

[49188.]—**To "Fellow Workman" or "Alfojoe."**—Among other tools of which I have become possessed, there is an adjusting-rod for watches. Will you kindly instruct me how to use it? Also, if there is any way of taking twist out of hair-spring of English lever, quickly and with certainty. I lent a good watch to an acquaintance some time ago. When returned, I found it would not go—hair-spring had been tampered with (in moving regulator, I suspect, a pin had been run among coils by accident). On examination I found it twisted, and in contact with plate, and I have not been able to get it right since.—SCOTUS.

[49189.]—**Electro-Motor.**—Will Mr. Fred. Walker, or some of our kind readers, answer the following? I have a Siemens armature, 3in. long and 1¼in. diameter, and two pole pieces, same length as armature. Which would be the best to screw to the pole-pieces, round or flat bars, for electro-magnet? What size of wire should

I have on armature and magnet? Also, should the armature and magnet be annealed? If so, how to anneal them? The armature is cut from solid wrought iron. Please tell me if I can make this work, and oblige—Poor Jack.

[49190.]—**Liquidation.**—To Mr. Wetherfield.—A customer obtains goods on credit, and asks for his account to be sent in. He is called upon for payment, and promises to do so the following Friday. He is called upon that day when he says he has not quite sufficient cash, but as he will be wanting more goods the following Monday he will send the amount at the same time he sends for the goods. The next morning (Saturday) a notice of his liquidation is received. This looks to me like obtaining goods under false pretences. Now, sir, is there no law to punish such a debtor? Can a man legally obtain goods one week and liquidate the next? If he can, the sooner the law is altered the better. Your kind and early reply will be esteemed.—Jimbo.

[49191.]—**To Flautists.**—Is there any description of concert flute made (with the ordinary fingering) in which the span between the holes is in any way lessened, thereby enabling a player with a very small hand to execute with almost the same ease as on a piccolo? For what purpose are the four extra keys on a twelve-keyed flute?—Flauto.

[49192.]—**Japanese Violin.**—I have heard what was called a Japanese violin played, and, admiring the tone, wished for one. Could any friend give me instructions that I could make one by giving the length of neck, and width, depth, and breadth of belly? Also, what is used for strings, and what are they tuned to? The violin in question is long-necked and square-bodied, looks as if it was made of beech, and is played resting on the knee.—Veritas.

[49193.]—**Spectroscope.**—Can anyone tell me what is the smallest aperture which can be usefully employed with a McClean star spectroscope?—Draco.

[49194.]—**Salt in the Fire.**—What is the cause of the purplish colour seen when common salt is thrown into a clear fire?—Aziola.

[49195.]—**Brake Failure.**—Late in June last I was travelling in an express train on the Midland Railway from Leeds to Bradford, and the brake being out of order when required, it caused the train to collide with the buffer-stops, giving us a severe shaking. On looking over the Board of Trade "Railway Returns" for six months ending June, I failed to see any report of the above. Perhaps Mr. Stretton would tell me if this would be reported by the Midland as a brake failure, as, in my opinion, it was a very great one, and should have been thoroughly investigated, and a proper overhauling made of the brake apparatus to prevent a recurrence at any other time.—X. Y. Z.

[49196.]—**Injector.**—Would some one of ours say where the fault is in an injector which will not send water in the boiler working at 90lb. per sq. inch, only when I stop water elsewhere, so as to give a greater pressure at the injector, which is very inconvenient at the works? It seems to have plenty of water at the air tap at all times. I am feeding the injector with 2in. steam tubing out of the boiler front, and is supplied with 2in. tubing for water.—B. Halme.

[49197.]—**Income-tax.**—To Mr. Wetherfield.—What is the fullest abatement that can be claimed on a salary of £208 per year, and which is the proper schedule under which to be assessed? The collector of income-tax has sent me a demand note of payment for £2 7s. 6d. I have not had an assessment paper for this year up to the present. I understand he has been to my employers and got the amount of my salary, deducts £120, then sends me the above note for payment for £88. Is this a legal proceeding?—Phosphorus.

[49198.]—**Comet Wells.**—I understand that the ascending node of the orbit of Comet Wells lies very close to the earth's orbit. When will the earth pass the point? Considering what is known concerning comets and meteor streams, is it not possible that when the earth does pass it there will be a shower? And if no shower takes place, will this circumstance not afford proof that Comet Wells is not followed by a meteor stream?—Cepheus.

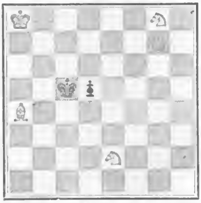
Distance Indicators for Locomotives.—An instrument has been lately invented by a Sicilian, Signor Vito, which is meant to show the driver at any moment, with close approximation, the point reached, and which also sets the whistle in action at a given point, where special attention may be necessary. The first part, for indicating the length of line run, is an ordinary counter, with three discs, each divided into 100 parts, and traversed by a needle set in motion by the engine wheels. The first disc} indicates 10 metres for each division, the second kilometres, the third 100 kilometres. For the second part, Signor Vito uses a cord of a certain length, which the reaction of a spring tends to wind on a drum. This cord passes between friction-pulleys, governed by the counter, so that its rate of winding on the drum depends on the progress of the locomotive. A spiral spring wound up, and held by a peg, is connected to the valve of the whistle. Suppose, now, the driver has to give special attention after running 100 kilomètres. At starting, the counter-needles being at zero, the driver winds round the peg a certain length of cord corresponding to the distance named (the cord having been divided into measured sections). During the journey, the cord unwinds uniformly, and when 100 kilomètres is run this motion suddenly stops, but the peg yields to the pull, and the liberated spring opens the whistle, which continues to sound till the driver coils the spring again and replaces the peg, whereupon he may set the apparatus for another indication.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCXV.—By A. Briggs.

Black.



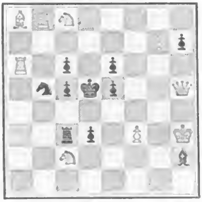
White. [5+2

White to play and mate in two moves.

PROBLEM DCCCXVI.—By J. Rayner.

(One of first prize set in Lebanon Tourney.)

Black.



White. [9+10

White to play and mate in two moves.

Solution to 811.

White.	*Black.*
1. Q to R 6	1. Anything
2. Mates	

This problem can also be done by 1. R takes R.

Solution to 812.

White.	*Black.*
1. Kt to Q 3	1. Anything
2. Mates	

Game in English Mechanic Correspondence Tourney between Messrs. Reynolds and Russell:—
(Petroff's Defence.)

White (Mr. H. B. Reynolds).	*Black* (Mr. T. Russell).
1. P-K 4	1. P-K 4
2. Kt-K B 3	2. Kt-K B 3
3. Kt takes P	3. P-Q 3
4. Kt takes B P	4. K takes Kt
5. B-Q B 4 (ch)	5. P-Q 4
6. P takes P	6. B-Q 3
7. P-Q 4	7. B-K Kt 5
8. Q-Q 3	8. Q Kt-Q 2
9. Kt-B 3	9. Kt-Kt 3
10. B-Kt 3	10. R-K sq (ch)
11. B-K 3	11. Q-Q 2
12. P-K R 3	12. B-K B 4
13. Q-Q sq	13. B-K 5
14. Kt takes B	14. R takes Kt
15. Castles	15. Q R-K sq
16. P-Q B 4	16. B-B sq
17. R-B sq	17. R-Q sq
18. P-Q 6	18. K-Kt sq
19. B-Kt 5	19. P-B 3
20. Q-Q 3	20. Q R-K sq
21. B takes Kt	21. P takes B
22. P-B 5 (disc. ch.)	22. Kt-Q 4
23. B-B 2	23. K-R sq
24. P-B 3	24. R-K 7
25. Q-K B 5	25. B takes P (ch)
Resigns.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 811, 812 by Dicky Sam, Donald Mackay, A. Briggs, Stanley Follwell; to 811 by W. T. Bayne.

A. Briggs and W. T. Pierce are thanked for problems and game.

Mr. Briggs of 98, Durham-street, Rochdale, sells a very neat rubber-stamp which imprints a clear impression of a chess diagram 2in. square. The price, including carriage, is 5s. 6d.; also a large sheet of such impression, containing 16 clear diagrams, at 2d. each, post free, or 1s. 7d. a dozen. These we believe to be by far the cheapest diagrams ever published, and no one could want better. We may mention that the stamps are mounted on brass, with ebony handle, pad and ink complete. Mr. Briggs is himself a problem composer, and we have pleasure in publishing one of his problems in the present number.

In Mr. Meyer's two-move enigma in last week's issue, the White Pawns are at K B 6, K Kt 3, and 5: in Black's pieces K 5 in top line ought to be Kts.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 10, and unacknowledged elsewhere:—

Leroy and Co.—H. A. Ivatt.—J. A. Woodworth.—W. J. Brown.—R. Murray.—Dr. W. H. Brown.—W. B. Coulcher.—W. L. Stephens.—R. Prentice.—Rev. W. H. Wright.—R. C. Mawson.—J. T. Newburn.—A. J. S. Compton.—U. Dini.—Mawson and Swan.—J. S. A. Dunbar.—Dr. G. Wilkins.—C. E. Allan.—Rev. E. A. Gillett.—W. Nolan.—Shaw.—Bath.—Pure Air.—Barley Bree.—J. L. F.—R. D H. B.—J. B.—H. Bill.—Whitworth Threads.—Tormented.—Enquirer.—A Fellow of the Royal Astronomical Society.—J. A. Brashear.

Comet. (1. No. 2. What is the proper colour? If black, varnish it with the blacking given on p. 520, No. 749. If ordinary leather, stain with logwood and acetate of iron.)—Mec Ha Nic. (See p. 603, No. 910. Nearly every volume contains two or more recipes. 2. You must use some softer spelter. See the papers on Hard Soldering in Nos. 839, 843, 846.)—Home. (See Hardwicke's "Shilling Charities," and the "Poor Law Returns." No one can tell how many in private houses. From the Registrar-General's return, which is published by the Queen's printers.)—One Unsettled. (Apply to the bandmaster of the regiment.)—T. T., A Subscriber. (See p. 240, No. 842, and p. 531, No. 864.)—F. J. N. (Will not the one illustrated on p. 216, No. 841, suit? See also Nos. 449, 450.)—Novice. (Which do you mean? Some are made of compo, (glue, whiting, and rosin), others of thin brass, stamped in a machine.)—A. G. Bene. (Heat is the only thing. We believe billiard-table makers supply suitable hot-water tins for the purpose. 2. We could not answer the second question if we knew; but we can advise you to apply to some of our advertisers. Probably they do such work.)—G. Hirst. (Get a wood engraving or a photo-zincographic block of a signature. Take mould in the usual way, and make stamp from that.)—M. G. (All joints are soldered. You will find directions in Culley's "Practical Telegraphy." For electric lighting, the wires are carefully cleaned, twisted over one another for an inch or two, and soldered up solid. If the leads are of rod, the two ends are scarfed and encircled by a piece of split tube, and the whole thoroughly bound together with solder.)—Edwd. Thos. Scott. (There is little more to be said than has appeared in recent articles. The great advantage is that it is self-charging. See, however, an article in this number.)—J. L. (Must refer you to the indices. The question is purely a commercial one.)—M. Aulosong. (Yes. No stamp required.)—W. D. J. (We really do not know, unless you draw them with ink. Lithography means printing from stone. In practice, ink lines are drawn on stone or zinc, and impressions taken from them.)—Beginner. (As a "beginner," you should look through your back numbers. See pp. 72, 165, present volume, and the indices of recent volumes.)—H. E. Grones. (1. The rules are given in any textbook. 2. One, if properly constructed. See p. 398, Vol. XXXIV. We presume you mean electro-magnets. 3. Indefinitely. 4. The following is the order of non-conductibility, the substance offering the greatest resistance being placed first: Mica, guttapercha, shellac, sulphur, glass, silk, &c.)—S. S. R. (We do not know why "Jack of All Trades" has taken no notice of query 48597. We fear he is ill again, as we have heard nothing of him lately.)—Comet. (We know nothing at all of the advertiser referred to, but will keep a look-out.)—Sun Shade. (The correspondent referred to ceased to contribute some time ago, and is not likely to contribute again.)—Jas. Cowley. (The firm referred to is not one we should recommend you to do business with. If they do not send the goods, we should serve them with a County Court summons.) J. Smiles. (He may say so; but he cannot "maintain" it, because, to do that, he must support his statement by argument, and the facts will not allow him to do that. Advise him to read the lectures by Prof. S. P. Thompson, commenced on p. 399.)—BOILER. (It is impossible to say what such small affairs will do until they are tested; but we should expect to get the power you mention out of it. Charcoal iron is the best.)—A POOR MAN. (Under the circumstances, he would not reply; but he has already answered a similar question. The herbalists are usually very successful.)—F. C. B. (Particulars sent are insufficient. Is the wire silk-covered, and how are layers insulated? Look up the many replies and similar queries.)—H. PASKELL. (The question has been answered before. You purchase the tongues of the right size, and then scrape the free end to sharpen, the rivet end to flatten. The difficulty is in tuning, and that needs a trained ear and skilful fingers.)—GEO. GREY. (Cover the paper at back with Canada balsam, diluted with turpentine. 2. Described many times, most recently on p. 391, reply 48850.)—J. O. JONES. (No examination at all, we believe; but if you apply to the secretary, at 4, Broad Sanctuary, Westminster, he will give you all particulars.)—A. HAWKENS. (Get the catalogue of Weale's Series, published by Lockwood and Co., Stationers' Hall-court, E.C.)—CURLY. (See previous answer, and get the catalogues of other publishers.)—W. ROBSON. (No book of the kind. The process is described in such works as Ure's Dictionary and Watt's "Chemical Technology." You will also find a number of recipes in back volumes.)—N. J. B. (There are several systems. The simple cold-air method was described on p. 82.)—PARKES. (The best treatment is an active purgative, to be followed by a salt-water enema.)—S. MOSS. (1. No book published on the subject. The antiseptic is probably chloride of zinc. 2. What zinc solution do you mean? 3. Cannot say without more particulars. Most likely it can't be done, except by the makers.)—COUNTRY COUSIN. (We never heard that a patent had been granted for lighting a fire at the top, but it is quite possible patents are granted every week for ideas quite as old. Scores of patents have been taken out for plans embodying recesses at back, top, sides, front, over, under, and in the middle of the fire, so that unless we have some clearer idea of which invention you are looking for, we cannot help you.)—G. G. (We should certainly communicate with the police if matters are as you say. We cannot insert your letter, because it would be libellous.)—ANXIOUS ENQUIRER. (Lumbago, probably; but impossible to say more on such vague symptoms. Stick to your doctor's advice, and have patience.)—ISAAC PEARSON, J. CHERRY, AND OTHERS. (We regret that want of space and other reasons prevents us from inserting mathematical problems taken from textbooks.)—ROMEO. (As a general rule, you have always understood aright; but some men find themselves apparently able to eat heavy suppers with impunity.)—LEGAL OR NOT. (All raffles are illegal—many of them swindles.)

USEFUL AND SCIENTIFIC NOTES.

◆

A Clock for Railway Stations.—A very ingenious electric clock for use in railway stations has been recently exhibited in Boston. It gives automatically the signals for starting trains at the proper times, and it is automatically regulated at noon each day by electric impulse from some astronomical station. Though the details of the apparatus are rather complicated, the principle is simple. The mechanism for giving the signals shows two discs, each pierced with 1,440 holes arranged in spirals of 24 turns, with 60 holes in each turn. Small metalic pegs are inserted in the holes corresponding to any given minute and hour, and the contact of these with an electric conductor allows passage of the current for the signal. When any change is made in the time of starting trains, the pegs are shifted. One, two, three, or more successive and different signals can be given for each train. It is proposed to connect all the stations of a railway with the main office, so that signals for starting trains will be given from a singe apparatus.

Interlocking-Signals and Continuous Brakes.—In his report on the collision which occurred on the 18th of November, at Shoreditch Station, on the North London Railway, during a fog, Major Marindin says:—"Like many other accidents of this class, however, it would not have been caused by the mistake of one of the signalmen concerned if the out-of-door signals and the block telegraph instruments had been interlocked, as is now done upon some lines, and it is precisely to such lines as the North-London that such a system is best suited. If the fog-signalman's statement as to the position of the detonators is correct, then the driver could have averted the collision if he had had at his command a quickly-acting continuous brake throughout the whole length of the train."

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent garden, London, W.C.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except Index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctor's bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in Packets, labelled "JAMES EPPS and Co., Homœopathic Chemists, London."—Also makers of Epps's Chocolate Essence.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

◆

Wanted, **Tricycle**. Will give 3in. back gear 2ft. Bench Lathe, with treadle, all from V steel, what offers?—BROWN, Queen-street, Colchester.

Glass Cylinders for Electrical Machines. One small, one large. Both fitted with caps, also supports. What offer in exchange?—Address, 123, Coltman-street, Hull.

Piano (cottage), walnut and gold, iron-plated, 7 octaves, nearly new, 20 guineas. What in exchange?—13, Ann-street, Linton-street, New North-road.

Chest, fitted with six drawers, lot of various tools, list, exchange watch or offers.—D. S., 8, Court Walsall-street, Wolverhampton.

Patent **Oxygen Apparatus** (no gas-bags required). Exchange for small washing machine.—J. FRANCIS, Rochford, Essex.

Microtome wanted, glass plate preferred, for cutting animal and vegetable sections; first class Slides, &c., in exchange, or part cash.—FREDERICK MARTIN, Clevedon.

"**Knowledge,**" Volume II., complete, with index, clean and perfect; offers in exchange.—EVANS, 5, Shipstone-street, New Basford, Nottingham.

Hand Drilling Machine and half-horse Engine; exchange for 4in. or 4½ Back gear lathe, or offers in lathe parts.—GOULD, 3, Keen-street, Warrington.

Wanted, a **Boiler,** suitable for a 2 or 3in. cylinder; copper preferred; will give 24 numbers of Hogarth's Works, 2s. each, and cash.—Address, 149, Freedom road, Walkley, Sheffield.

Wanted, **Bicycle or Fittings,** in exchange for Dubroni's Patent Photographic Apparatus, complete, with printing frame, take plate 2½ by 2½.—WM. PICKLES, Livery-street, Whitefield, near Manchester.

16in. **Flywheel,** bored out, 1¼in. hole, heavy rim, turned and polished. Price 9s.—17, Wakefield-street, Warrington.

6in. centre **Lathe,** £4. Half-horse Horizontal Engine, 30s.—G. GOULD, 3, Keen street, Warrington.

Set of half-horse Horizontal **Engine Castings,** 17 shillings. Set in rough, 9 shillings.—G. GOULD.

Wanted, "**English Mechanic,**" in exchange for Religious and Scientific Books, or Photographic and Electrical Apparatus.—D., 13, Ward street, West Hartlepool.

Wanted to exchange, full-size **Lantern Slides** for others. Would purchase if cheap and good.—19, Gwyn street, City-road, Bristol.

"**Engineer and Surveyor's Draughtsman,**" containing every variety of ornament used in the profession, quite new, cost 15s. What offers?—WILLIAMS, 174, Undercliffe-street, Bradford.

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For Exchange, a good Tailor's **Sewing Machine,** value £2 10s., as I have no further use for it.—J. CARTER, Pinfold-lane, Armley.

Will exchange a large **Electric Machine** with Battery, for a Lathe, 4in. or 4½in. centre.—Apply, A. F., 83, Hackney-road, E., London.

Wanted, 50in. **Bicycle.** Will give almost new Organ Accordion, cost £3 5s.—WILLIAM SHACKLETON, 69, Avenue Parade, Accrington.

Equatorial Mounting for a heavy Metal Reflector, 10in. dia.; appearance no objection if the adjustments are all in working order, for a second size Microscope, by Baker, of Holborn, first quality, and accessories.—By letter to A. J. W. C., Milanese Villa, Bath road, Ventnor, I. of W.

"**English Mechanic**" 130 odd back numbers, and 2 indexes, slightly soiled. Exchange.—H. L. CARTE, Bromborough Pool, Cheshire.

Choice **Magic Lantern Slides,** in exchange for others, or offers.—E. H. FANNANT, Pallasgreen, Limerick.

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Lathe, 4½in., iron bed, slide-rest, self-centring and other chucks, D. H. G.'s overhead. Offers.—F., 1, Kent Villas, York-road, Barnet.

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Wanted, **Lathe,** about 3in. backgeared, slide-rest, gap preferred, bench or otherwise. Exchange cash and 87 numbers ENGLISH MECHANIC, volume XXII. to XXVI.—Particulars and price to S., Coldharbour, Whetstone, N.

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Pair of **Scales** (Salter's Improved Spring Balance). Will weigh up to 56lb. quite correct. What offers?—17, Wakefield-street, Warrington.

Railway 100 yards; cylinders, 2in., 2½in., and 3in. diam.; large quantity of other things, small propellers, &c.—16, Katherine terrace, Ashton-under-Lyne.

Slow-Combustion Boiler, Steam Coil, and Cash, for high pressure house boiler, or anything I want.—BURN, 6, Brunswick-place, Wellchorse-road, Croydon.

Fan for Blast Furnace, &c., Patent Bellows, Grinding machine, steam boiler and engine, for any other useful tools.—Address as above.

Wanted, Vol. IV. of **Holtzapffel's Turning and** Mechanical Manipulation, Parts 13 to 24 of JOURNAL OF SOCIETY MECHANICAL SOCIETY. Good exchange.—Box 24, Southport.

"**Old and New London,**" first eight (2s.) parts, and black autocopyist. Offers. Wanted, Stick Air-gun.—"MAHONEY," 25 Shirlock-road, N.W.

Lathe Standards, four-speed turned wheel, crank turned treadle, complete. Walter Henfrey, engineer, London; exchange mutual approval.—W. SMITH, Bilston road, Wolverhampton.

50in. **Bicycle** and accessories, bright, and in capital order; Tyres brown and vermilion, front-wheel spoon brake; exchange; want a 46in.—R. PATTON, Burton, Westmoreland.

Pair of 4½in. **Launch Engines;** all wrought and cast-iron parts finished, cost £30; useful offers in exchange requested.—"AZIMA," Dover.

20ft. Copper-fastened **Boat,** nearly new; make good sailing-boat or steam-launch; exchange for anything useful.—"AZIMA," Dover.

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Sewing Machines, the Champion of England, value £2; also Taylor's sewing machine, value £1 5s.; exchange for watches or musical instruments.—GOODMAN, 23, Lumley road, Skegness.

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Three 3½in. Double Gong **Magneto Sounder Instruments** in first class order, 15s.; also quantity silk covered wires; useful exchange.—"AZIMA," Dover.

Three 7in. 30lb. Bourdon's own make **Pressure,** and Three 7in. Vacuum Gauges; offers of anything useful in exchange requested.—"AZIMA," Dover.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—KING and Co., Electricians, Bristol. (List Twopence.)

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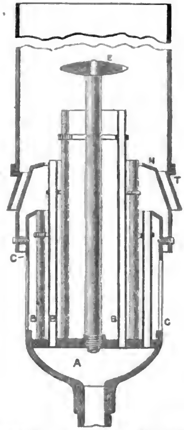
Inventors requiring use of Dynamos and Steam power 10 H.-P., apply to OTTERMANN BROS., Old street.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 19, 1883.

THE GAS AND ELECTRIC EXHIBITION AT THE CRYSTAL PALACE.

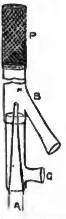
ALTHOUGH the exhibitors of the electric light at the Crystal Palace have still much to do to make their portion complete, the gas section, with one notable exception, is now in full swing, and that exception—the incandescent system of M. Victor Popp, of Paris—is being put into shape. During a recent visit, we found the only electric arc-lights going were Lea's naked lamps, shown in the Lions' Court of the Alhambra by Mr. Werdermann, whose large semi-incandescent light in the "dome" was, from some cause or other, simply a dull red; the McKenzie lamps in the nave at Messrs. Strode's stall; and a solitary arc-lamp in the Roman Court, shown by the Duplex Electric Light Company. Swan incandescent lamps were, however, in use, but they are now familiar objects; and such novelties as are promised by the catalogue have still to come. Lea's light, which is a naked arc, deserves some notice, not only because it has special features in its mechanism, but because Mr. Werdermann has elected to exhibit it without glass shades or reflectors. Four of these arc-lights are swung from the roof and illuminate the Lions' Court, rendering it as bright as daylight, if not brighter, for the shadows thrown on the marble pavement are blacker than the diffused light of the sun would make them. At first sight, the regulator would be condemned as too complicated; for, besides the ordinary supply of magnets, there are apparently too many springs and other details to render it a commercial success. Still, it is so well arranged, from both an electrical and mechanical point of view, that it is sure to attract attention; and when properly adjusted, it leaves nothing to be desired so far as effects are concerned. Without a number of elaborate diagrams, it is impossible to give a description of the mechanism of the Lea arc-light; but it must suffice to say that the upper or positive carbon is held in position by rollers mounted in a metal frame; and a supplementary frame carries a jockey roller, which regulates the feed, and adapts itself to different-sized carbons by means of a spring and a gripping lever, which, when acted upon by one of the electro-magnets, causes the rollers to revolve and bring the upper carbon into proper position. The negative pole is held in place by a clamp of such form that almost any size carbon can be used. The device is ingenious throughout, but we are afraid that it is too complicated to become commercially successful; and we understand that Mr. Lea has in hand several modifications which will simplify the construction, though he can scarcely hope for better results, which, as we have intimated, are very good indeed. It must not be forgotten that if electric lighting by means of arc-lamps is to become commercially successful, the greatest possible simplicity must be aimed at; for a lamp, however good, that is costly to make and requires skilled attendance, is heavily handicapped in the race for popular favour. Somewhat similar remarks apply to the more novel exhibits in the gas section; for it requires no great amount of foresight to discover that the regenerative systems will have the advantage over those in which compressed air is used—the latter involving the use of some machinery for creating the blast. We have already given descriptions of several plans, but some further remarks may be useful now that they can be seen in action. The Siemens regenerative burner gives, so far, the greatest amount of light from a given consumption of gas—that is, so far as has been officially tested and verified; but although the lamps have been considerably improved, there is still, of necessity, the objection that the cumbrous nature of the burner prevents much of the light being thrown down vertically beneath. Viewed at the level of the eye, the Siemens regenerative burner gives a splendid light for a moderate consumption of gas (5 to 7 candles per cubic foot); but the size of the burner cuts off much of the light that should be thrown downwards to the floor, and the defect is not altogether remedied by the use of reflectors. We gave an illustration of Herr F. Siemens' later burner in the last volume (p. 538), but reproduce it here (Fig. 1), as it serves to explain the principle, and is useful for comparison, while specimens can be examined at the stall of the Siemens Patent Gas Company in the West Corridor, where the actual construction adopted is shown by a burner cut through the centre. The object of the regenerative system is to heat both gas and air up to the temperature which gives the greatest luminosity, and in the earlier Siemens lamp that is accomplished by causing the gas-flames to curve over a porcelain cylinder, which forms the outlet for the products of combustion. These are drawn downwards by the draught and heat the incoming air and gas by conduction from the metal surfaces of the burner. In the later device, the air and gas being led through a number of metal tubes, are intimately mixed, and the air as it enters the burner takes up some of the heat imparted to the metal by the flames of the jets. The lamps shown in the South Nave, including the large 1,000-candle burner near the great clock, are of the "regenerative" type proper, in which the gas-flame is drawn down through a central tube, around which the gas and air pass to the point of combustion. In the Grimston burner, exhibited by Mr. G. Bower, the action is much the same, but the arrangement is reversed, for the flame is projected downwards, and there is nothing but a glass cover to prevent the full light being thrown on to the floor. In both plans the hydrogen and carbonic oxide of the gas are used to obtain a very high temperature, while the hydrocarbons are utilised to obtain a light which, owing to the high temperature, is very brilliant. As we have previously described the Siemens burner, both in its earlier and later forms, we need do no more here than mention that, owing to the body of the burner being larger than the annulus of flame, the shadow thrown is considerable. In the Grimston burner, on the contrary, the flame is directed downwards in this way:—The burner consists of a cylinder within a cylinder, the two being connected by horizontal tubes through which the air passes to the inner cylinder. The latter contains a number of vertical tubes through which the gas passes from a supply pipe at the top to the jets at the bottom. The hot products of combustion projected against the glass cover at the bottom re-curve and rise up between the two cylinders, thus passing amongst the horizontal tubes bringing the air to the central cylinder, and also passing around the gas supply. The heated air passing through the central cylinder and around its nest of pipes, raises the temperature of the gas flowing through them, and a flame of great brilliancy is produced, projected downwards, while the whole body of the burner, being above the point of combustion, the shadow is consequently thrown upwards. The hinged glass-cover is made to fit practically air-tight, and the lamp, while easily started, attains its full brilliancy in a few minutes. It might be supposed that, the flame being directed downwards against the glass cover would cause fractures; but judging from what can be seen at the Crystal Palace, there seems no danger of this kind, and the Grimston lamp will probably be voted the best of the regenerative class—not, be it observed, because it gives a better light for a given consumption of gas, for of that we have no information, but because from its construction it throws all the light where it is most wanted, downwards. The shape of the flame is represented by the recurved flower of the convolvulus. Of the so-called incandescent systems, Lewis's is shown by Mr. Bower in the Birmingham Court with the Grimston, and also at a stall close by in the South Nave. We gave an illustrated description of Lewis's on p. 343, last volume, but reproduce the figure, with the intimation that two pipes are now fitted to admit the external air (Fig. 2). It will suffice to say that it is worked by compressed air, the flow of which induces an additional air supply direct from the atmosphere, and accelerates the motion of the gas, the mixture being consumed without flame in a cap of platinum gauze, which is raised almost to white heat. The result is a glowing column or rather stump of light, which is very effective; but as we have mentioned, is accompanied by the drawback of providing machinery for compressing the air. In this case that is obtained by means of a Körting gas-engine, and a gas-exhauster used as compressor for air, which is stored in a receiver, and the pressure governed by a vessel resembling a simple form of gasometer. All the members of the system are in the one exhibit made by Mr. Bower, and are well worth inspection for their in-

FIG. 1.



A, gas supply; B, concentric rings of tubes leading gas to point of combustion; C, casing with air inlets; E, deflector, of porcelain; N, second casing; T, third casing and gallery.

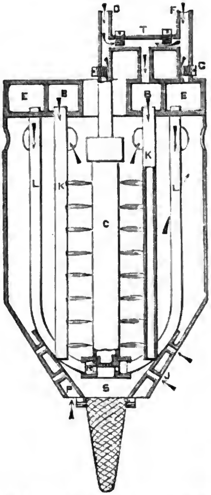
FIG. 2.



A, compressed air supply; B, air inlet; G, gas; P, platinum gauze.

dividual merits, as well as for their effectiveness in the special work they are doing. As regards the Lewis incandescent light, it may be said that the Grimston regenerative burner gives decidedly the whiter illumination, for the platinum gauze of the former is rather nearer a bright red than incandescence, a term which is supposed to imply a yellowish-white heat at least. As is well known, however, platinum raised to a white heat is just on the threshold of the fusing-point, and it may be only prudence to keep the light down to a safe margin within that limit to the durability of the lamp. The Lewis incandescent lamp is really a modification of the Bunsen or Herapath blowpipe, and though unquestionably capable of doing good work in suitable localities, will probably give place in ordinary circumstances to one of the regenerative systems. The Körting gas - engine, supplying the compressed air for the Lewis incandescent lights, is of the vertical type, with a pump for supplying a charge of the explosive mixture to one side of the piston at each revolution. The lighting jet is produced by a finely-bored nozzle projecting into the combustion-chamber, and having its wide end near a gas-light burning in the open air. When the cylinder is being charged the mixture escapes through this nozzle, and is ignited by the gas-flame; but, owing to the velocity of the incoming charge, does not fire the contents of the cylinder. The latter having received its charge, the supply is shut off, and at that instant the flame retreats, so to speak, within the cylinder, and explodes the charge.

FIG. 3.



B and K, mixture of gas and air; C, compressed air; E and L, gas; D, compressed air supply; F, gas supply; P, passage for products of combustion; J, air inlets; R, burner; S, jet, projected into the magnesia basket.

The Clamond incandescent light is shown in the Chinese Court, the compressed air being supplied by an Otto half-horse gas-engine driving a small Root's blower. This is the simplest of the systems using air at a pressure, for a simple elastic reservoir is all that is necessary between the blast-producer and the burners, and a pressure of $\frac{13}{16}$ths is found sufficient to give excellent results, the light being very white and brilliant, and very economical, if, as stated, it gives about 10 candles per cubic foot of gas. The principle of the lamp is shown in the annexed engraving (Fig. 3), which was fully described in Vol. XXXV., p. 514. The gas and air are heated by the regenerative system, and by the use of special gas-jets for warming the air. The latter being supplied at a pressure, the flame is projected into a little basket or cone made of threads of magnesia, and supported by a platinum netting. The magnesia is thus rendered incandescent just as the lime cylinders are in the oxyhydrogen light; and the flame being projected downwards, there is no shadow on the floor from the body of the burner. The magnesia baskets last from 40 to 50 hours, and for the smaller sizes cost about three half-pence each. As will be seen, however, a portion of the gas is used solely for heating the air. Messrs. Henry Greene and Son exhibit a very simple form of regenerative gas-burner, which is said to yield a light of five candles for each cubic foot of gas consumed per hour. An Argand burner is fitted with a chimney led into a flue, enveloping the top portion. Surrounding the chimney is a glass shade, the bottom of which is closed air-tight by a cap resting on a boss beneath the burner. The whole of the air required for the combustion of the gas must thus pass between the chimney and the shade, and, becoming heated, it perceptibly increases the luminosity of the flame. The addition of the extra glass is, however, an obvious disadvantage, as the risk of breakage is thereby doubled, a portion of the light is lost, and we suspect the chimney will need frequent cleaning. Still, if such an economy as 5 candles per cubic foot can be obtained, the very simplicity of this arrangement will commend it to public favour, as it is applicable to any of the ordinary patterns of argand or ring burners. Among other objects of interest we may direct attention to the large meter made by Parkinson and Co., through which passes all the gas used by the exhibitors. It is fitted with a glass front through which the motion of the patent three-partition drum can be seen, and as the gas passes rapidly (about 5,000ft. an hour), those who can cannot "read the index" have here an excellent opportunity of learning a useful lesson. Assuming that each cubic foot gives an illuminating power of three candles, it will be seen that the gas section of the exhibition is now illuminated with a flood of light equal to 15,000 candles. There is, in fact, a rumour that the combustion of so much gas is injuring the plants, and that the exhibition will come to a premature end; but we suspect that is an invention of the "enemy." Of the great variety of burners, regulators or governors, cooking apparatus, &c., all that can be said is that there is abundant room for choice on the part of purchasers, and that good service might be done to the public if the Crystal Palace Company appointed a jury of experts to test the various exhibits and draw up a report. There are very good reasons why the majority of the electric-lighting exhibitors who had a place at the Palace in the spring of last year, should be absent now; but there seems no good reason why those who undertook to light a given space should have failed to keep faith with the public, and left the stalls in the north nave in comparative darkness. The exhibitors in that portion of the building have a real ground of complaint.

ON THE LUMINOSITY OF FLAME.

THE light emitted from burning gases which burn with bright flame, is known to be a secondary phenomenon. It is the solid, or even liquid, constituents separated out by the high temperature of combustion, and rendered incandescent, that emit the light-rays. Gases, on the other hand, which produce no glowing solid or liquid particles during combustion, burn throughout with a weakly luminous flame of bluish or other colour, according to the kind of gas. Now, it is common to say, merely, in explanation of this luminosity, that the gas highly heated in combustion is self-incandescent. This explanation, however, has not been experimentally confirmed. Dr. Werner Siemens was, therefore, led recently to investigate whether highly-heated pure gases really emit light.

The temperature employed in such experiments, should, to be decisive, be higher than those produced by luminous combustion. The author had recourse to the regenerative furnace used by his brother Friedrich, in Dresden, in manufacture of hard glass. This stands in a separate room which at night can be made perfectly dark. The furnace has, in the middle of its longer sides, two opposite apertures, allowing free vision through. It can be easily heated to the melting temperature of steel, which is between 1,500° and 2,000° C. Before the furnace apertures were placed a series of smoke-blackened screens with central openings, which enabled one to look through without receiving, on the eye, rays from the furnace walls. If, now, all air-exchange was prevented in the furnace, and all light excluded from the room, it was found that not the least light came to the eye from the highly-heated air in the furnace. For success of the experiment, it was necessary to avoid any combustion in the furnace, and to wait until the furnace-air was as free from dust as possible. Any flame in the furnace (even when it did not reach into the line of sight), and the least quantity of dust in it, illuminated the field of vision.

As a result of these experiments, Dr. Siemens considers that the view hitherto held, that highly-heated gases are self-luminous, is not correct. In the furnace were the products of the previous combustion and atmospheric air: consequently oxygen, nitrogen, carbonic acid, and aqueous vapour. If even one of these gases was self-luminous, the field of vision must have been always illuminated. The weak light given by the flame of burning gases that separate out no solid nor liquid constituents, cannot, therefore, be explained as a phenomenon of glow of the gaseous products.

It appeared to the author probable, that heated gases did not, either, emit heat rays; and he set himself to test this idea, experimenting, in company with Herr Fröhlich, in Dresden. They first convinced themselves in this case that the light emission of pure heated gases sunk to zero, even when the field of vision was not always quite dark, and it was only possible to observe this a short time; but the repeatedly observed perfect darkness of the field of vision was demonstrative. On the other hand, experiments made with sensitive thermophiles, in order to settle the question of emission of heat-rays from highly-heated gases, failed.

Afterwards, however, Dr. Siemens was convinced, by a quite simple experiment of a different kind, that his supposition was erroneous. An ordinary lamp, with circular wick, and short glass cylinder, was wholly screened with a board, and a thermopile was so placed that its axis lay somewhat higher than the edge of the board. As the room-walls had pretty much a uniform temperature, the deflection of the galvanometer was but slight, when the tube-axis of the thermopile was directed anywhere outside of the hot-air current rising from the flame. When, however, the axis was directed to this current, a deflection occurred, which was as great as that from the luminous flame itself. That the heat radiation from hot gases is but very small in comparison with that from equally hot solid bodies, was shown by the large deflection produced when a piece of fine wire was held in the hot-air current. On the other hand, however, it was far too considerable to admit of being attributed to dust particles suspended in the air current.

It must be conceded to be possible (the author says) that the light radiation of hot gases, as also the heat radiation, is only exceedingly weak, and therefore may escape observation. It is, therefore, much to be desired that the experiments should be repeated at still higher temperatures and with more exact instruments, in order to determine the limit of temperature at which heated gases undoubtedly become self-incandescent. The fact, however, that gases, at a temperature of more than 1,500° C., are not yet luminous, proves that the incandescence of the flame is not to be explained as a self-incandescence of the products of combustion. This is confirmed by the circumstance that, with rapid mixture of the burning gases, the flame becomes shorter because the combustion process goes on more quickly, and hotter because less cold air has access. Further, the flame also becomes shorter and hotter if the gases are strongly heated previous to combustion. As the rising products of combustion still retain for a time the temperature of the flame, the reverse must occur if the gases were self-luminous. The luminosity of the flame, however, ceases at a sharp line of demarcation, and evidently coincides with completion of the chemical action. The latter itself, therefore, and not the heating of the combustion products, which is due to it, must be the cause of the luminosity. If we suppose that the gas-molecules are surrounded by an ether-envelope, then, in chemical combination of two or several such molecules, there must occur a changed position of the ether-envelopes. The motion of ether-particles thus caused may be represented by vibrations, which form the starting-point of light and heat-waves.

In quite a similar manner we may also, according to Dr. Siemens, represent the light-phenomenon occurring when an electric current is sent through gases, which always takes place when the maximum of polarisation belonging to them is exceeded. As the passage of the current through the gas seems to be always connected with chemical action, the phenomenon of glow may be explained in the same way as in flame, by oscillating transposition of the ether envelopes, by which the passage of electricity is effected. In that case the light of flame may be called electric light by the same right as the light of the ozone tube or the Geissler tube, which is mainly to be distinguished from the former in that it contains a dielectric of an exremely small maximum of polarisation. This correspondence in the causes of luminosity of flame, and of gases traversed by electric currents, is supported by the similarity of the flame-phenomena in strength and colour of light.

[These researches were lately described by Dr. Werner Siemens to the Berlin Academy.]

PRODUCING PICTURES ON GLASS, STONE, METAL, &c.

AN improved process for producing pictures on glass, metal, and other substances, has been recently patented in this country on behalf of M. E. Godard, of Paris. The invention has for its object the reproduction of images and drawings, by means of vitrifiable colours on glass, wood, stone, on canvas or paper prepared for oil-painting, and on other substances having polished surfaces, e.g., earthenware, copper, &c. The original drawings or images should be well executed, and drawn on white, or preferably bluish paper, similiar to paper used for ordinary drawings. In the patterns for glass painting by this process, the place to be occupied is marked by the lead, before cutting the glass to suit the various shades which compose the colour of a panel, as is usually done in this kind of work; the operation changes only when the glass cutter hands these sheets over to the man who undertakes the painting. The sheets of glass are cut according to the lines of the drawing, and after being well cleaned, they are placed on the paper on the places for which they have been cut out. If the window to be stained is of large size and consists of several panels, only one panel is proceeded with at a time. The glass is laid on the reverse side of the paper (the side opposite to the drawing) the latter having been made transparent by saturating it with petroleum. This operation also serves to fix the outlines of the drawing more distinctly, and to give more vigour to the dark tone of the paper. When the paper is thus prepared, and the sheets of glass each in its place, they are coated by means of a brush with a sensitising solution on the side which comes into contact with the paper. This coating should be as thin and as uniform as possible on the surface of the glass. For more perfectly equalising the coating, a second brush is used.

The sensitising solution which serves to produce the vitrifiable image, is prepared as follows: Bichromate of ammonia is dissolved in water till the latter is saturated; five grammes of powdered dextrin or glucose is then dissolved in 100 grammes of water; to either of these solutions is added 10 per cent. of the solution of bichromate, and the mixture filtered.

The coating of the glass takes place immediately afterwards in a dark room; the coated sheets are then subjected to a heat of 50 or 60 degrees C. (120 degrees to 140 degrees Fahr.) in a small hot chamber, where they are laid one after the other on a wire grating situated 35 centimetres above the bottom. Care should be taken not to introduce the glass under treatment into the hot chamber before the required degree of heat has been obtained. A few seconds are sufficient to dry each sheet, and the wire grating should be large enough to allow of the dried glass being laid in rows, on one side where the heat is less intense. For the reproduction of the pictures or images a photographic copying frame of the size of the original is used. A stained-glass window being for greater security generally divided into different panels, the size of one panel is seldom more than one square metre. If the picture to be reproduced should be larger in size than any available copying frame, the prepared glass sheets are laid between two large sheets of plate-glass, and part after part is proceeded with, by sliding the original between the two sheets. A photographic copying frame, however, is always preferable, as it presses the glass sheets better against the original. The original drawing is laid flat on the glass of the frame. The lines where the lead is to connect the respective sheets of glass, are marked on the drawing with blue or red pencil. The prepared sheets of glass are then placed one after the other on the original in their respective places, so that the coated side comes in contact with the original. The frame is then closed. It should be borne in mind that the latter operations must be performed in the dark room. The closed frame is now exposed to light. If the operations are performed outdoors, the frame is laid flat, so that the light falls directly on it; if indoors, the frame is placed inclined behind a window, so that it may receive the light in front. The time necessary for exposing the frame depends upon the light and the temperature; for instance, if the weather is fine and cloudless and the temperature from 16 to 18 degrees C. (60 degrees to 64 degrees Fahr.) it will require from 12 to 15 minutes.

It will be observed that the time of exposure also depends on the thickness of the paper used for the original. If, however, the weather is dark, it requires from 30 to 50 minutes for the exposure. It will be observed that if the temperature is above 25 degrees C. (about 80 degrees Fahr.) the sheets of glass should be kept very cool and be less dried: otherwise, when exposed the sheets are instantly metallised, and the reproduction cannot take place. The same inconvenience takes place if the temperature is beneath 5 degrees C. (41 degrees Fahr.) In this case the sheets should be kept warm, and care should be taken not to expose the frame to the open air, but always behind a glass window at a temperature of from 14 to 18 degrees C. (about 60 degrees Fahr.) The time necessary for the exposure can be ascertained by taking out one of the many pieces of glass, applying to the sensitive surface a vritrifiable colour, and observing whether the colour adheres well. If the colour adheres but slightly to the dark shady portions of the image, the exposure has been too long, and the process must be recommenced; if, on the contrary, the colour adheres too well, the exposure has not been sufficient, the frames must be closed again, and the exposure continued. When the frame has been sufficiently exposed it is taken into the dark room, the sensitised pieces of glass laid on a plate of glass or marble with the sensitive surface turned upward, and the previously prepared vitrifiable colour strewed over it by means of a few light strokes of a brush. This powder does not adhere to the parts of the picture fully exposed to light, but adheres only to the more or less shady portions of the picture. This operation develops on the glass the image as it is on the paper. 30 to 40 grammes of nitric acid are added to 1,000 grammes of wood-spirit, such as is generally used in photography, and the prepared pieces of glass are dipped into the bath, leaving them afterwards to dry. If the bath becomes of a yellowish colour it must be renewed. This bath has for its object to remove the coating of bichromate, so as to allow the colour to adhere to the glass, from which it has been separated by the layer of glucose and bichromate, which would prevent the vitrification. The bath has also for its object to render the light parts of the picture perfectly pure, and capable of being easily retouched or painted by hand. The application of variously coloured enamels, and the heating are then effected as in ordinary glass painting. The same process may be applied to marble, wood, stone, lava, canvas prepared for oil painting, earthenware, pure or enamelled iron. The result is the same in all cases, and the process is the same as with glass, with the difference only that the above named materials are not dipped into the bath, but the liquid is poured over the objects after the latter have been placed in an inclined position.

NON-CONDUCTING COMPOSITIONS FOR HEAT AND SOUND.

THE compositions described below have been patented by Mr. E. C. C. Stanford, of Glasgow, as suitable for diminishing the loss of heat by conduction, for preventing the access of heat to substances it is desired to keep cool, and also for preventing the conduction of sound. The improved compositions or cements consist mainly of charcoal or other carbon, any cheap variety of which may be employed; or two or more kinds may be mixed when convenient. Amongst the kinds of carbon which may be used are common coke, wood charcoal, peat, sawdust, wood chips, or shavings, carbonised seaweed, and nitro-carbon manure. Carbonaceous residues from paper-works, prussiate-works, and oil-works may also be used, or any sufficiently cheap substance containing a large proportion of carbon. The carbon is ground to powder and then mixed into a paste with a suitable agglutinating substance. What is known as pot-ale sediment, and is a distillery refuse, answers the purpose satisfactorily and economically, but other glutinous or mucilaginous substances of a cheap kind may also be employed, such as gluten from starch-works, refuse flour of sago or of wheat or other grain, rough dextrine, refuse or cheap nitrogenous substances, and the like. These agglutinating substances can in most cases be rendered more suitable and efficacious by treatment with caustic or carbonated alkalies or alkaline earths. The proportions of the ingredients forming the improved compositions or cements may be considerably varied in different cases; but by way of example it may be stated that a very satisfactory cement is formed by combining the following quantities.

2 cwt. pot-sediment.
14 lb. flour thirds.
1 cwt. pitch-pine shavings or chips.
16½ cwt. seaweed char.

With these ingredients it is usual to combine about 14lb. cow-hair as a binding material. The wood shavings or chips are useful to impart bulk and for the same purpose blaes or waste shale may be used when conveniently obtainable. The paste or moist cement is applied to the surface to be protected or coated by means of a trowel and by preference in two or more coats. It can be applied to boilers and other objects in a cold state, which is a great practical advantage; and it is stated to adhere closely and permanently to the boiler or other surface, and does not crack nor peel off. According to the patentee, it can be used of about half the thickness of most of the non-conducting compositions in use, so that it requires less space; and a very important advantage is that it is quite inodorous and inoffensive.

PRACTICAL NOTES ON PLUMBING.—LVIII.*

By P. J. DAVIES, H.M.A.S.P., &c.

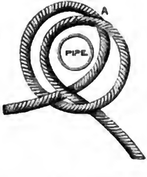
(*Continued from page* 423.)

WE will now proceed with the fixing of the Jack or suction-pump. Again refer to Fig. 297. Here you have the well say 18ft. deep, with one stage, as shown at W, Fig. 297. In this case, the stage is an oak plank say 3in. by 9in. wide, having a hole bored, and a little counter-sunk on the top side; the hole should pass through the centre, but nearer to one end than the other, say 8in. from the brickwork, which is known as the "steaning" or "staning." Now prepare your suction-pipe by nailing a block of oak, say 6in. square and 12in. long, having one end, shaped as shown at OAK BLOCK, Fig. 297, to enter the end of the suction; then bore a quantity of ⅜in. or ½in. "blast holes" round the bottom of the pipe, as shown at BLAST HOLES. Bore enough of them. If you have a 2in. pipe, how many ½in. holes will you require? Answer, 16. Because you have a 2in. hole, and the square of 2 being 4, you require the ½in. multiplied by 4, which equals 16. Then bore half as many again, and you pump will work easier, because in the 16 holes the friction will be 16 times as great as through the 2in. pipe.

Some plumbers, instead of using bored blast-holes, simply cut three or four long cuts with the chipping knife: these holes allow anything to get out of the barrel into the well, should it fall in when repairs are going on, &c. This, in some cases, answers better, though blast-holes are generally used.

Now, with copper nails fix the block within the lead pipe. Cut open a piece of your suction-pipe for the flange. Say the pipe is 2in., then your piece of pipe for the flange 6in. long, and with the chipping-knife cut it down, and after this, with the turnpin driven through, the piece of pipe is easily opened. Flatten it out, and then cut or burn, with a red-hot plumbing-iron, a hole through the centre, large enough to slip over the suction-pipe. Now, with a piece of sash-cord form the knot, as shown at Fig. 298, making two half-hitches, and slip them over the end of the pipe as shown. Bring the ends together, and with the longest end form one half-hitch (which is really only one of the former hitches, as shown at 1, 2, 3, 4, Fig. 299), over the end, say about 12in. down the lead pipe; then with the aid of one man on top of the well holding up the pipe you enter the well, but not until you have lowered a lighted candle to see if it will burn. If it will not keep alight do not go down, as there is foul air there, which would smother you, although you cannot see it. See further on—repairing pumps, foul-air pumps, &c.

FIG 298



Now slip the end of the suction-pipe through the oak stage, and slip the lead flange over its end, then turn the flange over for a taft joint, get a nice wad of paper or something to stuff into the pipe. Next prepare the joint A, Fig. 297, of the pump for an underhanded joint, and wipe on the length A to F ready for fixing the pump, the nozzle of which should not exceed 3ft. in height, or above the ground. The back should be fixed against a wall, or if no wall is near fix it upright, and make the flange joint W, Fig. 297; but take care that no lead shavings or other hard substances get into the pipes. It is now ready for the carpenter to make and fix his frame to, as shown at Fig. 300. The supports, A, B, are let down into the ground, and having pieces or grooves cut out to receive the head, as at E to G, and F to J, this supports the pump and steadies it: the back is next nailed on, and then the front is fixed, from the nozzle upwards with screws, or sometimes a door is used. Should there be no regulating head, then the flanges F C, Fig. 296, fit into the grooves E, G, F, J, Fig. 300, which keeps the pump upright and steady. The slot K, as also the hole B for the lever and pin, may be prepared before the frame is fixed; but care must be taken to fix this lever slot in its proper position to work the bucket-rod. Plumb over the centre of the barrel.

FIG. 299.

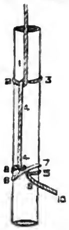
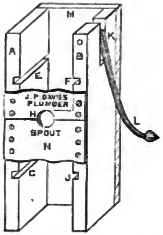


FIG. 300.



I have already explained how to set the sucker-box, and the various kinds of pump buckets. Some plumbers may ask, What is the use of the cock and pipes, F, G, H, Fig. 297? The answer is, to allow the water to run back into the well during the winter. Now suppose everything to be finished, and water required in the pump: you will have first to fill the barrel with clean water, and quickly work the handle, and in a moment or so you will feel the handle to work a little heavier and heavier, until the water is seen running out of the spout or nozzle. Keep up the pumping for a minute or two: this will bring any small substance up from the sucker-box, which by accident may have got there. Of course, nothing should be there, but sometimes it happens that there is. Now stop pumping, and notice whether the water dribbles a long time after the pumping has ceased. If it does it is sure to be "right." If not "the sucker-box is not right."

Repairing Pumps.

Something is under the valve, the box may not be properly cemented in, or the valve is bad, the leather may be a bad one, or half a dozen other things. Something is the matter; the pump "loses water," "it runs back." In this case, take out the bucket, get the pump-hook, E, F, A, B, Fig. 279, screw the screw into the lead clack, as shown at Figs. 278 and 280. Now this clack will not move, because it has been properly set, or cemented in. If it is loose it is bad setting, by reason of not being properly knocked down, or not sufficient fat or tow used, and will easily be pulled up. Or perhaps the leather has not been properly nailed on the sucker-box. If the latter is the case then the clack will be loose, if so it is easily drawn; it will be loose in the bottom of the barrel, and the sucker or pump-hook must be used carefully, or you may spoil the face of the sucker-box. Always try for this by pushing the point of the sucker-hook lightly over the top of the clack. Perhaps all will be firm; if so, screw the screws into the clack, screw it tightly in, and do not screw the rod round without pressing well on the top, nor too far. If it is hard to draw, the clack is nailed on properly, and requires a kettleful of hot water poured into the barrel; half fill the barrel and let it stand for a few minutes. Now pull the clack open, let the best part of the water run back, and shut it again; this allows the water to run through, and warm up the mutton suet. Now pull the clack up. Generally the box and all will come, as it should, together, but at times the clack comes away from the box; if so, after the clack is got up, as before directed, put the pump-hook carefully through the hole in the sucker-box, until the hunch or hook is below the bottom of the box, as shown at C, E, F, Fig. 279. Now give a good pull, and the thing is up, but perhaps it won't come; then get a piece of dog-chain, or a strong piece of sashcord, and threadle it through the eye B, and prize up the hook with the aid of the handle or lever of the pump, or substitute a lever as best you can. The box is now up, and perhaps it is found that a lump of brick, a piece of solder, or something, is brought up with it, or that the face of the box or leather is bad, or else nothing is found. If so, take a pail of water and suddenly empty the lot down the pump; this will wash any small stuff through the blast holes and into the well. I always do this before I set a sucker-box, especially in a new pump *not having a tail-valve*. Now, as before instructed, prepare your clack and sucker-box and set it again, and fix the pump-bucket, fill up the pump-barrel with clean water, and "fetch the water." It is now all right, and the pump "*holds water*," meaning that the pump is "sound." Perhaps something else is the matter. After "she" has stood for an hour we have to pump for a minute or so before the water comes, and at first it is all froth, or on a foam. "She draws air," that is, there is a pin-hole in the suction-pipe, or the joint A, Fig. 297, is bad, perhaps porous. If the cock F is used perhaps it is there: whatever it is it must be found. For this purpose the ground must be stripped off the pipe, and the well uncovered. If the pipe is an old one most likely the chemicals held in the earth have eaten holes into the lead, or twenty other things may be wrong. The pin or air-hole, however, must be found and soldered up, or a new suction-pipe fixed.

(*To be continued.*)

DYNAMO-ELECTRIC MACHINERY.—III.*

By Prof. S. P. THOMPSON, B.A., D.Sc.

(*Continued from p.* 426.)

Commutators, Collectors, and Brushes

ab. COMMUTATORS and collectors being liable to be heated through imperfect contact, and liable to be corroded by sparking, should be made of very substantial pieces of copper.

ac. In the case of a collector made of parallel bars of copper, ranged upon the periphery of a cylinder, the separate bars should be capable of being removable singly, to admit of repairs and examination.

ad. The brushes should touch the commutator or the collector at the two points, the potentials of which are respectively the highest and the lowest of all the circumference. In a properly and symmetrically built dynamo, these points will be at opposite ends of a diameter.

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* Extracted from the Cantor Lectures, delivered before the Society of Arts.

ae. In consequence of the armature itself, when traversed by the currents, acting as a magnet, the magnetic lines of force of the field will not run straight across, from pole to pole, of the field-magnets, but will take, on the whole, an angular position, being twisted a considerable number of degrees in the direction of the rotation. Hence the diameter of commutation (which is at right-angles to the resultant lines of force in machines of the Siemens and Gramme type, and parallel to the resultant lines of force in machines of the Brush type) will be shifted forward. In other words, the brushes will have a certain angular lead. The amount of this lead depends upon the relation between the intensity of the magnetic field and the strength of the current in the armature. This relation varies in the four different types of field-magnets. In the series dynamo, where the one depends directly on the other, the angle of lead is nearly constant, whatever the external resistance. In other forms of dynamo, the lead will not be the same, because the variations of resistance in the external circuit do not produce a proportionate variation between the two variables which determine the angle of lead.

af. Hence in all dynamos it is advisable to have an adjustment, enabling the brushes to be rotated round the commutator or collector, to the position of the diameter of commutation for the time being. Otherwise there will be sparking at the brushes, and in part of the coils at least the current will be wasting itself by running against an opposing electromotive force.

ag. The arrangements of the collector, or commutator, should be such that, as the brushes slip from one part to the next, no coil or section in which there is an electromotive force should be short circuited, otherwise work will be lost in heating that coil. For this reason, it is well so to arrange the pole-pieces that the several sections or coils on either side of the neutral position should differ but very slightly in potential from one another.

ah. The number of contact points between the brushes and the collector, or commutator, should be as numerous as possible, for by increasing the number of contacts, the energy wasted in sparks will be diminished inversely as the square of that number. The brushes might, with advantage, be laminated, or made of parallel loose strips of copper, each bearing edgeways on the collector.

Relation of Size to Efficiency.

The efficiency of a dynamo-electric machine is the ratio of the useful electrical work done by the machine to the total mechanical work applied in driving it. Every circumstance which contributes to wasting the energy of the current reduces the efficiency of the machine. In the preceding paragraphs it has been shown what the chief electric sources of waste are, and how they may be avoided. The precautions needful to obviate Foucault currents, to avoid reversals of magnetism, to get rid of needless resistance, to obviate opposing electromotive forces, have been detailed. Mechanical friction of the moving parts can be minimised also by due mechanical arrangements. But one thing cannot be entirely obviated, because even the best conductors employed have a certain resistance. We cannot prevent the heating of the conducting coils; and the more powerful the current generated by the machine, the more important does this source of waste become. There is but one way to reduce this, and that is by increasing the size of the machines. For some three years or so I have been the advocate of large dynamo machines, not because I have any admiration for mere bigness, but because, as in steam-engines so in dynamos, the larger machines may be made more efficient than the small, in proportion to their cost. In discussing the relation of size to efficiency, I shall assume, for the sake of argument, that the size of any machine can be increased n times in every dimension, and that though the dimensions are increased, the velocity of rotation remains the same; and that the intensity of the magnetic field, per square centimetre, remains also constant. If the linear dimensions be n times as great in the larger machine as in the smaller, the area it stands on will be increased n^2 times, and its volume and weight n^3 times. The cost will be less than n^3 times but greater than n times. If the same increase of dimensions in the coils be observed (the number of layers and of turns remaining the same as before), there will be in the armature coils a length n times as great, and the area of cross-section of the wire will be n^2 times as great as before. The resistance of these coils will, therefore, be but $1 / n$ part of the original resistance of the smaller machine. If the field-magnet coils are increased similarly they will offer only $1 / n$ of the resistance of those of the smaller machine. Moreover, seeing that while the speed of the machine is the same, the area cut through by the rotating coils is increased n^2 times, these coils will in the same time cut n^2 times as many lines of force, or the electromotive force will be increased n^2 times. Supposing the whole of the circuit to be similarly magnified, its resistance will also be but $1 / n$ of the previous value.

If the machine is a "series"-wound dynamo, an electromotive force, n^2, working through $1 / n$ resistance, will give a current n^3 times as great as before. Such a current will, as a matter of fact, much more than suffice to bring up the magnetic field to the required strength—viz., n^2 times the area of surface magnetised to the same average intensity, per square centimetre, as stipulated; for the mass of iron being n^3 times as great, it need not be so much saturated as before to give the required field. Here an economy may be effected, therefore, by further reducing the number of coils, and therefore the wasteful resistance of the field-magnet coils, in the proportion of n^3 to n^2, or to $1 / n$ of its already diminished value. Even if this were not done, by the formula given above for the electrical efficiency of a "series" dynamo, the waste, when working through a constant external resistance, will be n-fold less than with the smaller machine. Now, if the current be increased n^3 times, and the electromotive force n^2 times, the total electric work which is the product of these will be n^5 times greater than in the small machine, and it will consume n^5 times as much power to drive it. It is clearly an important economy if a machine costing less than n^3 times as much, will do n^5 times as much work (to say nothing of the increased ratio of efficiency). A machine doubled in all its linear dimensions will not cost eight times as much, and will be electrically thirty-two times as powerful a machine.

Suppose the machine to be "shunt" wound, then to produce the field of force of n^2 times as many square centimetres area will require (if the electromotive force be n^2 times as great) that the absolute strength of the current remain the same as before in the field-magnet coils. This can be done by using the same sized wire as before, and increasing its length n^2 times, to allow for n times as many turns, of n times as great a diameter each, in the same number of layers of coils as before. In this case, the work done in the shunt being equal to the product of the n^2-fold electromotive force into the unaltered current, will be only n^2 times as great, while the whole work of the machine is augmented n^5 times. Now, if while augmenting the total work n^5 times, we have increased the waste work not to n^5 times, but only n^2 times, it is clear that the ratio of waste to the total effect is diminished n^3-fold. There is, therefore, every reason to construct large machines, from the advantage of economy, both in relative prime cost and relative efficiency.

Methods of Exciting the Field Magnetism.

It only remains to develop certain theoretical considerations respecting the method of exciting the magnetism of the field, in which the armatures are to revolve. The four main methods have already been alluded to at the outset of this lecture; but nothing has been said about the advantages or disadvantages of the four systems.

Magneto - Dynamos. — The magneto dynamos (Fig. 4) have the advantage, in theory at least, that their electromotive force is very nearly exactly proportional to the velocity of rotation; though, of course, the variable difference of potential between the terminals of the circuit will depend on the relation of the resistance of the external circuit to the internal resistance of the armature coils. They possess the disadvantage that, since steel cannot be permanently magnetised to the same degree as that which soft iron can temporarily attain, they are not so powerful as other dynamos of equal size.

Separately - excited Dynamos.—The separately-excited dynamo (Fig. 3) has the same advantage as the magneto-machine in electromotive force, being independent of its accidental changes of resistance in the working circuit, but is more powerful. It has, moreover, the further advantage that the strength of the field is under control. For by varying either the electromotive force or the resistance in the exciting circuit, the strength of the magnetic field is varied at will. It has the disadvantage of requiring a separate exciting machine.

Series Dynamos.—The ordinary, or series dynamo (Fig. 1) is usually a cheaper machine, for equal power, than any of the other forms, as its coils are simpler to make than those of a shunt machine, and it wants no auxiliary exciter. It has the disadvantages of not starting action until a certain speed has been attained, or unless the resistance of the circuit is below a certain minimum. It is also liable to become reversed in polarity, a serious disadvantage when this machine is applied for electro-plating or for charging accumulators.

From its arrangements it is clear that any increase of the resistance in the circuit lessens its power by diminishing the strength of its magnetic field. Hence it is better adapted for use with lamps arranged in parallel arc than for lamps arranged in series. An additional lamp switched in, in series, adds to the resistance of the circuit, and diminishes the power of the machine to supply current. While, on the other hand, an additional lamp in parallel reduces the total resistance offered by the network of the circuit, and adds to the power of the machine to provide the needed current. It is easy to regulate the currents given by a series dynamo, by introducing a shunt of variable resistance across the field-magnet, thus altering the magnetising influence of the current.

Shunt Dynamos.—The shunt dynamo (Fig. 2) has several advantages over other forms. It is less liable to reverse its polarity than the series dynamo, and it is commonly considered as providing the magnetising power to the magnets with less waste of current. Moreover, for a set of lamps in series, its power to supply the needful current increases with the demands of the circuit, since any added resistance sends additional current round the shunt in which the field-magnets are placed, and so makes the magnetic field more intense. On the other hand, there is a greater sensitiveness to inequalities of driving in consequence of the great self-induction in the shunt. As previously pointed out, when there are sudden changes in the electromotive force acting in a complex circuit, the momentary currents thus set up do not distribute themselves in the various parts of the circuit in the simple inverse ratio of the resistances, for their distribution depends also, and in some cases chiefly, upon the self-induction in the various parts. It is more difficult to set up a sudden current in a circuit whose self-induction is great (or which, for example, consists of many turns wound closely together, so that they exercise great inductive action on each other, especially if they be wound about an iron core) than in one in which the self-induction is small. We cannot here follow further the mathematical law of the action of self-induction on momentary changes of electromotive force. But the application to the shunt-wound dynamo is too important to be passed over.

Any of these systems may be applied either in direct-current or in alternate-current machines. Each of these four systems of exciting the field magnetism has its own merits for special cases, but none of them is perfect. Not one of these methods will insure that, with a uniform speed of driving, either the electromotive force or the current shall be constant, however the resistances of the circuit are altered.

But though theory tells us that none of these systems is perfect, theory does not leave us without a guide. Thanks to the genius of M. Marcel Deprez, we have been taught how to combine these methods so as to secure in practice a machine which shall, when driven at a constant speed, give either a constant electromotive force or a constant resistance. A consideration of the various methods of combining the four systems of exciting the field-magnetism is reserved for the lecture on the dynamo in practice.

Meantime it may safely be said that there is no such thing yet as a best dynamo. As with the different kinds of voltaic batteries, some of which are used for telegraph work, others for electric bells, and others for blasting, so is it also with dynamos. One form is best for one purpose, and another for another. One gives steadier currents, another is less liable to heat, a third is more compact, a fourth is cheaper, a fifth is less likely to reverse its currents, a sixth gives a greater volume of current, while a seventh evokes a higher electromotive force. Indeed, in the present transitional state of our knowledge with respect to dynamo-electric machinery, it is safe to assert that for a long time to come, there will be no finality attained to.

PROF. TYNDALL ON LIGHT AND THE EYE.

IN his fifth lecture on "Light and the Eye," Prof. Tyndall proceeded with his illustrative experiments on the spectrum. He made it first fall from Thollon's prism on a screen of red flannel, the result being that all the prismatic rays were quenched except the red. What had become of the rest, it was asked. They had not been annihilated, for throughout nature nothing was ever lost. The missing light had been coverted into heat. In like manner, when the prismatic rays were sent through a glass vessel filled with blue liquid, all of them vanished from sight save the blue, which was slightly tinged with green. The rest had been changed into heat. But the spectrum extended in both directions beyond its visible limits. Beyond the visible red they had rays of high heating power, though incompetent to exhibit themselves to the sense of sight; beyond the violet they had a vast body of rays, which, though feeble as regards heat and unable to give light, were of the highest importance, because of their capacity to cause chemical action. In the case of the electric light, the energy of the non-luminous calorific rays emitted by the carbon points was about eight times that of all the other rays taken together. It was posible so to sift either the solar or the electric beam as to intercept its luminous rays, while allowing the non-luminous rays free transmission. This was demonstrated experimentally. The beam was made to pass through a solution of iodine in front of the lamp, when the central bands of the spectrum were first cut out, and, by transmission through another solution, the whole spectrum was quenched. But the substances which thus eliminated the light allowed free passage to the rays of heat. To show this the beam was made to converge in the dusty particles of the theatre by means of a plano-convex lens. The heat present at the focus was at once detected by the needle of the thermopile. The heat of the dark rays having been intensified by means of conjugate mirrors, it was proved by various experiments that paper and wood could be kindled by it, non-refractory metals fused, and refractory ones, such as platinum, heated to whiteness. Platinum thus heated rivalled the brilliant magnesium light. It was proved in this way that non-luminous calorific rays might thus be transformed into luminous ones yielding all the colours of the spectrum. This passage from the non-luminous to the luminous condition by the intervention of a refractory body, is termed calorescence. But the audience was reminded of the extension of the spectrum beyond the visible portion side of the violet also. These other invisible rays, when allowed to fall on certain substances—the disulphate of quinine, for instance—rendered these substances luminous, and were thereby themselves rendered visible. This change is termed fluorescence. Many beautiful experiments illustrative of this subject were performed. The phenomena of phosphorescence were next illustrated, mention being made of Balmain's luminous paint, and of more or less unsuccessful attempts to prevent colliery accidents by the introduction of phosphorescent lamps. A phosphorescent butterfly was greatly admired. Passing to spectrum analysis, Dr. Tyndall remarked that metals and their compounds impart to flames peculiar colours, which are characteristic of these metals, as was exemplified in the instances of mercury, thallium, silver, sodium, chloride of lithium, and chloride of strontian, the identifying bands of which substances were shown upon the screen. Hence, since we had acquainted ourselves with the bands produced by all known metals, new bands in the spectrum were proof of the presence of new metals in the flame. It was thus that the founders of spectrum analysis—Bunsen and Kirchhoff—discovered rubidium and cæsium, and that thallium, with the superb green band the audience had just seen, was brought to light by Mr. Crookes.

In the sixth and concluding lecture, Thollon's vivid spectrum was again thrown upon the screen, and the lecturer then proceeded to illustrate experimentally the analogy between sound and colour. A square disc of brass was made to give forth notes whose pitch from the lowest to the highest was marked by the varying lengths of the lines caused by the vibrations of the sand strewn over the plate. These lines were termed nodal lines. The difference between a chorister boy's shrill voice and the bass tones of a man was that the nodal lines left by the latter were longer. The air, which was the medium of conveying sound, might be compared with the luminiferous ether pervading all space, and in the spectrum the luminous waves were found to lessen in length in passing from the red to the violet ray. The ether's movements were undulatory, though the waves, like those of water in the chaotic foam of the Niagara Falls, a view of which was thrown upon the screen, might cross and recross in every direction. Newton's emission theory was first opposed by the celebrated astronomer Huyghens, and the no less famous mathematician Euler, and no scientist of any repute now upheld Newton's conception of light as an infinite number of projectiles impinging upon the eye. When tested by the facts, that notion had utterly broken down; whereas not one of the facts had been left unexplained by the undulatory theory. It accounted for all the phenomena of reflection; for all the phenomena of refraction, single and double; for all the phenomena of diffraction; for the colours of thick plates and thin, as well as for the colours of all natural bodies. It accounted for all the phenomena of polarisation, as was shown experimentally in the course of the lecture; for all those chromatic splendours exhibited by crystals in polarised light. Thousands of isolated facts might be ranged under each of these heads: the undulatory theory accounted for them all. It traced and illuminated paths through what would be otherwise the most hopeless jungle of phenomena in which human thought could be entangled. This was why the foremost men of the age accepted the luminiferous ether, not as a vague dream, but as a real entity—a substance endowed with inertia, and capable, in accordance with the established laws of motion, of imparting its thrill to other substances. It was Dr. Thomas Young, Prof. Tyndall reminded his audience, his own predecessor in the chair of Natural Philosophy in the Royal Institution in the first year of the present century, who finally overthrew the emission theory. Young never saw with his eyes the waves of sound, but he had the force of imagination to picture them, and the intellect to investigate them. And he rose from the investigation of the unseen waves of air to that of the unseen waves of ether, his belief in the one being little, if at all, inferior to his belief in the other. Young proved that by adding light to light darkness could be produced, just as by superinducing sound upon sound silence could result. Light thrown on water was accordingly quenched, as the lecturer showed by a beautiful experiment, when oil of turpentine was cast upon the surface. The explanation given was, that by the action technically styled interference, the light reflected from the upper surface deadened that reflected from the lower. Iridescence was illustrated by reproducing Newton's famous soap-bubble experiment, and the same philosopher's beautiful ring.

LANTERNS AND SLIDES.*

It cannot be too widely known that the size of the glass on which the picture is taken is important; that it must be three and a quarter inches high, this being the standard adopted in all countries. The length of the glass is of less moment. The French slides, for instance, are three and a quarter inches high and nearly four inches long; the Woodbury (and American) three and a quarter inches high and four and a quarter inches long; while the current English size is 3¼ × 3¼. The mount is of less importance, but it should invariably so mask the picture as to cut off all clear glass at the edges. Inattention to this materially affected the brilliancy of several pictures shown the other evening.

Uniformity in size and shape of the mask or mount is hardly to be expected. All subjects do not look equally well in a square mount. As a general rule, a square mask with the corners rounded (cushion-shaped), two and three-quarter inches either way, or a trifle wider, is the best where the subject will permit it. It is better that the four corners should be rounded rather than dome shaped, for the reason that the condenser, which is found most efficient and economical, is four inches in diameter. A little must be allowed for the mount or cell, and it will then be found that the utmost such a condenser will illuminate is the size I have mentioned. Any lantern with condensers of less diameter must be considered as a toy.

Slides of the highest excellence can be produced by a great many different processes. Two qualities only are absolutely essential—viz., purity of the whites and transparence of the shadows. Those who were fortunate enough to have shown slides that evening with which they were satisfied on the screen will have a standard of reference by which to judge the quality of other subjects; but others who were not so fortunate may be glad to known how they can judge if a transparency will be effective on the screen.

It is very simple and absolutely certain. The two essential qualtities, I have said, are purity of the whites and transparence of the shadowe. The first can *only* be judged by laying the unmounted slide, face downwards, on a piece of white paper. The highest lights must then be pure white. If there be the slightest trace of fog, throw it away at once; it is utterly useless as a lantern slide. Do not attempt for a moment to delude yourself with the idea that with the limelight a little filminess will not matter. It is absolutely fatal to brilliancy with either lime light or the ordinary oil-burning lantern. When lying on the paper the most delicate tones, which held up to the light would be almost invisible, will be distinctly seen. If they are thus seen they will be faithfully shown upon the screen; but any hard, white patches thus seen upon the paper will be seen just the same in the lantern, like some we saw the other evening, when sun-lit roads and trees looked as if they were powdered with snow, and were by some actually imagined to be so. On the paper very nearly all the half-tones should be *clearly* visible—not all the detail in the shadows; if so, the picture on the screen will be poor and weak.

The final examination of the slide must be done by transmitted light; and this is best done in the evening by one's ordinary lamp. I find nothing better than the opal globe of a Silber lamp. After it has been alight for some time the eye has become accustomed to it—judgment far more easily effected with a comparatively uniform light than by daylight, which varies so much. The details in the shadows which were confused when lying on the white paper must now be *clearly* visible against the opal globe. It should be a *moderately* vigorous picture, full of detail in the shadows. If the slide will stand these two tests it will give a perfect picture on the screen with any lantern and any light. No greater mistake can be made than to suppose that a denser slide is required for lime light than for oil light. A good one is equally good with either.

And now as to tone. This is to a great extent a matter of taste, and I venture to say, of comparatively little moment. Experts were probably struck with the great variety of tones of the slides exhibited at the recent meeting; but I doubt if, great as the range was, any would have failed to thoroughly please on account of its tone being either too warm or too cold, if otherwise harmonious. It was a point which I was particularly watching, and judging from the applause with which the various pictures were greeted, tone had very little to do with it.

Colouring is unquestionably a mistake. It is so nearly impossible for the minute details of a photograph to be accurately coloured that the expense of really effective colouring puts it quite out of the reach of the ordinary tax-payer, and inferior colouring is out of the question with such an optical arrangement as we had, where every slip of the brush or impurity of the colour is prominently brought out as a blotch on which the eye *will* fix itself. I have always found—and last week's meeting was no exception—that good slides are gladly welcomed, uncoloured. However, as there is a demand for coloured slides, I must add one word of advice on the subject: let the slide be a good one, to begin with; no colouring will improve a bad one. If the colours are not transparent they are useless for lantern work; and if they are transparent they will not obscure the shadows. If the slide be of a proper depth of tone before colouring—well, you may not spoil it.

MR. ESPIN'S DOUBLE STAR NEAR 16 AURIGÆ.*

In the last edition of Webb's "Celestial Objects" (page 238), a multiple star is noted near 16 Aurigæ (O Σ 103), which was discovered by Mr. Espin. As no measures of the components were given, I looked it up with the 18½in. of the Dearborn Observatory in the early part of this year for the purpose of ascertaining the exact position, and making some measures. The principal star was identified as D.M. (30°), 1005, Weisse V., 244, the magnitude in the first catalogue being 8·0, and in the second 8·9. This is 32s. following 16 Aurigæ, and 10′ north. The two principal stars were measured on two nights as follows:—

P = 11·9°	D = 13·96″	8·5 .. 9·0	1882 ·239
8·6	14·09	8·5 .. 9·0	·244

The double companion mentioned in Webb is about 78″ distant from the principal star, in the direction of 169·2°. Both nights were too hazy to measure the faint stars satisfactorily, but the distance between them appeared to be about 5″, and the magnitudes 11·5 and 11·5 (Struve's scale).

In searching for this group, two new pairs were found in the immediate vicinity, which may be mentioned in this connection. These stars are Nos. 886 and 887 of my last catalogue of new stars, now in the hands of the Royal Astronomical Society. The first, as a wide triple, is Σ 687, but Struve failed to notice that one of the stars he measured was itself a close pair. The following are his measures, and my own for comparison, of the old stars, and a single observation of the new pair:—

Σ	A B	67·6°	17·17″	8·2 .. 9·0	1829·24
β		68·5	17·51	8·5 .. 8·6	1882·23
Σ	A C	153·5	48·73	9·2	1829·24
β		153·2	48·48	8·7	1882·22
β	C D	246·9	0·90	8·5 .. 10·0	1882·22

There does not seem to be any material change in the old companions. Σ 687 is described by Webb on page 241.

The other new pair is somewhat similar to the one just given, but the components are smaller, and therefore perhaps more difficult. The following are the results of measures on two nights:—

A B	194·3°	1·00″	9·0 .. 10·5	1882·22
A C	332·8	10·56	12	1882·24

There is another very faint companion, similar to C in magnitude and distance, in the direction of about 109° from the principal star. This is the larger of a small cluster of minute stars.

These pairs will be easily found from their relative positions, which are as follows:—

O Σ 103	5h.	10m.	37s.	+ 33°	14′
Espin	5	10	49	+ 33	24
β 886	5	14	24	+ 33	41
β 887	5	14	53	+ 33	18

S. W. Burnham.

Chicago, Dec. 10, 1882.

CUTTING STEEL WITH A WET IRON DISC.

A CORRESPONDENT of the *American Machinist*, Mr. G. E. Stauffer, of Stroudsburg, Pa., writes:—"I am now building a very large pulp-engine for the Chemical Pulp Co., of this place. The fly-bars are made of homogeneous steel 4in. wide and ⅜in. thick, each requiring a slot at both ends 2¼in.

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* Extracted from a paper by Mr. George Smith, in the *British Journal of Photography*.

* Read at a recent meeting of the Liverpool Astronomical Society.

deep and 1in. wide. All this not new, but how I made the slot may be of interest to at least some of your readers. I did as follows: First, I drilled an inch hole 2¼in. from the end, I then took out my emery wheel and put in its place a disc 12in. diameter, No. 14 sheet iron (scant ⅛in. thick), I also made a table with a gauge to rest the fly-bars upon, with a lever at back end to press the bars to be slotted against the revolving disc. I made two slots at each end with wheel, cutting to the hole. I cut them at the rate of a trifle over 4in. per minute (made 18 cuts in ten minutes); I also found that when I ran the edge of the disc in water it cut twice as fast as when I ran it dry. The speed of the disc was 2,800 revolutions. I think a higher speed would have done quicker work, but I could not speed it any higher without making changes in my pulleys, which I did not care to do as it worked very satisfactorily as it was."

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE January meeting was held at the Society's Rooms at Burlington House, on Friday, the 12th inst., E. J. Stone, Esq., President, in the chair.

Amongst the presents announced, the President mentioned that Dr. Peters had sent a series of zodiacal charts, taking in stars down to the 14th and 15th magnitudes. Dr. Peters had prepared these charts for his use in the discovery of minor planets, and had now published them at his own expense. The President also drew attention to some beautiful photographs of the Great Comet, which had been taken by Mr. Gill, at the Cape of Good Hope, with an ordinary photographic camera, mounted equatorially, and driven by clockwork. The photographs show a large number of small stars in the region of the Comet, as well as a great deal of detail in the structure of the tail. The President invited Mr. Hind to express his opinion with regard to Dr. Peters' charts.

Mr. Hind said: The work of Dr. Peters in preparing these twenty charts must have been a very long and arduous one. I have myself done a little work of the kind when I was searching for minor planets; but I only made my charts so as to include stars of the 11th magnitude. I have some idea, however, what the work must have been, when carried so far as to include stars of the 14th magnitude. Dr. Peters mentions that he has done the whole of the observing and drafting himself, and that he is about to publish the charts at his own expense, for gratuitous distribution. However honourable that may be, I think it is a mistake, as charts of this kind soon get damaged by use, and if gratutuitously circulated, they will fall chiefly into the hands of those who happen now to be engaged on the same kind of work, and by-and-by they will become very scarce. I therefore hope that, if Dr. Peters is going to publish the charts, he will give us the opportunity of purchasing as many copies as we like.

Mr. Glaisher: We have a number of small papers on observations of the Transit of Venus, made by the Rev. S. J. Johnson at Marseilles, Mr. F. Brodie at Fernhill, in the Isle of Wight, Padra Denza of Moncaliere, Mr. Gill at the Cape of Good Hope, Mr. J. R. Walker at Antigua, and Mr. Horner at Bath.

The President said: These miscellaneous papers will all be published; it is difficult to estimate their value till they are printed. We have the pleasure of seeing amongst us this evening one of the most distinguished of our foreign associates, Prof. Simon Newcomb, who has recently returned from the Cape of Good Hope, where he has been to observe the Transit of Venus. It is probable that he will be able to give us some information with regard to it.

Prof. Newcomb said: Mr. President, the rule imposed by your own Government and ours on the members of the different expeditions, prohibits them from publishing their observations in advance, so that I cannot make any formal communication as to the results obtained, to the Society. At the same time it may be interesting to the Society to hear a general statement, such as we are allowed to give. It is, perhaps, known to members of this Society, that I am not amongst those who lay great stress on the observations of the Transit of Venus as a means for determining the Solar parallax. I do not know that my ideas differ greatly from those generally accepted as to the absolute amount of error to which such observations are liable; but I think that there are other much more accurate means of determining the parallax, such as measuring the velocity of light, on which I have been engaged for the last three years. Accordingly, about a year and a half ago, when the question was raised whether expeditions should be sent out to observe this Transit, I gave it as my opinion, that while we ought to make preparations for the observation of the transit within our own country—where the whole transit would be visible—it would not be worth while to send out foreign expeditions, my idea being that the principal object of the observations would be to obtain accurate data for the position of Venus. When, however, the opinions of all astronomers were compared, it was found that I was in a minority, not of one, nor of two, but all the rest were unanimously in favour of sending out expeditions, and, when the expeditions were finally organised, I volunteered to take charge of one party, because it is my intention to attempt a general discussion of all the observations, in view of the very great diversity of description which observers have given as to the phenomena observed. I wished to see for myself, under the most favourable circumstances, what the Transit really was, and what phenomena were really exhibited. I knew the climate of South Africa was rather favourable in December; but, until I got there, I had no idea how clear it was. Mr. Gill advised me to go to Beaufort, some 300 miles inland, where cloudy weather is almost unknown in December; but I heard rumours of frequent clouds of dust and afternoon thunderstorms there, and thought it better to secure a position not so distant, where the weather might be risked for better general conditions. I, therefore, chose Wellesley, about 45 miles to the north-east of Cape Town, where I found an American female seminary, the grounds of which afforded me a position where I could have that seclusion which is absolutely necessary for observations. On the morning of the Transit the sky was somewhat clouded; but the weather improved, and I think that, during the hours of the Transit, which commenced about three o'clock, the definition of the Sun was as fine as I have ever seen it in my life. There was but one physical phenomenon that was worthy of note, and that was so well marked that it could not escape anyone; it was a line of light that surrounded the dark hemisphere of Venus, which was off the sun. I looked very carefully before first contact, to see whether it was possible to see Venus projected upon the corona; but I was unable to see any sign of the planet until it had actually entered upon the sun's disc. When it was half-way on, it appeared as if a piece of the sun had been sharply cut out with a knife; and the line of light which has been described by so many observers, and which I had looked for in vain before, began to show itself; but it was not continuous all round the planet. On the contrary, it was only seen at certain points. As the internal contact approached, I found that the line of light slowly became brighter; and for some seconds before internal contact, it was quite continuous, and was seen as a fine arc of light joining the cusps of the sun. It was so bright that it somewhat interfered with one's judgment in determining the time when the solar cusps met. The cusps were somewhat blunted or spread out by irradiation, whereas the line of light around the planet was narrow and sharp. I observed the cusps gradually dissolve into this line of light; and for a period of five seconds, there was a certain hesitation, in my mind, as to the character of the phenomena, and whether the true geometrical contact had, or had not, taken place. After that five seconds, the light began to flow in on either side with great rapidity; and after that I did not notice anything like a shade or ligament joining the planet and the sun's limb.

The President: I am sure we have listened with great pleasure and interest to the remarks of Prof. Newcomb; and if the observations can be made with anything like the accuracy he has indicated—viz., to within two or three seconds—we may hope to get very accurate results from the observations. But a great number of the observers do notice something like a shade or ligament, and it is a persistent kind of phenomena which they hold on to; but so long as they carefully describe what they see so as to enable us to judge when the geometrical contact took place, I believe that their observations will give us a very reliable method of determining the solar parallax.

Mr. Knobel read a paper by Prof. Langley on "Observations of the Transit of Venus, as observed at the Allegheny Observatory." The paper was accompanied by a drawing showing the line of light with a patch of increased brightness on one side, and a minute stellar point in the midst of the patch of light, which shone with great brilliancy.

Prof. Newcomb said that Prof. Langley's drawing very accurately represented what he himself had seen.

Mr. Horner, who had observed the transit near Bath, said that the sketch did not quite represent what he had seen. He had noticed a hazy patch of light which seemed to extend over the body of the planet to a third of a radius from the limb. In Prof. Langley's drawing the patch of light extended inwards over the body of the planet to a distance of, perhaps, an eighth of a radius within the limb.

Mr. Knobel read a paper by Mr. Hopkins, on observations of the great comet (*b*), 1882, made with a 5in. telescope at Dalstone. He described the tail of the comet as broader towards its extremity and fainter on its northern than on its southern edge.

Prof. J. C. Adams was called upon to read a note on William Ball's observation of Saturn's Ring. He said—In the first volume of the *Philosophical Transactions*, a brief account is given of an observation of Saturn, made by Wm. Ball, at Mainhead, near Exeter, in the year 1665. In a few copies of the volume this account is illustrated by a figure in which the external boundary of the ring, instead of being elliptic in form, has two blunt notches or indentations at the extremities of its minor axis. The plate is wanting in by far the larger number of copies. It may be safely asserted that no telescope capable of showing Saturn's Ring could have exhibited it in this form, and if the above figure faithfully represents what Wm. Ball saw, it shows he was an inaccurate and careless observer, or that he was provided with very inaccurate instruments. On the other hand, we have a remarkable proof that he was a careful and assiduous observer. Huygens, in his collected works, repeatedly appeals to Ball's observations in England in confirmation of his own, and it is clear that Huygens' had in his possession drawings made by Ball, which represented the various appearances of the planet from 1656 to 1659, and that he had carefully compared them with those he had himself taken. Having mentioned the dark band he had observed on the disc of Saturn at the time when the remainder of the ring was invisible, he quotes a letter from Dr. Wallace, in which reference is made to this band having been observed by Ball. This was before the publication of Huygens's book. Huygens notes the fact, and says that he himself did not dare to represent the phenomenon other than it was, because if he did he might be corrected by the English observer. This judgment by so competent an authority as Huygens leaves no doubt as to the merit of Ball's observations. In order to see whether any other light could be thrown on the subject, I have recently taken an opportunity of consulting the manuscripts in the Royal Society, and I find a letter in William Ball's own hand, dated the 14th of April, 1666, in which he mentions that the observations were made with a telescope of 38ft. in length, and with an eyepiece of two lenses, and partly with another telescope of 12ft. focal length; and in a postscript to the letter, he gives a small pen-and-ink sketch of Saturn as it appeared in 1666, and he mentions that the same appearance was presented by the planet in 1664. In this figure the external boundary of the ring is formed of a regular oval, without any notch or other irregularities, and no allusion is made to the different appearance, which, according to the *Philosophical Transactions*, the planet presented in 1665. The letter of Ball, on which the paper in the *Philosophical Transactions* is founded, is not to be found in the archives, but there is preserved a paper cutting representing the planet and its ring, which is of the figure represented in the engraving in the *Philosophical Transactions*. The defect in the paper cutting, I suppose, might have arisen from the paper having been folded first in the direction of the minor axis, and then in the direction of the major axis, so that only a quarter of the ellipse had to be cut and through want of care the notch was formed. I imagined that the writer of the article took the paper cutting to be correct, and when it was found that the figure was erroneous the engraving was cancelled, and that accounts for only a few of the volumes containing a copy of the engraving. The other figures on the plate were represented in a few of the volumes, and the fact that these were repeated is a pretty clear proof that the cancelling of the plate of Ball's drawing took place designedly. I find no evidence that Ball, any more than Huygens, had noticed any indication of the division of the ring, and the credit he has derived for the observation seems to have arisen from a mistake.

Endowments at the French Academy.—Each member of the Institut receives an official salary of 1,500fr. When full, the Institut has 228 members, being 68 for the Académie des Sciences, and 40 for each of the other four branches. The total grant, therefore, on this account would amount to nearly £14,000 a year. And there are not a few extra items. The members of the Académie Française receive a payment for attendance or "jeton de presence," which raises their salary to 5,000fr. Five of their body charged with the secular compilation of the dictionary get an additional 1,500fr.; those who are engaged upon a history of French literature get 2,400fr.; four members of the commission of medals get 800fr. each; and 5,000fr. is allotted for a dictionary of fine arts.—*The Academy.*

THERE are now 828¾ miles of water-mains for the supply of London, which are constantly charged. Of these the New River Company has 214 miles; Lambeth, 136¾; Southwark and Vauxhall, 117; West Middlesex, 86½; Kent, 85; East London, 85; Chelsea, 67; and Grand Junction, 37½ miles.

SCIENTIFIC NEWS.

FIVE complete observations of Barnard's comet (*c* 1882) have been secured by Mr. Gill at the Cape between Nov. 11 and 30, so that a number of places taken during about twenty days after perihelion will be available for calculations.

The *Sidereal Messenger* for this month contains a number of reports from observers of the Transit of Venus in different parts of the United States. Prof. Frisby, using the 26in. equatorial of the Washington Observatory, failed to see any black drop or irregularity whatever—only true geometrical contact. Prof. H. L. Smith, of Hobart College, New York State, reports the black drop seen distinctly at third contact; but contacts three and four were observed through flying clouds. Mr. Burnham and Prof. Hough at Dearborn observatory report no black drop, but the atmosphere of Venus caused a haziness at the point of contact. Capt. Sampson, at Washington, saw the black drop at end of third contact. Prof. E. C. Pickering, of Harvard, makes no mention of the black drop, but says that spectroscopic observation showed no peculiarity in the spectrum of Venus. Prof. C. A. Young, observing at Princeton with the 23in. equatorial, says the planet's atmosphere was conspicuous as a delicate halo around its disc between the first and second contacts, and spectroscopic observations showed unmistakably the presence of water-vapour in the planet's atmosphere.

Prof. Huxley has been appointed Rede Lecturer at Cambridge during the present year.

The thirty-sixth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday next, at 25, Great George-street, Westminster. The following papers will be read and discussed: "Report on the Hardening of Steel," by Prof. F. A. Abel, F.R.S.; "On the Molecular Rigidity of Tempered Steel," by Prof. D. E. Hughes, F.R.S.; "On the Working of Blast Furnaces, with special reference to the Analysis of the Escaping Gases," by Mr. Charles Cochrane, Vice-President; "On the St. Gothard Tunnel," by Herr. E. Wendelstein; and "On the Strength of Shafting when exposed both to Torsion and End Thrust," by Prof. A. G. Greenhill.

Under the auspices of the Society for the Extension of University Teaching, a course of ten lectures on electricity will be given by Mr. T. W. Waghorn, R.N., in St. Jude's Schoolroom, Whitechapel, on Tuesday evenings, at 8.15. The first lecture, which was free, was given last Tuesday: the others, to which a nominal fee admits, will be followed by a class, in which the lecturer will answer questions and explain any difficulties his audience may experience. The hon. secs. are Mr. F. Rogers, 62, Nicholas-street, Mile End, E., and Mr. A. Milner, 54, Claverton-street, S.W. The lectures will be freely illustrated, and will be made intelligible to beginners.

Mr. W. T. Bashford, hon. sec. of the Edinburgh Photographic Society, sends us a photograph taken by Mr. Frank Moffat by moonlight, the illumination so weak that lamps had to be placed in the windows in order to focus the image. The photograph shows a house and trees very distinctly, and the line of demarcation between a lawn and a raised bank—both grass—is clearly distinguishable. A paper read before the above-named Society gives full details of the process. It will shortly be published.

The Vienna Electrical Exhibition, postponed last year on account of the Munich Exhibition, is to be held during August, September, and October next. No prizes will be awarded, but a commission will be appointed to test the machines and appliances in co-operation with the exhibitors. All applications must be in the hands of the managing committee, Vienna, I., Wallfischgasse 9, on or before the 1st of March next, and all exhibits must be in place and fixed by the 15th of July.

The following gentlemen have promised to deliver popular lectures with lantern illustrations at the Royal Victoria Coffee Hall on Friday evenings at 9 o'clock. Jan. 19th, Wm. Lant Carpenter, Esq., B.A., F.C.S., on "The Telephone, and How to Talk to a Man 100 miles Away." Jan. 26th, C. A. V. Conybeare, Esq., "On Pompeii." Feb. 2nd, a Magic-Lantern Entertainment (instead of a lecture) entitled "Here, There, and Everywhere," will be given by Major George Verney. Feb. 9th, E. B. Knobel, Esq. (sec. R.A.S.), "The Sun and his Family, with a Glance at other Suns."

While cremation is certainly the most direct and effectual way of remedying the insalubrity of cemeteries, there is, naturally, a strong body of sentiment against it. In view of this, Dr. Alex. Mayer proposes in *Le Genie Civil*, a mode of burial which offers various advantages. For wooden coffins he would substitute glass ones; the glass thick and opaque, and hermetically closed with a silicated mastic as inalterable as the glass. So inclosed, bodies would give out neither gases nor liquids, and would have no injurious effect on the public health. The body, moreover, might be preserved indefinitely from decomposition, by substitution of an antiputrid gaseous atmosphere, under suitable pressure, for the air contained in the coffin. For this purpose, two tubulures would be added, one for entrance of the gas, the other for exit of the air. If carbonic acid were used, the difference of density of that gas and air would render the operation very easy. This mode of preservation, it is claimed, would present all the advantages of embalming, without mutilation or great expense. Glass coffins would allow of deferring burial, as is sometimes desirable; in the case of death during a voyage, the body need not be consigned to the sea, but kept till arrival.

That measles is a disease of parasitic nature, has been held by Herr Tschamer, who found a small organism in the urine of persons having scarlatina, and the same in cases of measles and diphtheria. M. Le Bel, however, has lately found a vibrion peculiar to measles; it is a short, slightly curved rod, highly refringent, and very slow in movement. Its spores are held in a pouch of dead protoplasm, which gradually disappears. Usually, these vibrions appear in the urine and during a few days at first; they disappear when the fever comes. In one case another occurrence of spores was observed on the thirty-fifth day in an adult, and the vibrion persisted. To have an idea of the intensity of the disease, it is well to examine the urine immediately after emission. Again, vibrions were found in the skin at the time of desquamation (scaling). M. Le Bel cultivated the organism in a mixture of urine and bouillon, and injected some of the liquid into a guinea-pig. The animal was not inconvenienced; but on the tenth day thin vibrions were noticed in its urine; they disappeared on the twelfth.

The sewing-machine industry shows rapid growth. There are in Germany 62 manufactories, with a total capital of 25 million marks (say, £1,750,000). In 1880, they produced 416,417 machines, representing a value of 26 to 30 million marks; and in 1881, this production was increased 30 to 40 per cent. More than half is exported to Russia, Austria, Italy, England, Spain, France, South America, Africa, Australia, and, spite of 45 per cent. duty, even North America. The Stettin manufactory, in 1881, doubled its production, and had to employ more operatives and add to its material.

Brazil has just adopted a new patent law. Inventions relating to food, drugs, and chemical products are submitted to previous testing operations. Any inventions adverse to morals, public safety, or health are excluded from protection by patents. Inventions are considered new which have not been publicly used at home or abroad nor described in a public print. For inventions patented abroad, a period of seven months is allowed, reckoned from the time of notification, during which the thing may be publicly worked out or described without the right to patent being lost. The duration of a patent is 15 years; if there is a foreign patent for the invention, the Brazilian patent is limited in its duration by that of the foreign one. For a patent an annual tax must be paid, about £2 the first year, and £1 for each successive year. For improvements additional payments may be acquired, for which a single payment of £2 is made, and which stand or fall with the main patent. A patented invention must be worked out within the first three years, and must then never remain a year unapplied. Patent infringements are punished by fine, to the amount of about £5,000, besides damages. Patents are untransferable. Foreigners have the same rights as Brazilians, but must appoint a representative living in the country.

In a lecture on school-hygiene, delivered recently, Prof. Cohn, of Breslau, made the remark that in the use of the ordinary slate, a child who would see ordinary ink writing quite distinctly at a distance of 12in., must approximate his eye to 8in. from the slate to obtain the same distinctness. He considers that slates should be banished from schools, and he recommended dull, white tablets of artificial stone, supplied by Priebatsch, in Breslau, which are written on with a special kind of pencil.

To facilitate carriage of goods on rivers and railways, Herr Greve, of Biebrich, has recently designed a goods-waggon, which, in general, differs from an ordinary one merely in water-tight closure of axle boxes, and an altered form of the body. This waggon can be placed on wheels and used as a railway waggon, or it can be used as a boat in water, without transference of its charge. In the latter case, a large number of these pontoons may be coupled together by their longitudinal sides, and a bow piece and stern piece of special form added, the motor being placed on the stern piece. Thus a goods train may with ease be transformed into a jointed vessel, which, even though of considerable length, provided the couplings are elastic, will readily go round curves. The arrangement is described in *Dingler's Polytechnisches Journal*.

An interesting series of experiments in the testing and driving of piles was recently made, in the course of some recent constructions at Buda-Pesth. The agent used was dynamite. A plate of wrought iron was placed on the top of the pile: it had two diametral holes to receive lateral bars, and in the middle of the upper surface was placed a charge of dynamite in parchment paper. After connecting the fuse and electrodes, the charge was covered with clay. Lieut.-Col. Prodazovic, who made the experiments, estimates that, on an average, a dynamite charge of 500 grammes is equivalent to five strokes of a "monkey" of 760 kilogrammes weight, falling three metres. The iron plates bore, on an average, 20 to 24 shocks. The cost of testing is given as about 7s. a pile. The advantage of the use of dynamite increases with the number of piles to be tested, and with the charge they are capable of bearing. The conditions are not favourable where the pile emerges much above the ground, and therefore vibrates greatly. In his paper to an Austrian Society, the author shows how, from the test so made, one may deduce the load which the pile is capable of supporting.

In a recent number of *Carl's Repertorium*, Herr Obach describes a device of his for showing to an audience the different resistances of wires to passage of a current. A wire composed of four equal lengths of different metals, is stretched between two adjustable standards. On each of its several sections is hung a glass bead by means of a short cross bar of easily-melted material (a mixture of beeswax and Venetian turpentine), which supports the terminal hooks of a forked piece of wire attached to the bead. Below the beads are four bells of different pitch, on which the beads fall, when the corresponding sections of the supporting wire, heated by the current, cause the cross-bars to melt and give way. A background is provided for the glowing wires. The experiments may be varied in several ways as the author describes, *e.g.*, the influence of thickness of the wire, as well as of its nature, being illustrated, &c.

An ingenious hydropneumatic clock has been recently invented by M. Bourdon. It is described, with figures, in *Annales Industrielles*, 24 Dec. The motor recalls to some extent that of the ancient clepsydra, and the intermediary between that organ and the clockwork proper is the circular-flattened tube, which M. Bourdon has utilised for his gauge, and in other ways. The motive agent is essentially atmospheric pressure, acting by virtue of a certain degree of vacuum produced by means of the laboratory trompe (of improved form). For details, we must refer to the source indicated.

AT the November meeting of the trustees of the East River Bridge it was reported that the total cost of the bridge up to the present time is £2,809,136.

THE engineer constructing the Washington monument reports that it reaches a height of 340ft., 90ft. having been added this year. He expects that it will be finished in 1884, the total height being 550ft.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

SCIENTIFIC WORK WITHOUT STATE AID—APPARATUS FOR ILLUSTRATING THE PRECESSION OF THE EQUINOXES—SOLAR EYEPIECES—ADJUSTING AN EQUATOREAL WITHOUT CIRCLES—THE NEW COUNCIL LIST OF THE ROYAL ASTRONOMICAL SOCIETY—HUYGHENIAN EYEPIECE—THE CHRONODEIK—PRECESSION AND THE LUNAR ORBIT—THE O'GYALLA OBSERVATIONS—THE GREAT COMET.

[20953.]—YET another illustration lies before me of the splendid scientific work which is being achieved on the other side of the Atlantic, by the aid of that wise munificence that has already produced such valuable and enduring results in America. It is the first volume, published by the Washburn Observatory of the University of Wisconsin. Built and equipped at his sole charge and cost, by the late Governor Washburn, the structure was commenced, and instruments ordered in 1878. In the autumn of that year, Professor Watson was appointed Professor of Astronomy in the University and Director of the Observatory; entering upon his duties forthwith. He continued to occupy himself in the completion and arrangement of the main building, to which additions were made on his recommendation, and at the time of his premature death, in 1880, was occupied in building a solar observatory, as well as a small one for students: *both at his own expense.* When I say that he is succeeded by Professor E. S. Holden, I need scarcely add that no fear need be entertained that any deterioration in either the quantity or quality of the work bequeathed to his successor will be involved by Mr. Watson's lamented decease. Associated with Professor Holden as astronomers are the world-renowned double-star observers, Mr. S. W. Burnham and Mr. G. C. Comstock. Of the mere building itself I need not speak here. All interested in its structural details and the ingenious mechanical devices in connection with the dome, observing-seat, &c., will find them in the book itself, which should (I imagine) be procurable in London through Trubners, or other American booksellers. It may suffice to say, with reference to the instruments, that they comprise a 15·6in. equatoreal, having a focal length of 20ft. 3in., by Alvan Clark and Sons. It is fitted with all the usual appliances. The ingenious form of micrometer attached to it was described in these columns (Vol. XXXIV., p. 39), by Mr. Burnham himself, who was its designer, at the time of its construction. The meridian circle, by Repsolds, of Hamburg, has an object-glass (of Alvan Clark's work) 4·8in. in aperture. The circles are 22in. in diameter. The clocks and chronograph demand no special notice. In the students' observatory (to which I have previously referred as having been built by Professor Watson at his own private cost), is an 8in. equatoreal, and a 3in. combined transit and zenith instrument, which seem to leave nothing to be desired for simplicity and efficiency. The Solar Observatory—or rather the building for it—commenced by Professor Watson, has been completed; but has, at all events for the present, been turned into quarters for one of the assistants. In conclusion, I may glance at the work which has been accomplished during the brief period in which the Observatory has been in working order. Imprimis, an original Catalogue of 195 stars has been formed. In the next place, no less than 27 new nebulæ have been discovered during a series of zone observations, extending from April 23 to September 30, 1881. Then follow two successive lists of double stars, discovered and measured at the Washburn Observatory between the dates just specified. The 60 stars comprised in List I. were mostly detected by the director himself; the 88 stars which form List II. were found by Mr. Burnham, who measured every object in both lists. In addition to this, we have a Catalogue of 150 double stars selected by Mr. Burnham for special measurement from those previously known. This again is followed by Observations of 84 red stars, and a list of 27 new red stars discovered during the zone observations. Then we have observations and fac-similes of drawings of the Great Comet of 1881, details of the appearance of a bright meteor, of six apparitions of the aurora, and the observations by Messrs. Holden and Burnham of the Transit of Mercury on Nov. 7, 1881. The usual meteorological observations for the year complete the volume.

Two months ago I invited attention in these columns (letter 20724, p. 249) to a very ingenious little star-finder, or popular equatoreal, devised by M. Ad. de Boë, F.R.A.S. of Antwerp, for the purpose of enabling the beginner to identify any given object in the sky. As will be remembered, it consisted mainly of the frame and meridian of an old or disused globe; the mode of employing this primitive foundation having been described and illustrated subsequently in an editorial article on p. 266. From the current number of *Ciel et Terre*, it would seem that the indefatigable Belgian astronomer has by no means exhausted the educational uses of a globe-frame, inasmuch as he has now produced, as a superstructure on it, a piece of apparatus quite as simple as the one he previously devised; the object of his new arrangement, however, being to explain in a very popular and intelligible manner the Precession of the Equinoxes. In it a vertical axis is fastened by a screw, in the middle of the circular wooden horizon, and at right angles to it; the horizon now representing the plane of the Ecliptic, and the extremities of the axis, of course, its poles. Cutting this at an angle of about 23°, is another axis representing that of the Earth. The place where the two axes intersect is in the plane of the Ecliptic. Finally, this second axis carries a disc at right angles to it, to represent the plane of the Earth's Equator. A moment's consideration will show that this plane must form a constant angle of 23° with that of the wooden horizon. If now the smaller axis be moved round the vertical one in the direction in which the hands of a watch travel, it will be seen that the opposite points at which the plane of the equatorial disc cuts the plane of the horizon (our ecliptic) must travel round too. But these points are those in which the Sun appears to be *on* the Equator; in other words, the Equinoxes; and hence, as the Sun seems to travel through the sky from right to left, the Equinox will advance to meet him, as it were, before he gets to his old place in the Ecliptic—which is only another way of saying that the Sun completes his Equinoctial Year before he has quite described 360° on the Ecliptic. Evidently, as the disc travels round at this constant angle, the terrestrial axis (say, the northern half of it) must sweep out a cone in the sky round the Vertical or Ecliptic axis; and as the star immediately over the Earth's North Pole must quite evidently be our Pole Star, it is obvious that in the course of ages the present Pole Star must cease to deserve that name, and that another will reign in its stead. Another obvious effect of this conical motion of the Earth's axis is, that occupying, as it does, 25,695 years to perform a complete revolution round the pole of the Ecliptic, while now the Earth's axis points towards Polaris, and the Sun is in the Constellation Sagittarius at the date of our Northern Winter Solstice—12,847 years hence—our North Pole will point near Vega, and our Winter will begin when the Sun is in Gemini. Anyone who wishes to construct M. de Boë's remarkably simple piece of apparatus for himself, should get the number of *Ciel et Terre* for January 1st. It only costs half a franc, and a sous for postage. I may add that a cognate, but more elaborate, contrivance for exhibiting the phenomena of precession, by the late Mr. T. W. Burr, F.R.A.S., will be found described and illustrated on p. 164 of Vol. XV. of the R. A. S. *Monthly Notices.*

If "W. G. T." (query 49103, p. 416), chooses to go to the expense of a polarising eyepiece for Solar Observation, he will, undoubtedly find it superior to one of Dawes's form for general use. Dawes's eyepiece is simply a Ramsden one, with a very small hole in a diaphragm placed in the common focus of it and the object-glass; the diaphragm being, as it were, insulated by being surrounded with ivory, or other bad conductor of heat. The effect of this is that we see a very small portion of the Sun's surface at one time. In fact, as the diaphragm is perforated with holes of various sizes, we may, in this way, isolate a spot from the photosphere, and study its structure undisturbed by the glare of its surroundings. But, under any circumstances, we cannot dispense with a dark glass of some colour; and this, of course, precludes us from ever seeing the Sun of its real tint. The polarising eyepiece is a very elaborate affair. In Merz's form the light from the object-glass falls first upon a prism set at the polarising angle: something like 0·94 of the light goes through this prism altogether; the remainder being reflected from its face, and polarised by such reflection. It then impinges on a second prism, and here a great further loss of light occurs. From this second prism it suffers two more reflections, as it falls in succession upon two black glass mirrors, and by turning these round an axis parallel to that of the telescope, the light may be extinguished entirely, in the manner so familiar to everybody who has ever used a common polariscope. Of course, by turning it round less, more light is permitted to pass, so that the observer can regulate to the utmost nicety the intensity of the illumination. Evidently, in this form of eyepiece, no dark eye-shade is needed, and everything is seen of its real and proper colour. Where cost is not a consideration, the polarising solar eyepiece is very much the better form for use.

In letter 20894 (p. 405) I stated, in reply to "E. R." (query 48991, p. 368), that I did not know how to adjust an equatoreal unprovided with circles. By one of those curious coincidences which occasionally occur, some few hours after penning paragraph two above, I received (through our Editor) a letter from M. de Boë, in which that gentleman is good enough to point out a method by which an equatoreal may be adjusted without circles; at all events, without any *attached* circles. Whether this method is of sufficient simplicity to meet the wants of my original querist, I do not know; but I will reproduce it as literally as I can for his benefit, from the communication with which I have been favoured. The requisites, according to M. de Boë, are a clinometer (at least this is what I presume is meant by "un niveau de pente,") and the correct local time at the observer's station. "In the first place," says the writer, "the level enables us to render the declination axis horizontal, and to give the polar axis the desired inclination. Having the time, and waiting for the transit of a (known) star, we get the instrument into the meridian. We now proceed to direct the instrument upon a given star by its co-ordinates. This may be done in the following manner:—The telescope being now in the meridian, by the aid of the level we give it an inclination equal to the declination of the star sought: and we so fix it *that it cannot turn about the declination axis.* It only remains to resolve a spherical triangle when we know—1st, the distance from our zenith to the pole; 2nd, the Star's polar distance; 3rd, its hour angle: from which we can deduce the Star's zenith distance. We need, then, only so set the clinometer that it indicates an inclination corresponding to this zenith distance; and placing it thus on the telescope tube, or on the finder if that is not cylindrical, turn the instrument about the polar axis until the bubble of the level shows that the telescope has attained the elevation indicated by calculation, and the Star will be in the field." "This is not," its ingenious deviser goes on to say, "very expeditious, but *one can* use an equatoreal without circles." "E. R." will note that, in addition to a clinometer and good time-keeper being requisite, M. de Boë's method presupposes a familiarity with spherical trigonometry.

To those who have either pooh-pooh'd, or point-blank denied, my reiterated assertions that a persevering and systematic attempt has, for some years past, been made to pack the Council of the Royal Astronomical Society with supporters of the "Endowment of Research" party, I would commend a study of the new "House List," recommending names for the February election of Officers and Council. From it disappear the names of four well-known opponents of Endowment: men whom one would hardly have thought that those who are responsible for the List would have dared to attack—viz., Sir George Airy, The Earl of Crawford, Mr. Marth, and Mr. Neison. Now, I have made inquiry, and cannot find that any one of them has either, formally, or informally, retired from the Council; though I learn that Lord Crawford did write resigning *the office of Foreign Secretary.* And now, whom do we find set up by a certain majority in the Council in the place of such men as those whose names I have mentioned? Imprimis comes Captain Abney, a South Kensington pluralist, and a member of the "Solar Physics Committee," who is bound to forward South Kensington schemes and interests. Next we have Dr. de la Rue, a well-known supporter of the "Solar Physical Observatory," and, thirdly, Professor Pritchard, who, though he at one time denounced that proposed Observatory scheme as "a gigantic job," is now known to entertain much more friendly views towards the promoters of it. Comment on this is needless: but I cannot abstain from saying that if the Fellows of the Royal Astronomical Society are content blindly to vote such a list as that on which I am commenting, public spirit is at a lower ebb among them than I am willing, even now, to believe.

"Dorky" (query 49126, p. 439) has pretty obviously gone to the wrong "dealer" for the materials for his Huyghenian eyepiece. Your correspondent is quite right as to the relative foci of the field-lens and eye-lens, which should, moreover, be placed at half the sum of their focal lengths apart. The idea of two lenses of 1in. focus giving power of 80 on a 30in. object-glass is ridiculous. What "Dorky" really requires is two lenses of the respective focal lengths of ¾in. and ¼in.: the former for a field-glass, the latter for his eye-glass. Placed ½in. apart, these will form a Huyghenian eyepiece, which will give him a power of 80 with his 30in. objective.

The chronodeik (query 49137, p. 439) is made for sale in the United States, but, so far as I know, is not procurable in this country. The address given at the time in the *Science Observer* was "Box 2,725, Boston, Massachusetts," and the price was stated to be 15 dollars.

"W. A. H." (query 49155, p. 440) asks a question—or a series of questions—to which it is extremely difficult to give replies in a popular form. I may, though, say that nutation does not affect the motion of the Moon in its orbit. In the next place, the apex of the double cone described in virtue of the Earth's precessional movement coincides with her centre of gravity, and not with that of the Earth and Moon. Lastly, the inclination of the lunar orbit is not in any way sensibly affected by the position of the Earth's axis due to precession.

I am afraid that "J. H. L." (query 49159, p. 440), will not be able to purchase the volumes issued from the O'Gyalla Observatory, as I have some idea that Dr. Von Konkoly only distributes them privately. Possibly, a line to Mr. Wm. Wesley, the bookseller, of 28, Essex-street, Strand, London, would meet with a response, intimating, whether or not, these volumes can be bought.

I may tell "C. A. B." (query 49170, p. 440) that when the Great Comet was first seen at the Cape, on September 8, it was at some degrees distance from the sun, and was much more than 90°, reckoned on its own orbit, from its perihelion position. Its motion was so rapid at perihelion that it passed through 180° of its orbit in less than a day. Because the comet is in opposition it does not follow that it will be "in the direction of its major axis." It comes into opposition because the earth has moved in its orbit so as to be between the sun and the comet. It will not come into aphelion until half its period has elapsed, which is, according to Mr. Chandler, for another 1500 years.

"Draco" (query 49193, p. 441), will find that McLean's star spectroscope will give him very beautiful spectra of such stars as Sirius, Capella, α Orionis, α Herculis, &c., upon a 3in. telescope. No smaller aperture can be usefully employed.

A Fellow of the Royal Astronomical Society.

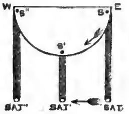
ECLIPSES OF SUN BY JUPITER'S SATELLITES.

[20954.]—IN a recent lecture at Victoria University, Manchester, Prof. Schuster drew attention to the triple eclipses of the Sun from a station on Jupiter, that is to say, the satellite's shadow first overtakes and passes the station, but as the equatoreal rotation of Jupiter exceeds the motion of the shadow, as the station approaches the Meridian (that is a vertical plane passing through the Sun's and Jupiter's centres) and the motions become parallel or nearly so, the station overtakes the shadow and causes an eclipse in the reverse direction; and as the station's motion again becomes more angular to the satellite's motion, the shadow again overtakes the station, and another eclipse occurs in the right direction. This can only, I believe, occur with the 4th satellite, and only within a certain distance of the equator, N. or S., and the first eclipse must occur within a short time of station's sunrise (somewhere about twenty to forty minutes.) There are interesting phenomena also in latitudes too polar to admit of the three eclipses: for instance at about 48° latitude N. or S., the motion of a station will about equal the satellite's motion, causing a prolonged eclipse, amounting to a totality of between two and three hours, I think, and all meridian eclipses between the maximum latitude and the equator will gradually diminish to a shortened eclipse at the equator, as the station's motion exceeds the shadow's motion, and is of course greatest at the equator. The same thing occurs in a different ratio from the maximum prolonged eclipse to the polar eclipse, as the stations will there have a less motion than the shadow, terminating at the pole at nil; and consequently at the pole the duration will be normal—simply the time the shadow takes to sweep across.

With the 3rd satellite, a double eclipse occurs at a station within a certain distance of longitude of the meridian at time of eclipse; and may be first a right eclipse followed by a reversed one, or a reversed eclipse followed by a right one (a right one being the shadow overtaking the station), and of course the duration will vary with the latitude, and the relative rate of travel of the station and shadow.

The same phenomena occur as seen from the earth with transits of the satellites, although the shadow may not be on Jupiter at all.

On the 22nd of this month the shadow of the 3rd satellite enters the planet at 7.15 p.m. and leaves at 10.1 (your astro. information does not give the transit immersion, which would be about 4.0 p.m., the planet being then risen about three hours and well visible if the sky is clear), and on the 29th there is a transit and shadow passage. Transit immersion at 7.25 p.m., em. 11.15 p.m., shadow im. at 10·5 p.m., em. at 2.2 a.m., 30th inst.



TRIPLE ECLIPSE, JUPITER'S 4TH SATELLITE (INVERTED).—S. S′. S″., station; Sat. Sat′. Sat″., satellite; S. Sat., 1st eclipse; S′. Sat′., 2nd eclipse; S″. Sat″., 3rd eclipse.

I would direct your astronomical readers who possess telescopes of sufficient power to show small markings and the satellites and their shadows on Jupiter, to these occurrences, and to note the relative position of any markings in the vicinity of the satellite or shadow, or *vice versâ*, so as to verify the theory by observation. There are no transits of the 4th satellite this month of this apparation.

This does not profess to be exact, but merely to draw attention to the phenomena, as I do not know whether the subject has been throughly investigated, or if it is merely known that they can occur. Perhaps some of your astro. readers can say what is known. **S. Broughton.**

SIZE OF FLATS IN NEWTONIAN TELESCOPES.

[20955.]—THANKS to "A. S. L." (20934) for his remarks on this subject. He considers that the focus of a 10ft. mirror observing the sun will be, instead of a point, 1⅛in. diameter. This would necessitate, as he says, a flat of 2in. at 12in. from it. I shall be glad to have his opinion of the diameter of the focus of a field of view which takes in three-quarters of the moon or a cluster such as that in Perseus; also of Jupiter, Saturn, and a double star—say, Rigel—and would they vary with 10½in. and 12¼in. mirrors?

It would seem, if "A. S. L." is correct, that different-sized flats should be used on different objects.

My remarks as to the diameter of the cone of rays have been on the supposition that the focus comes to a point. My flat is, as I have said, 1¾in., 12¼in. mirror, 9ft. 3in. focus.

Fordingbridge. **T. Westlake.**

[20956.]—I FEAR, from Mr. Westlake's letter, 20935, I have not made myself quite clear. Perhaps my meaning may be better understood by supposing the flat and the eyepiece joined together, so that, on the observer pulling the latter towards himself, the flat is also drawn, until it touches the inside of the main tube, or even passes outside it. In this latter case, of course, a long oval hole would have to be cut in the side of the tube to give passage for the rays from the mirror when rotated (on a vertical axis) so as to throw its focus on the flat. The position of the observer's head would only be moved back from the main tube a distance of half its diameter or so, and therefore, as far as obstructing the light, or convenience of observing goes, would be practically the same. The flat also would be more firmly fixed, and more accessible for adjustment, &c. **Faber.**

[20957.]—IN reply to "A. S. L." No. 20934, I will ask him, if he thinks, when he directs his telescope to the sun, that more than the column of rays equalling the size of his mirror are reflected to his flat? It appears to me that, no matter to what the telescope is directed—only the whole of the parallel rays that fall on the mirror require to be reflected by the flat—and, if large enough to reflect the whole of them, it is sufficient.

It is a subject of great interest to me—and I am anxious to be convinced if I am wrong—for I shall be sorry to lose the full effect of a large and expensive mirror by using too small a flat. I have but just mounted the 17¼in., and have had no opportunity of trying it on stars as yet. But on a watch-dial and artificial star at 100 yards distant, the whole of the mirror is reflected in the 2in. flat, as I prove by cutting out 16in. of the centre, and yet getting the image of the dial in the eyepiece, so that for any more distant object the focus will be shorter and the flat more effective.

For the 15in. I have two flats mounted each on its own arm—one 1¾in., and the other 2in. These I have frequently changed one after the other, and found no difference in the light or definition of either one or the other; so that I feel satisfied that the 1¾in. flat is sufficiently large for that mirror. I ought, perhaps, to say that the tube is about 15in. wide, and the mirror just clears each side, so that the flat is as near to the centre as possible; and for the 17¼in. the tube is no larger than just to admit the mirror, and the sliding plate is fixed to the inside of the tube; so that, in this case also, the eyepieces are placed as close as possible to the centre of the mirror.

In answer to Mr. Westlake (20935), I will assure him that the sliding plate and arm is as capable of perfect adjustment as that of any other arrangement; and, if well made and properly fixed on the tube, never requires more than the adjustment of the flat on the arm to reflect the whole of the rays from the large mirror directly into the eyepiece.

As to the chance of the sliding tube being true or not: no one knowing anything about a telescope would allow of chance in that matter, as no one would put up with imperfection there; but get a new one, or get that made perfect.

I can also assert that no well-made sliding plate is affected by any shake. **Philip Vallance.**

TELESCOPES.

[20958.]—I WISH to ask "F.R.A.S." one or two questions. The first relates to the formula as to separating power of telescopes. "F.R.A.S." has shown us that this is a function of aperture, and that it is expressed by dividing aperture by 4·56. Now Ball's division in the ring of Saturn is about half a second, and would require nine inches of aperture to show it if the formula applied to it; yet I find that others, as well as myself, can see the division with the telescope reduced to 2in. In fact, I have perceived it in the following ansæ with 1¾in. The question I venture to propound to "F.R.A.S." is, why the formula does not apply to this object (as it evidently does not) and what is the rule for the visibility of lines of separation betwixt objects other than fixed stars. I cannot see why the same rule is not applicable; but I have no doubt our ever-obliging friend will make it clear to me.

The next question relates to spectroscopy. Burning petroleum without a chimney, and viewing the flame with Horne and Thornthwaite's miniature spectroscope, I lower the spectroscope until the light begins to fade, when a luminous line in the blue becomes faintly visible, and a still fainter one in the violet. No doubt "F.R.A.S." is familiar with these facts; but he would much oblige if he would inform me if they are hydrogen lines.

Ought I to see anything of the spectra of stars with Horne and Thornthwaite's miniature universal spectroscope and a 9in. reflecting telescope? The makers give instructions in their book, but I have been unable to make anything of it. The spectrum is not brilliant enough to show even the colours distinctly.

Has anything been discovered of divisions in the rings of Saturn with Mr. Common's large instrument, and are any accounts published relative to its performances; or any drawings of what is seen with it? How would a Coddington lens do for a high-power eyepiece?

It is of course only natural that Mr. Wray should prefer refractors to reflectors; but I own my surprise that his utterances should show he has had so little actual experience of reflectors. Still, his opinions are entitled to great weight, and I should like to ask him his opinion of the prospect of a large refractor, say, 24in., being constructed, with any decent approach to the perfection of Mr. Common's mirror—more especially with respect to the colour-correction? **John Hanneford.**

REFLECTOR v. REFRACTOR.

[20959.]—THE queries relating to this subject have produced a lot of valuable information. I was asked for my reasons for preferring the refractor. I gave some of them accordingly, with my observation and experience. It will not tax the credulity of our readers when I say that my object has been to get rid of instruments, whereas the object of such gentlemen as Messrs. Holmes, Vallance, and Westlake has been the opposite of this. My preference for the refractor accords with my observation. The fact that instruments more frequently turn up in the trade that require readjustment, repolishing (and resilvering) of the reflector class of instrument than the refractor, leads me to base one portion of my reasoning and preference on this experience. Undoubtedly, the great care used by these gentlemen gives the mirrors a chance of lasting longer than they would with rougher usage; but, are they as good as newly-silvered (in the case of glass), or newly-polished (in the case of metal)? The real fact is that metallic surfaces are constantly deteriorating, and it depends upon the greatest care being taken to keep them workable for any length of time. An o.g. wiped once a year on the inside will not contract "green mould" in our climate at all. This is a few minutes' work. Does Mr. Westlake hold a brief for reflectors, or would he be surprised to learn that some disinterested people are yet extant? I can assure him that my cake has come from reflective, refractive, and dispersive sources. If I say I am perfectly disinterested, would it be possible for a gentleman who "dreams of briefs" to believe me?

The information derived from these letters is useful to us all, and will show the querists that there is as much hobby-riding in this as in all matters mundane. Still, I should get a refractor if I was able instead of a reflector. If I could not afford a refractor, a reflector. I do not see that anything has been said about the distorting influence of air-currents passing up and down the body of a reflector, or through the lattice-work that does duty for a body in some cases. Mr. Holmes, prone as ever to exaggerate, as usual in such cases, underrates every one else. He asks, "What do I know about it"? I answer, a great deal more than Mr. H. likes to admit; we all know but little yet.

Prismatique.

THE BLACK DROP.

[20960.]—THE opinion of several of your correspondents with regard to this phenomenon observed during transits of Venus—that it is due to the sensible diameter of the pupil of the eye—can, I think, be shown to be erroneous. If an opaque object held not far from the eye be made to approach the line joining the eye with a more distant bright object, there will appear a dark projection leaping out from the opaque body before apparent contact; and this is better seen if two opaque bodies at different distances be made to approach the same visual line upon a bright background. This is caused by the different view which one side of the pupil obtains from that which the other side has, and is, therefore, due to the sensible size of the pupil; but if both bodies are at the same distance from the eye, no such appearance presents itself, the parallaxes of the two opaque bodies being the same. Now, in viewing a transit of Venus, the planet and the sun's limb form images in the telescope which are in the same plane, and at the same distance from the eye. If, therefore, this appearance is observed, it must be due to some other cause, especially as in most eyepieces the orifice is reduced almost to a pin-hole in a high power. The black drop seems to be explained by irradiation, the bright sun seeming to encroach upon the black disc, except at the limbs in contact, aided by the unsteadiness of the air. With regard to query 49194, the blue flame given by salt in the fire is, I fancy, due to the combination of the chlorine with the carbon of the coal. Its spectrum is very interesting, full of bands—not those of the Bunsen flame nor those of chlorine under the electric spark. I have not tried the spectrum of the chlorides of carbon, but believe it would be found to resemble that of the salt-flame. To see the Bunsen spectrum to perfection the lamp should be allowed to roar with excess of air, and to burn with the bright blue-green flame; the effect then is very beautiful.

Chesterfield. **F. B. Allison.**

THE SLIDE-RULE.

[20961.]—I OBSERVE that there are numerous clerical errors in my letter which appeared in No. 928 for January 5th, at p. 410—some attributable to myself, and others to the compositor: it is, therefore, not surprising that Mr. Thos. Dixon should have failed to accept the statement I made relative to the cubing-rule furnished by Messrs. Dring and Fage—see his letter, No. 929, p. 432. The statement made in my former letter was scarcely as definite as it should have been—namely, that *the breadth and depth in inches and quarter inches* being brought together on the slide, and on the upper fixed line of the rule—and the *length in feet* being found on the lower fixed line, the cubic contents *in feet*, and decimals of a foot, will be found over the length.

The explanation is simple. On the side of the rule arranged for that purpose there are four logarithmic systems on the same scale, and differing but slightly from one another. The top line, marked E, has the scale *inverted*, the figures running from right to left; the upper line on slide, marked B, has a similar scale direct, figures reading from left to right. The *subdivisions* on these two scales are divided, so that the *quarter inches* can be accurately read off.

The lower line on the slide, marked C, and the lower fixed line, marked D, are exactly similar logarithmic lines, on the same scale as E and B, but both direct; that is, figures reading from left to right, and only differing from the other two lines in their *subdivisions* being decimally divided.

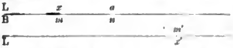
The essential point in this arrangement is, that the 12 on the fixed inverted line E shall coincide accurately with the 12 on the lower fixed line D; and, of course, when the slide is closed up, the figures 12 on all four lines are in a line one over the other. It will be perceived that by this arrangement, the breadth and depth (in inches and quarters) are *each* divided by 12, as well as multiplied together when brought together, so that the product becomes divided by 144; and this being multiplied by length in feet gives the cubic contents *in feet*.

I have but once seen the spiral instrument, but it appeared to me very clumsy in working, and certainly not more accurate to four places of figures than the circular instrument, which gives the fourth figure clearly enough when the left integer does not exceed 7; with 8 and 9 for the left integer, the fourth figure is somewhat obscure: but what is wanted, is a ready means of reading numbers to *six* places of figures.

January 14th. **Gamma Sigma.**

[20962.]—IT must be admitted that the construction of a Roget's slide rule on Professor Everest's method is somewhat tedious; but it is not necessarily inaccurate, if carefully done. By proper arrangements it may be taken up in any spare half-hour without increasing the risk of error. But, of course, Mr. Kapteyn is best able to judge whether or not he can spare the time.

The equation $\left(\frac{P}{Q}\right)^{\frac{m}{n}}$ must first be reduced to the form $a^{\frac{m}{n}}$ as division is not possible on a Roget rule. Then denoting by L the line of log. logs., and by B the ordinary line of logs. on the slide, we have—

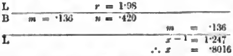


the answer may be found on the upper line, or on the lower as indicated by m'/x'.

If a is a fraction, take its reciprocal r and find x^{-1} of which the reciprocal x will be the required answer.

Example—

$$\text{Let } a^{\frac{m}{n}} = (\cdot505)^{\frac{\cdot136}{\cdot420}} = x, \text{ then } r = \frac{1}{\cdot505} = 1\cdot98.$$



In this case m runs off the scale to the left, and the slide has to be shifted one radius to the right, when the answer is found on the lower line L.

This result was obtained on a 10in. rule, each radius being only 5in. long; the last figure of 1·247 on a 25in. radius, the 7 would be obtained with certainty, and an additional figure by estimation.

If that amount of accuracy is not sufficient for Mr. Kapteyn's purpose a Roget rule would be of no use to him, and he must resort to logarithms. The calculation of the above equation is appended to show that the value obtained by the rule is fairly correct, and but slightly in excess.

a	·505	$\bar{1}$·7032914
r	1·980198	0·2967086
	0·2967086	$\bar{1}$·4723301
	·136	$\bar{1}$·1335389
	·420 co.	0·3767507
log. log. x^{-1}		$\bar{2}$·9826197
x^{-1}	1·247605	0·0960771
x	·801536	$\bar{1}$·9039229

A. D. L.

SCREW-CHASING TRAVERSING MANDRELS.

[20963.]—THE letter of "Mechanicus" (20933) gave me great pleasure, and was of great interest, irrespective of its support of my paper on "Screw-mania." I recently missed by accident the purchase of a French lathe, which was made 100 years since by Père Hulot, and belonged to a Rev. Dr., recently deceased, in Cambridgeshire. It was a Rose-engine with traversing mandrel for the "pumping" or endlong motion, and had the same sort of collars as described by "Mechanicus." It fetched, I am told, 50s. only, including an eccentric and an oval chuck and some tools. It was on a wooden bed, with overhead flywheel, on a beech support. I have seen some splendid ivory work turned on this lathe, which continued to run quite true. It was latterly allowed to get very dirty, and looked like a marine-store affair; but I knew it was all right below its dirty coat. I don't know who bought it, as it was sold by auction, and I was unable to attend the sale. I daresay it is doomed to some scrap-heap or old metal store. The collars were called pewter by the owner, but were probably of type metal. This substance, or rather compound, is really of great value for bearings, and will stand very high speed in the shafting even when oiling is somewhat neglected. There is only a *trade reason*, I believe, for dropping the manufacture of these excellent mandrels. I hope to find another trade reason for their restoration.

O. J. L.

A VIOLIN WITHOUT A SOUNDPOST.

[20964.]—I BID adieu to "Capt. Cuttle," as he refuses to accept my challenge, while I thank him for his reference to my principle. Mr. Schucht is a friend indeed, who not only talks but acts, and I have read his letter (p. 432) with delight. I believe he is the first inventor who has constructed a soundboard by layers of veneer and soft wood; the experiments he is making are very valuable, and I hope he will excuse a few remarks thereon. We will dismiss the curve and bend of the wood, as agreeing that they are not conducive to fulness of sound, and will refer only to the flat surface and plate of soundboard. Now a tuning-fork, either A or C, will sound equally as well on a contra-bass as on a violin, or on a panel of a door; but a tuning-fork or any other sound-producer pitched to lower C or A would only sound well on the larger board. Why? Because the area is larger and the size of both vibrators (fork and soundboard) more equalised. No soundpost will make a small soundboard equal to the large vibrations of a deeper pitch than the small soundboard is capable of receipt or *reaction*. The hard back of a violin reinforces the treble, but it takes away from the elasticity requisite for the bass. I would give a hint here to piano-makers—viz., to have their soundboards thinner in the bass, so as to allow more vibratory action, but not too thin or a species of wolf will appear: this I would get rid of by adding to the back of the soundboard. Of course there is more difficulty in fining down the bass in a cottage piano than in a grand, because the size is smaller in one than the other. The question is, How can we construct a soundboard to sound treble and let us say alto at the same time? They are not far removed, and the violin is supposed to possess a bass string G, which has peculiarities in the soloist's hands, so if you please we'll say treble and bass. Now our readers will see why there is so much carving out and thinning down in the violin, and why a single fault in this respect will mar a good instrument. I really think it must be allowed that no violin is equally as good on the treble string and on the bass, because if it's thin enough for the bass it may not be thick enough for the treble, notwithstanding the addition of a hard wood back, which is but a second-hand addition, and cannot be said to form part of the soundboard proper. Almost, but not all, violins have been made with a duplex soundboard—viz., two pieces joining down the middle, probably with the idea of accommodating the tones of their respective strings; but then the area to each set must be smaller. I do say it, who perhaps ought not to do so, that as the new violin has two soundboards all these difficulties are obviated, and while I should like one of Mr. Schucht's soundboards for my treble, I must look elsewhere for my bass soundboard, even to Dame Nature. I'm afraid the glue would be too stringent. Mr. Schucht starts an interesting theory about the surface of wood transmitting the vibrations to the air: this is true enough, but the wood and vibrations must act together first, and when this is done we might copy the electricians and call our resonators field soundboards, as they do their magnets. Please allow a trespass here. The Voss electrical machine has *two* glass discs revolving in different directions—why not do the same with a dynamo machine—the magnet one way, the armature the other? I hope the electric field will be disturbed very considerably this year.

I did not quite understand the "Trumpet" (20943) but "War" has brought it home to me, and if he will send me his address I shall be glad to communicate with him. Do my violins turn out equally good? No. I burn the bad and improve on the good. The secret consists in adapting the best form to the best material—that is, for the purpose in hand. To conclude, I sent one of our violins to the U.S.A. and valued it at £2, when they assessed it at £7. I need hardly remark that our cousins evidently want to detain it—perhaps patent it; but will they be able to make it afterwards? Well it's only a box and four strings.

Fiddler.

HIGH CHIMNEYS.

[20965.]—THE fall of the Bradford chimney has suggested to me the question whether it might not be possible to do without such costly erections. The main objects of a high chimney are to create a strong draught, and to somewhat mitigate the smoke nuisance by removing it as far as possible from the ground. The first object might be obtained by urging the fire with a fan or other blower, as is done on a small scale in torpedo boats; and the second, by passing the smoke through a gallery filled, by means of paddle wheels or otherwise, with a spray of water, as was shown at the Anti-Smoke Exhibition at Kensington. The question of the profit and loss would of course have to be considered; but it must be remembered that, beside the cost of a lofty chimney, there is a waste of heat necessary to cause the draught. With the fanblower fire the whole of the heat would more profitably be spent on the boilers, and the smoke would therefore require but little water to condense it. If much heat did pass the boilers it might be utilized to warm the mill on the hypocaust principle. If this, or a similar plan were found to be really efficient, it would be well worth the while of the corporation of a manufacturing town to promote its adoption by bounty or otherwise.

Faber.

DIRECT-ACTING TRICYCLES.

[20966.]—I AND a friend of mine resolved to make one early last spring. Never having seen one before, we made it, and were astonished at its working so well. We have gone over a lot of ground with it. Wheels are 52in. diameter; small wheel 20in.; cranks, 6in. throw; double-spoon brakes on large wheels; steering behind; we sit side by side, some 5ft. from the ground. We have gone at great speed and have never once been thrown. We smoke and chat together with perfect ease. As to mounting hills, we have turned round on our machine and looked back with surprise, so easily have we mounted them. We sit direct over our cranks, same as a bicyclist on his bicycle saddles. Many a time we have put the whole weight of our bodies on the cranks in hill-climbing without any fear whatever of going over. We have been told frequently that we should come to grief, and the machine would not act; but practice is before theory, which we have proved.

Blackburn. **Thos. Pearson.**

[20967.]—I QUITE agree with "A Fellow of the Geological Society" as to the great advantages of a direct-action tricycle such as the "Royal National"; but the disadvantage is that you are either too high in the world or have such small wheels that the pedaling must be very rapid. In the recently-invented "Monarch" tricycle this advantage has been got over by a very simple experiment. The pedals are hung from the cranked axle in stirrups, so that, although chains, cogs, &c. are done away with, the centre of gravity is no higher than in an ordinary chain or lever tricycle, and the number of bearings are the same as in a bicycle. The cranked axle drives both large wheels.

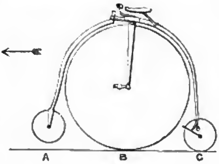
R. P. G.

THE "IDEAL" CYCLE—A NEW "BICYCLE."

[20968.]—FOR those of your readers who are interested in the improvement of bicycles and tricycles I give a description and sketch of the "Ideal." The machine steers as a bicycle. The rider turns B by an ordinary bicycle-handle; A also turns, because A and B are coupled by a short rod, so that A turns to the right or left more than B. C is kept on the ground by a light spring [illegible] simply a trailing-wheel for steering; it can rise three inches. When the rider mounts it is a bicycle; when in the saddle, A is clear of the ground, or only occasionally touches, whilst C simply touches with a pressure of 3lb. for steering. The machine thus practically runs on B only.

The object in designing this machine has been to place the weight on one wheel only, making the others mere balancing wheels, thus differing from an ordinary bicycle in not employing the back wheel to carry weight. Another, and perhaps even greater, advantage has been secured, as in this machine perpendicular action is fully obtained. Thus it has been found, through practically testing the machine, that there is a very great advantage from this cause, as the machine can be ridden all day, and yet the rider does not get fatigued as on an ordinary bicycle. In this machine the position of the body is much the same as in walking, the rider being able to press perpendicularly on his pedals, whilst in a bicycle, if he sits "upright," he is not perpendicular; but the line in which he sits forms an angle to the rear of a perpendicular line. This is an unnatural position for the human body, and the rider has, therefore, to pull at the handles, not only to drive the machine, but also to support himself, as he is not balanced over his work as in walking. If, on the other hand, on a bicycle, the rider leans over the handles to make the machine run easier by taking the weight off the back wheel, he puts himself in a far worse position for utilising his powers, besides the greater tendency to "go over the handles." The Ideal has the perpendicular motion, combined with practically running on one wheel, and having perfect safety also.

Besides these advantages, there is also the advantage of being able to stop the machine instantly down any hill by a most powerful brake without fear of going over the handles, whilst uphill the rider can "walk" on his pedals; and the weight instead of being thrown more on the back wheel, is, in this machine, still kept on the one wheel. Again, a most important point is that luggage can be carried in front, and the weight still balanced on the one wheel, whereas in a bicycle, where the luggage is carried behind, the weight is thrown on the back wheel, and the machine runs heavily, or, if carried by a knapsack, the result is worse by fatiguing the rider far more, besides the discomfort. Thus luggage carrying has been given up by a great many riders as hopeless. In this machine the luggage is not in the way at all, whilst the weight in this case also is only taken by the large wheel. Another point is that there is no vibration from the back wheel, and the comfort from this can only be appreciated by those who have ridden the machine for a whole day, and at the end of it find their spines have not been vibrating over every mile of the road. This machine rides excellently also on bad roads—its superiority is here thoroughly brought out: in fact, the difference between good and bad roads is not nearly so noticeable as in a bicycle; this is no doubt owing to its running on one wheel without having a little back wheel carrying weight falling into every depression in the road, and bumping the rider up and down.

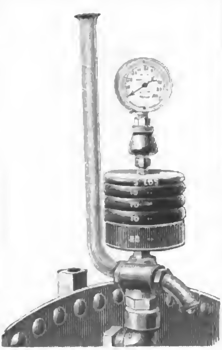


Thus, there are several great advantages claimed in this machine, most noticeably the perpendicular and natural position for the rider, and that it practically runs on one wheel with perfect safety and comfort. Experiments have been successfully carried out, and the machine practically tested up and down steep hills over country roads. The machine will be shown at the Albert Hall this month, and inspection is invited.

E. H. Hodgkinson.

SAFETY-VALVES IN BOILERS.

[20969.]—YOUR remarks on safety-valves in "ours" of the 22nd December, 1882, have induced me to inclose photo. and description of a small warning dead-weight safety-valve which I have been making and putting on boilers for many years. Since 1877 I have made these valves more complete by making the spindle hollow, and placing a water-holder and pressure-gauge on top of it, so that the steam-pressure under it can be seen all the way up to the blowing-off point. I never for a moment thought of superseding the ordinary pressure-gauge placed on boilers by them; but only to make it as nearly practically perfect and reliable of itself as possible. I have had one of these on my workshop boiler for several years, and it is a pleasure to me to notice, as the gauge-pointer gets up to 55lb., the steam beginning to blow down over the top of the fire-door, which, when the fireman sees, changes the position of the damper, or puts on more fresh fuel, or both. The two 3in. main-lever safety-valves on the boiler are loaded to 60lb. I do not remember ever seeing them blowing off; the small valve, with a difference of 5lb. of load, takes that duty entirely on itself. When giving the weekly cleaning it is turned round and round by the hand, so as to see that it is quite free. Should you think the inclosed worth illustration in the ENGLISH MECHANIC, it will perhaps add another to the variety of these small indicators of boiler-pressure.



Wm. Robertson, Engineer.

Dublin, January 10th.

THE EXPANSION VALVE.

[20970.]—THANKING Fred. Walker for giving the readers of the "E.M." such a useful piece of information on using the indicator, and reading the diagrams (letter 20884), I should like to see a letter from Fred. Walker on the expansion valve, explaining in what position the eccentric is placed, relatively to the common slide eccentric; also whether there is any lap or lead given to the common slide when expansion valves are used.

Shaw.

ON THE FLOW OF WATER FROM A PIPE WITH A FLAP.

[20971.]—SOME time ago I represented in these pages experiments made at the mouth of a pipe with a flap, by which it appeared that the water flowing therefrom carried with it a certain amount of air capable of exerting a definite pressure on the flap ("E.M.," Vol. XXXV., pp. 311, 381). But how this pressure was caused I was not able to find a satisfactory reason. The editor of a weekly periodical, in a "note" in that paper, though unable to give a reason for the experiment, remarks that a private correspondent of his "obtains rather different results." What these results are it would be interesting to know; and should that correspondent see this letter, I trust he will communicate his observations to this paper. Since last writing on this subject I have been reconsidering the whole matter, and think the following consideration will in some measure account for the experiment.

Suppose a reservoir full of water to have an outlet at the bottom by means of a sluice arrangement and pipe of some considerable length furnished with a flap. Now suppose the sluice raised through a semicircle: the water will not rush out immediately, but some of the air in the pipe will first find a vent through the water throwing it up in a cascade on the surface: this will continue until the water can overcome the remaining air in the pipe. Let d be the depth of reservoir, then the pressure on the sluice is $d^2 \times$ const. (31·25). Let d' be the diameter of pipe and l the length, then $\pi d'^2 l$ represents the quantity of air in the pipe. Thus at first the pressure exerted by $\frac{1}{4}\pi d'^2 l$ is greater than $d^2 \times$ const. But it is not natural to suppose that the whole of the air pressure will be exerted here, but that part at least will impinge on the flap at the other end and continue for some time to exert a pressure after the pipe is half-full of water. This pressure I have previously shown to be equal to $\frac{W \sin(\theta - \theta_{11})}{\sin \theta_1}$ where W is the weight of the flap, θ ∠ between mouth of pipe and flap, θ_1 ∠ between mouth of pipe and line tangential to the curved surface of water, θ_{11} ∠ horizontal line and flap.

The cascade on the surface of the water referred to I have frequently observed; but the phenomenon at the mouth of the pipe is not nearly so easy of observations, by reason of attending circumstances. It is necessary, for instance, that the flap should work easily on its hinges, and that the wind should be in the right direction and not too strong. However, such pipes being common all over the country, I am led to hope that other observers may obtain some clue to the matter.

C. H. Romanes.

Beckenham, Kent, Jan. 11th.

WHAT SHALL WE EAT AND DRINK?

[20972.]—I NOTICE that many of your correspondents, on the subject of "What to Eat, Drink, and Avoid," seem to imply that man is merely an animal, or even a machine, requiring a certain daily amount of anything that will keep him going. They always refer to the question, especially of drink, as one to be decided by the fact of whether or not one can or cannot do without it. We are no longer, I suppose, to talk of enjoying a good dinner. This is to go out of fashion. How delightful it is to contemplate in imagination a dinner-party at the house of Dr. Edmunds, for instance, each guest with his wholesome tumbler of hot water beside him. Now, I don't know what posterity may come to in the days of Dr. Richardson's "Hygeia," but meanwhile I enter my protest, and I think I do so in the name of ninety-nine people out of every hundred of the present generation, against the mania of running a muck against everything which obtains first score with some restless reformers. Are we to have no more cakes and ale because they are virtuous? The worst of it is that they don't agree among themselves, so that unfortunate people who look to them for advice must starve. Here we have orders to drink only tea and coffee; then we are told they are poisons. One says the salvation of mankind depends on eating nothing but vegetables; another suggests only raw meat. I once positively saw it recommended (in a paper I think in *All the Year Round* some years ago) that infants should be reared on *good wholesome pickles!* I am not joking. Now by all means let us do all that we can to put an end to drunkenness, where it exists; but the reformers of the present day seem to act totally regardless of the fact that, except among the very lowest, this vice is rapidly dying out. As I remarked not long since in the "E. M.," drunkenness is a disease which requires treatment like any other, but it is preposterous to insist on physicking ninety-nine per cent. of healthy people because the hundredth is sick. It often occurs to me that in attempting to put an end to drunkenness, that we quite overlook one side of the question, which our rulers might well deal with. Is not this vice very seriously increased of late years by the fact that all the liquor obtainable by the poorer classes is frightfully adulterated. How was it that our forefathers drank to the extent then in fashion with such comparative impunity, and that we nowadays cannot stand a fourth of what they consumed in the way of wine and beer? Why, simply that they got pure liquor. Let our Government, instead of shillyshallying about the matter, put their foot down firmly on this abuse, and half the evil effects of drink will at once be done away with. There is a great deal in the letter in your last issue, from Dr. Allinson, worthy of attention. All these questions of diet, or most of them, can be answered by a little common-sense. Advice as to eating and drinking may generally be summed up in the few words, "Don't take too much of anything." As to saying that meat or vegetables, or tea or coffee, or wine or beer—for goodness sake let us leave off continually referring to them as *alcohol*—are things to be avoided, I beg most respectfully to suggest that, it is talking nonsense. By all means avoid *too* much of any of them, and if you are a drunkard avoid the beer and wine entirely. If a moderate quantity of these disagree, it is probable that it is from want of sufficient exercise, or from some other evident cause, and as too much beer or wine may disagree, so may too strong tea and coffee. Everything depends on these two little words, "too much." In Australia, thousands of hard-working men drink nothing but tea, and this fact alone answers many questions as to its wholesomeness. A man need not be a Lucullus—there may be too much of good feeding. I must admit, personally, that I enjoy a good dinner, but no dinner would be enjoyable to me with only water; not even if it was warm, and I think that a very large proportion of your readers will be of my opinion.

F.R.C.S.

[20973.]—I REPLY to "Housekeeper's" three questions (49005) as asked. 1. The authority for tannin of tea forming leather with meat is seen in making leather. Skins are soaked in a solution of oak-bark, which contains tannin; the cells of the skins are hardened, and leather is the result. Now substitute flesh for skins, and tea for a solution of oak-bark, and the question is answered. 2. The chemical changes are the soluble gelatine is now made fibrous and insoluble—in fact, meat is changed into leather. 3. In meat teas the meat is not digested thoroughly; but part of it passes away as insoluble matter; that part not acted on by tea is dissolved, while the rest is useless.

Dr. Edmunds made a cruel hit at his own profession when he said that medical men knew no better; but it is true for all that. Doctors are men with an eye to business, and if they find the public like ale, wine, or spirits, then they allow the public to take them. Doctors are very like Members of Parliament, there is no getting them on your side unless you force them to adopt your views or starve. Were doctors foremost in the temperance cause? No. Are they foremost in the vegetarian cause? No. With regard to temperance, they first argued that strong drinks were necessary for man's welfare. Then they said some were best without them; and now they are veering round and saying that alcoholic drinks are not useful at all, neither as food, drink, nor medicine. I am speaking now of the medical thinkers; for amongst doctors, as amongst other bodies, there are a few who lead the rest, and whose word makes a thing orthodox, or stamps it with quackery. In vegetarianism the same thing is seen. Most medical men believe in the absolute necessity of animal carcases for food. Most doctors will inform you that we eat too much meat; some few will say, Well, you vegetarians can live on your diet; and a very very small minority say that vegetarianism is the only true and physiologically correct diet for man. But this dictum of medical men does not stop us vegetists from going ahead; on the contrary, we laugh at these pseudo-doctors, and we have to teach them the rudiments of knowledge of man.

I say with truth that vegetarians taught me more of the science of life than all my professors. Since joining them I have got to know more of man's real nature than I ever did before. I can now say with confidence that I shall never be ill, that is, if I only keep to my present way of living, and what is more, shall not think of dying before seventy or eighty, unless I am cut off by what is called accident. How many doctors can say that? It is a very common thing to hear of doctors being ill and dying before their time. Why? Because they either did not know the laws of health or else did not follow them. The first statement is most likely. At college students are taught the supposed beneficial action of drugs and of the knife; but—and I am sorry to say it—they are not taught the action of food on the system. Allow me to feed a person and I will make him dull and stupid or clever and bright, always ailing, or in uniform good health, and even long or short lived, and all by diet. We are what we eat; so if we eat gross food we must think grossly, and have gross constitutions. If any one doubts my statements about medical men, let him go to three general practitioners and ask them the amount of food necessary per day, and each one will give him a different answer.

The last part of "Housekeeper's" question is soon answered. When pain is present in the stomach, a glass of brandy and water may act in one of two ways. It may dilute the contents of the stomach and so prevent the acrid juices irritating the lining of the stomach, or it may paralyse the nerve filaments of the stomach and so prevent the sensation of pain being carried to the brain. The pain is there all the same, but the nerves cannot send the sensation on to the brain.

In reply to "Dandie Dinmont," I must first remark that "Dandie" is a temperate man, and so objects to being told that total abstinence is the best thing for everyone.

Alcohol is neither a food nor yet a stimulant. It is not a food, since we cannot get fresh energy from it: the way it acts is by causing stored up force to be used at once. It is not a stimulant, since a stimulant must be a substance which gives force to the system; now alcohol does not. What is alcohol then? A pure irritant, causing the heart to beat faster and increase the blood flow. We can give an ordinary example of a stimulant and irritant. A carter may get his horse to go faster by saying "Get along, Dobbin,"—this is a stimulant. Or he may lash Dobbin into a trot with the whip—this is an irritant. Ale is a solution of hops with a little gummy matter and about 5 per cent. of alcohol. If "Dandie" will boil his water or hops, and barley, and add his pure alcohol, he will have a drink like beer.

Wine is alcohol plus colouring matter, an ether, and a bitter principle. The alcohol varies from 10 to 20 per cent. in different wines.

Spirits are alcohol, water, and colouring, and flavouring matter. Allow me to inform "Dandie" that pure alcohol not only taints the breath, but also injures the stomach. It taints the breath since it is exhaled, or got rid of by the system partly by the lungs. It inflames the stomach since it is an irritant. Alcohol is the result of decomposition: a good food is turned into a hurtful drug. Sugar which is a food, is changed into alcohol, which is poison. Alcohol is not found in nature, except as the result of decomposition, and we do not usually eat rotten fruit. The sooner all alcoholic drinks (falsely called stimulants) are done away with, the better for the moral and physical welfare of the human race. Statistics show that total abstainers are most healthful; next come the temperate men; whilst the drunkard is very unhealthy.

T. R. Allinson, L.R.C.P., &c.

2, Kingsland-road, E., Jan. 13.

BRAKE FAILURES.

[20974.]—THE increasing number of failures on the part of the Midland and Great Western Co.'s automatic vacuum brake demands attention. The letters of your able correspondent, Mr. Stretton, have shown this. On December 1st the Westinghouse Brake Co. issued a pamphlet (a copy of which is now before me) describing the results of a series of experiments which have been carried out with the vacuum apparatus, and in which *great care has been taken to insure correctness.* The experiments were made with trains of fifteen and twenty carriages. A Clayton cylinder, having the usual leak-holes, was so arranged that it could be connected at various parts of the train-pipe, and the piston being attached to the recording apparatus, the effective force actually exerted on the piston, as well as the time required to bring the force into operation in different parts of a train, was automatically registered on an indicator-diagram.

One great feature in connection with this brake is the loss of power. This loss of power cannot be prevented, owing to the laws which control the expansion of air. If an absolutely perfect vacuum could be obtained, the upward movement of the piston would not reduce the vacuum in the reservoir; but as a partial vacuum only can be obtained, the stroke of the piston compresses the air remaining, and diminishes the vacuum.

Initial vacuum in inches.	Reduced vacuum owing to strength of piston.			
	4½in. stroke.	Per-centage of loss.	6½in. stroke.	Per-centage of loss.
24	22	8·3	21	12·5
22	19	13·6	17·5	20·4
20	16·5	17·5	14·5	27·5
18	14	22·2	11·5	36·1
16	11·25	29·5	8	50
14	8·5	39·2	5	64·2
12	6	50	2·5	79·1
10	3	70	0	100

The percentage of loss will be seen to be very great, but in reality it is still greater. Owing to the leak-hole, the power begins to diminish before it has had the opportunity of fully exerting itself. Moreover, the power due to the degree of vacuum in the reservoir above the piston, cannot be exerted until the large space formed below by the upward movement of the piston is filled with air. From these causes the effective pressure is still less than before.

Initial Vacuum in Inches.	Effective Vacuum at 4½in. stroke.	Per-centage of Loss.
24	16·6	30·8
22	14	36·3
20	11·6	42
18	9·5	47·2
16	7·5	53·1
14	5·5	60
12	3·4	73·3
10	1·5	85

Thus it will be seen that a driver who runs with 10in. vacuum, thinking that he has power enough to make a very fair stop, has, in reality, scarcely power enough to bring the blocks against the wheels at all.

Captain Galton's experiments upon automatic brakes proved that 30,000lb. of brake-block pressure was required for a carriage weighing 20,000lb. Does the Clayton brake fulfil this necessary condition? The following will show that it does not. In practice, a vacuum of 20in. on the gauge is above the average when running; but even with this initial pressure, the resulting brake-block force is only 13,554lb., or 40 per cent. of what it should be, and in 30secs. after full application this quantity has leaked down to 7,291lb. To obtain 30,000lb. of brake-force would require an *effective* pressure on the piston of the size now used (18in. diam. nominal effective diam. = 17¼in.) of 26in., or 13lb. per square inch. This would require an initial vacuum of 32in., or 16lb., which, of course, cannot be obtained.

The drivers now find it a very difficult matter to keep the maximum pressure of steam in boiler, for the difficulty of releasing the brakes compels constant recourse to the large ejector, and the pressure is sometimes reduced from 140 to 90. Drivers are constantly losing time from this cause, and are fined for so doing. Then they run with no vacuum in the train, in order to keep time; and so they go on—always "out of the frying-pan into the fire." I have a case before me which may illustrate the amount of coal consumed by constantly keeping a large ejector blowing. Two Midland engines, of exactly the same class, and built from the same drawings, are stationed at the same shed. One is fitted with the Westinghouse, and the other with the automatic vacuum.

	Average No. of carriages.	lbs. per mile.
Westinghouse engine..	13¾	27¼
Vacuum..............	10⅝	31¼

In addition to running heavier trains, the Westinghouse engine runs over the heavier road, having a bank of 1 in 100 for 14 miles, while the other engine has a much more level road. Of course, the drivers sometimes make a difference; but it is never so great as this.

In conclusion, I will give an instance of the manner in which this brake deceives the driver. Supposing a heavy express to be running down a heavy bank, at the bottom of which is a station or crowded junction. On arriving at the top of the bank, the driver finds the home-signal off, and, consequently, runs past it. Half-way down, the distant-signal for the junction is against the train, and the driver shuts off steam and puts on the brake, in order to stop at the home-signal, which is at some distance further down. All this time the driver feels the brake leaking off, and the speed increasing; and then, in order to have a good supply of power, he blows the brake off entirely, and quickly recreates another vacuum, which shows 20in. on the gauge. On attempting to stop at the home-signal, he finds that he cannot bring the least power to bear on the wheels, and the train dashes past the signal into another train, and not until he is standing in the middle of a heap of *débris* does the driver know how the brake can deceive him.

The reason is, that the driver, in quickly re-creating another vacuum, exhausts the air on the lower side of the piston *only*. This vacuum is shown on the gauge. It takes some time before there is any vacuum above the piston; in fact, more time than the driver has at his disposal. The finish of the whole business is, that the driver is, at least, fined heavily, and suspended, and probably dismissed, in order to *shield the reputation of the brake*.

I have had, at different times, letters from correspondents who wondered why Mr. Stretton condemned this brake, *which, as far as they have heard, gives satisfaction*. This is all very well: but they judge by the returns made to the Board of Trade. I need scarcely add, that not one-tenth part of the failures of this brake are reported. In fact, the Board of Trade would, at present, do well to head the returns, "Interesting *selections* from brake-failures." **Meteor.**

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[20975.]—(49058) Probably a form of *chorea*. Not further eligible for useful reply.

(49091) Cold Feet.—Not eligible for useful reply, unless upon personal examination.

(49100) Varicocele.—There is no cure for this but an operation, which, in properly picked cases, is a comparatively safe and simple matter. It is caused by varicose veins. Sometimes wearing a carefully-fitted truss gives temporary relief. Cold bathing and the local douche of cold water night and morning are useful.

(49005) Drinks again.—"A Sexagenarian" sends me an interesting private letter on this subject, arguing that "there is more in tea than I have admitted." A letter setting out his views would be of interest to the readers of the English Mechanic. "Housekeeper" still takes issue with my answer as to wine assisting digestion, but avoids answering the question which I put as a virtual answer to his —i.e., Why did our medical grandfathers and fathers bleed, starve, and mercurialise nearly every one who had the misfortune to be ill? My answer is, Because they did not know better; and that is my answer also to the question why so many well-meaning able medical men now prescribe alcohol as they do. The opinions on this subject which I have publicly advocated on all suitable occasions are now being practically endorsed by the practice of the best men of the day; but the question is too long and large a one for me to argue.

"Dandie Dinmont" writes an amusing letter, and appears also to take issue with me, but his conclusions seem to be the same as mine. 1. He "in ordinary practice is an abstainer." So am I. 2. He thinks teetotalers do their cause a great deal of harm by asserting too much. So do I. 3. He thinks alcoholics in large quantities work serious harm. So do I. 4. He thinks healthy persons do not require them, and, therefore, that it is their duty to abstain. So do I. In fact, that is just why I became an abstainer some twenty or more years ago. 5. He thinks that in some cases of ill-health alcoholics may be useful. So do I. He thinks it "abundantly proved that about three-quarters of a pint of ordinary ale is as much as it is safe for a man to drink in a day." So do I. He thinks that "it is in the fact that a glass of ale makes the exhausted man feel a different being one of the greatest dangers lies." So do I. But having thus laid down all the scientific data which make it clear that the duty and wisdom of all healthy people is to abstain, he goes on to argue much as if a sort of Mrs. Gamp still survived within him—the old lady who kept her gin in a tea-pot, and took a little when she felt "so dispodged." Taking up the brief for Mrs. Gamp, he then proceeds to argue that "teetotalers confound the effect of alcohol with that of wine and beer." Possibly. But I have not done so, as he will see on referring to my remarks. Then he urges that none of the teetotal beers possess the slightest value, while they frequently disorder the stomach. In this also I quite agree with him, but how does this prove that alcoholic beers are "*safe*" to acquire the habit of taking—or that they are wholesome even when taken in ever such moderate quantities? Then he says that "teetotalers, even eminent men in the profession, confound the effect of a small dose of alcohol with that of a large one." Possibly. But I have not done so. I hold that the *nature* of the effect of alcohol is the same, whether taken in a large dose or in a small one, but that the amount of the effect varies with the amount of the dose. If "Dandie Dinmont" will show that, while a large dose of alcohol will knock a man down, a small dose will set him up in virtue of the fact that alcohol is narcotic in large doses, but stimulant in small doses, I shall be much interested. This is a common, but, in my humble judgment, an erroneous theory.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

RHEUMATISM AND TEETOTALISM.

[20976.]—Medical men in all ages have been given to "fads"; they take up a fashion, be it an idea as to the cause of a disease, or some nostrum popular for the moment as to its remedy. Just now there are a class of them who have taken up teetotalism, and try to persuade the world that alcohol is the root of all disease. Mr. Allinson's letter (20944, p. 432), gives very admirable general advice, but he is apparently afflicted with alcohol mania, and the only effect of that sort of thing upon moderately-minded people is to make them smile, and disregard good advice mixed up with such weakness. I was myself a teetotaler for years, editor of temperance papers, and so on, and all my life have lived most moderately as to both food and drink, preferring the simplest conditions of life; and I may add that, travelling, as I have, over many countries, I reached 50 years of age without having had an illness, or being confined from my occupations for a day. But, in spite of all this, for years past I have never been free from rheumatism, and at times suffer severe pain from it. If Dr. Allinson tells me this means "alcoholic habits or much good living," I can certainly say that is pure nonsense. As to vegetarianism, will he tell me the mild Hindoo, vegetarian and teetotaler, does not have rheumatism? For myself, I never have taken meat above once a day, and then only in very moderate amount.

Rheumatism is the result of imperfect cleansing of the system, and is brought about by any cause which lowers nervous tone and interferes with the action of the liver. I am quite sure that my own rheumatism is the consequence of several years of Chancery suits.

The temperance cause is a good one, and there can be no doubt that generally people eat too much meat, and, in fact, too much altogether; but the temperance cause is over-weighted with nonsense. The experience of universal man is not to be set aside by the dicta of a few modern medical men taking up a notion that probably another generation will reverse. There can be no doubt that the abuse of alcohol is a fearful aid to crime, poverty, and disease; but it is preposterous to call it the principal cause of these. It is more truly an effect than a cause: it is the result of bad conditions, moral and physical, and then when adopted it becomes an accelerating agent.

But the reasonable use of alcoholic liquids is legitimate and beneficial in very many cases, and generally when the recuperative powers of nature are lowered by advancing age or ill-health. I was myself advised to take a small allowance of whisky, which I do, because I find whenever I leave it off, that in some three days, my nervous system becomes excitable, and digestion and sleep both disturbed; and I take that fact for better evidence than any amount of opinions.

Sigma.

LEGAL REPLIES.

[20977.]—Exhibition—Sale (49107).—If the querist took the cheque for the price of his horns, he has sold them, and there is an end to the matter. If he means to say (and his story is rather confusing) that he refused the cheque, and wants his horns back, he can sue for them in the county-court, and he should sue the person in whose possession they now are. As for his claim to damages because he might have got a prize, this seems too remote. In law, the querist delivered his horns to the custody of the Horners' Company, and they were bound to take care of them, and would probably be responsible for the acts of those in their service. But the querist had better consult a solicitor before bringing any action.

Real Property—Heirs—Legitimacy (49109).—If this property is freehold, then, unless the parents make a will, it must descend to the heir. An illegitimate son cannot be an heir, and so it would go to the eldest son who was legitimate, and then to his eldest son.

Mother—Apprentice—Support (49125).—A mother is not bound to support her son, an apprentice, until he is out of his time, or in any other manner, and her having independent means does not affect the question. But if the mother is a widow, which is not stated, she might have to support her son if he went upon the parish, though not otherwise.

Will—Promissory Note (49129).—This is a very strange story. If interest has not been paid upon the note for the last six years, then, unless there is a written acknowledgment of the debt, the claim is barred by the Statute of Limitations, and the promissory note is worthless. As to the "understanding," which is not a contract or a promise, we lawyers do not believe in "understandings," except that they always lead to litigation. The father had better make his will over again, and deduct the value of the note from the borrower's share, and not leave this understanding to be worked out after his death, at the expense of his estate.

Will—Reading—Execution (49144).—Here is another querist writing of an "understanding" in a will, which is nonsense. Either the will provides as he says it does, or it does not: but nothing can be "understood" upon such a matter. There is no rule or law rendering it necessary that a will should be read at a funeral. Anyone can read a will after it is proved by going to the proper office in Somerset House and paying one shilling. A will must be signed at the foot thereof by the testator, or by some one else by his direction, and it must be attested by two witnesses, who must see the signature and then sign their names in the testator's presence.

Debt—Husband and Wife (49160).—It is clear that the tradesman gave credit to the husband, as he took a bill from him which was dishonoured, and he cannot, therefore, have any claim against the wife simply because she has paid part of the debt out of her own estate. If he had given credit to the wife it would have been different, though before the new Act it was not easy to get at the separate property of married women, and they could not be made personally liable as they now are. So I fear the querist cannot legally press the wife for payment under the circumstances.

Bankrupt—Unfair Preference (49168).—I am not disposed to give the querist any assistance towards his object of unduly favouring one creditor beyond the rest. I may say, however, that a promissory note is no security at all, and that in the event of bankruptcy soon happening, no kind of fraudulent arrangement would stand if it were disputed.

Landlord and Tenant—Commencement (49185).—The mere increase in the rent would not alone create a new tenancy, neither would the coming in of a new landlord if the tenant went on paying as before, so that in this case as stated the original tenancy continues and dates from Michaelmas. The landlord must, therefore, give a notice to quit, expiring at Michaelmas. As to fixtures, the querist can remove all "tenant's fixtures," but what these words comprise would take too long to explain in these columns.

Loss of Goods at Sea (49186.)—As it is usual to insure goods carried by ships the question does not often arise. If a man orders goods to pay for when delivered, and he never gets them, he cannot be liable; if he pays for them first he would generally insure them with the underwriters. But I have generally enough to do without considering hypothetical questions.

Liquidation—Fraud (49190).—By section 11, subsection 14 of the Debtors' Act, 1869, any trader who obtains goods on credit within four months of his bankruptcy, under the false pretence of carrying on business, is liable to conviction for misdemeanour and may have two years' hard labour. But, unfortunately, this and other similar clauses of the Debtors Act, are hardly ever used.

Income Tax (49197).—The assessment is quite right; no further deduction can be claimed, and the collector seems to have acted in the usual way.

Fred. Wetherfield, Solicitor.

2, Gresham Buildings, Guildhall, London.

Blue Marking Ink for White Goods.—Dorvault recommends the following:—

Crystallised nitrate of silver..	1 drachm.
Water of ammonia	3 drachms.
Crystallised carbonate of soda	1 drachm.
Powdered gum-arabic	1½ drachms.
Sulphate of copper	30 grains.
Distilled water..............	4 drachms.

Dissolve the silver salt in the ammonia; dissolve the carbonate of soda, gum-arabic, and sulphate of copper in the distilled water, and mix the two solutions together.

From the report of the United States Commissioner of Agriculture, it appears that 2,500,000 packages of seeds have been distributed, and 250,000 copies of special reports printed by the department. The statistical division estimates the following as the yield of 1882:—Corn, 1,635,000,000 bushels; wheat, 400,000,000 bushels; oats, 470,000,000 bushels: barley, 45,000,000 bushels; rye, 20,000,000 bushels; and buckwheat, 12,000,000 bushels.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48329.]—**Railway Plant.**—During the latter half of 1871, the G.N.R. had 12 passenger-carriages built, at an average cost of £177 16s. 8d. During the year 1874, the M.R.Co. had 58 engines built, at an average cost of £2,923, and 20 composite-carriages, at an average cost of £450. During the latter half of 1874, the L. and Y.R. had 28 engines and 53 carriages built, the former averaged £2,286, and the latter £438. During the first half of 1876, the M.R. had 34 engines built, the G.N.R. 12, and the N.E.R. 71. Those of the M.R. cost £80,000; of the G.N.R. £21,000; and of the N.E.R. £171,000. During the first half of 1881, the M.R.Co. had 10 bogie-carriages built, which cost £548 each; and 30 more, £446 each. Would any reader kindly give full particulars, excluding dimensions, of the Lioness, Tartar, Avon, and No. 391, on the L. and S.W.R.?—E. F.

[48346.]—**Wood Screw Cutting.**—The reply on this on page 411, does not seem to satisfy the querist, but before accusing another correspondent of knowing nothing about it, he should have considered what construction would be most likely to be put upon his question. A wood screw sometimes means a screw such as joiners use for fastening the different parts of their work together, or it might mean a screw made of wood, such as a bench-screw, and these latter are made with a screw-box; that is, a box in which is fixed a knife, which cuts the screw as it is turned in. "H. H." did not describe the tools he had, and he did not say that he wanted to screw a box and lid, which, I take it, is very different from making a wood screw in the ordinary acceptation of the term. Querists should review their own questions before rushing again into print. In order to screw the box for the lid, turn the part to the size of the outside of the thread. A novice would make it a little larger, as if he makes a mistake he can turn it up again. The tools "H. H." has, are doubtless ordinary screw-chasers; and in starting a screw, commence at the right-hand side or tail-end of the lathe; as if you commence at the other end the screw will be left-handed. It is advisable to try on a plain piece of wood before operating on the box; turn the lathe evenly, and at a moderate speed, and move the chaser along the work. In chasing a screw on the plain piece of wood, don't go further than a quarter of an inch at first, as when you have succeeded in starting to a correct thread, the rest will be all plain sailing. The speed of the lathe must be regulated by the diameter of the work and the movement of the chaser; for the inside thread you must alter the position of the tool-rest, and stand so that you can see into the lid of the box. I have never found much difficulty in it—I succeeded the first time I tried, but I made the mistake above mentioned, and the screw was left-handed. If the wood is any way soft (or hard sometimes), don't attempt, after having cut the full thread, to continue the use of the chaser. If the work is too large, take the top off the threads with a chisel and then return to chaser, as when the threads are full cut the continued use of the chaser will be apt to strip them.—Os.

[48483.]—**Henry Lord Clifford (U.Q.)**—Might I suggest to this querist to ask these questions in the *Leeds Mercury Weekly Supplement*, and, most probably he will have an answer.—W. L.

[48492.]—**Swan's Lamps — Gas-Engine (U.Q.)**—I am sorry no one better qualified than I am has answered this query; but to take it out of the list of unanswered queries I will do the best I can. I saw, at Bradford, an Otto gas-engine, ½-h.p., nom., driving a small dynamo, said to be Siemens', but which appeared to me to be like Maxim's. This dynamo was driving 12 16-candle lamps. The armature of the machine was about 10in. long.—W. L.

[48596.]—**Harmonium Reeds.**—In reply to "Henri Etienne," p. 434, I beg to say that what I mean by an "undue force" is an "unnecessary force." It is when the expression-stop is used by an inexperienced player, that the injury is done to the vibrators.—G. FRYER.

[48607.]—**Combination of Levers (U.Q.)**—The querist does not appear to recognise that the spaces passed through by the power and weight are inversely proportional to the power and weight themselves; *i.e.*, if a power of 1lb. will raise a weight of 100lb., the power will have to fall 100in. while raising the weight 1in. This is one of the important fundamental truths of mechanics that it is often difficult to get clearly comprehended.—PLONI ALMONI.

[48689.]—**Lathe-Bed.**—Has not "W. J., pattern maker, St. Austell," got slightly confused with the number of the query he is answering? The sketch he refers to belongs to query 48829. He wants to know how "E. P.," of Liverpool, is going to lift out the sand, in the middle of the mould, "which has a joint as shown in his sketch." I don't think "E. P." intended the line to mean a joint in the mould; in fact, he says as much. I take it to be the depth of the ribs which will be in the casting. He has marked the part as B to clearly show this. I should like to see "E. P.'s" reply to this; and I take this opportunity of thanking him for his reply to my query.—W. H. SCRIVEN, Springfield, Chelmsford.

[48723.]—**Washing.**—All flannel or woollen goods, after being washed in a steam laundry, should be dried by the air of a hydro-extractor; this takes out every particle of water, and prevents them from shrinking.—ALLISON, Laundry Proprietor.

[48725.]—**Steam Laundry.**—The necessary plant and machinery for the above would be regulated by the amount of work you propose to do, also to some extent the quality of the work, and the locality or town you are in. I would suggest you write Messrs. Bradford and Co., of Manchester, for a catalogue of their steam laundry machinery, or, what would be better, pay them a visit.—ALLISON, Laundry Proprietor.

[48729.]—**Oysters.**—Very likely "men of the calibre of Drs. Carpenter and Michael Foster" would be the very first to disclaim any accurately formulated scientific knowledge as to the nature and true working of the recondite principle we call life. Probably, even Mr. Lancaster's exhaustive researches would be considered by them to be merely superficial compared with the deep-seated mystery life is to every thinking mind. I am pleased to see my pleasantries have broken no bones, and am glad to have Mr. Lancaster's explanation of what he would consider a sign of life (he did not specify in his last). Perhaps he will now tell us how he would decide when consciousness exists. For (so finely does life shade off into no life) that very explanation might be taken to mean that a man is not living when he is asleep, and, therefore, unconscious. I fancy my illustration, drawn from ciliary motion, would show that no one set of observed phenomena taken by itself can be considered conclusive on the subject of life or no-life, seeing that life is possible without motion, and movement possible without life. In conclusion I would say that Mr. L. will probably agree that we both, along with the great names mentioned, are too ignorant (profoundly so) of these subjects to make it worth our while to do aught but sit down and learn all we can or are permitted to.—PLONI ALMONI.

[48832.]—**Embossing.**—It is not quite clear what the querist wishes to do; but, to answer him generally, it is done by an arming press. He can emboss in an ordinary way by means of suitable tools, which are applied warm.—T. P.

[48835.]—**Fusible Plugs.**—"T. P.'s" remarks on this question are very likely to lead to serious consequences if this question is permitted to finish here. It is evident he has not penetrated the subject or gone sufficiently into the question, or his views would have been very much different to what they are. In the first place, he states they are a delusion and a snare. I can speak positively to the contrary. In my own knowledge, they have been the means of saving many lives, and preventing a great number of collapses which might have ended in serious explosion and great destruction to property. Now, I have had a fair, varied experience of the different waters of the United Kingdom, and I go so far as to say that some of these waters are entirely unfit for boiler purposes, unless the tubes and fireboxes are fitted with fusible plugs of a suitable description. Some people, and even prominent engineers, consider it impossible for overheating to occur whilst there is several inches of water above the tubes or fireboxes. Now this is entirely erroneous. There are certain precipitations that are always dangerous; and when boilers are fed with water containing these ingredients, and the fireboxes or furnaces are fitted with plugs, I am quite aware they are constantly blowing out; but this is not the fault of the plug. It is necessary to ascertain the actual cause; then we may endeavour to make a cure. I must admit there are many fusible plugs put into boiler furnaces that are entirely unworthy of the name, inasmuch as, in some cases, the alloy is compounded without for one moment ever taking into consideration its fusing point. There is one point which is frequently neglected — that is, cleanliness. A fusible plug ought to be cleaned as often as possible, both inside the boiler and also on the fire side. One moment's consideration will explain the necessity of this. Now, in choosing fusible-plugs, a few hints may be of service to many readers of this valuable issue. 1. Large openings are always essential, so that the incrustation offers no impediment to the steam. 2. A fair medium depth of alloy between fire and water-side. This is found in practice not to be so easily burned; consequently, fuses with certainty at a given temperature. 3. Large pieces of alloy should never be inserted; all fusible plugs ought to have a centrepiece of gunmetal or brass. 4. Plugs that are susceptible to leakage are always objectionable and unreliable. Fusible plugs are easily obtainable with all these good qualities. If suitable plugs are applied, and trouble is experienced from them, it is quite time attention is drawn to the nature of the water. If grease or other fatty substances are used, exclusion of this at once is necessary, frequent blowing out to keep the water as pure as possible, and numerous other things which are easily solved with due and careful consideration. It is found by practice that plugs that have a deep alloy in them, are quite safe under constant fire, from two to three years. Plugs that have nothing more than a piece of sheet alloy, or a thin block, should be changed about every three months. But these are never so reliable. The service the fusible plug has rendered to the public generally, is such that no boiler ought to be turned out of the boiler-yard without one. This is in reference to internally fired boilers. I give the above reasons in favour, independently of low-water.—B. W.

[48835.]—**Fusible Plugs.**—Much has already been said on this important fitting, as I consider it is of importance when perfect and properly attended to, which unfortunately seldom is the case. When of good construction and new, they are reliable; but my experience is similar to that of "L. O. V.," and our thanks are due to him for his slight experiment, which is that, after being in about 8 to 12 months, the alloy, which should be fusible at 300° to 400°, is scarcely fusible at all in an ordinary fire. I have actually seen a copper disc melted out of the centre of a so-called fusible plug, while the fusible metal has been left intact. The cause of this change of nature I should very much like to know, and trust some of our chemical readers will take the matter into consideration and give us the cause of the change. It is well known to all employed where they are used that there are constant cases of collapse, distortion, or overheating without the plug giving warning—no doubt due to the age of the plug. Melting out with water level above them may be due to several causes—spheroidal condition of water where heavily fired, flowing deposit in feed-water, grease in feed-water, and neglect in cleaning carbon from fire side or scale from water side, by which means alone it can be examined, as I have known cases in which plugs have become leaky, and on at once paying boiler off and clearing the plug there has not been the least trace of fusible alloy, but the space found full of hard carbon and scale, with just a slight passage made by the recently-found leakage, the fusible metal having disappeared in the following manner:—The fires have been drawn and boiler blown out, when the heat in the hot fire-bars and bridge have been sufficient to melt the fusible alloy, which has run on to the fire-bars, the opening still being sealed by a coating of incrust on the water side, and the fire side rapidly fills with carbon, and so permanently seals what should be the fusible plug, until the incrust is accidentally or otherwise removed, and the water gradually percolates through the carbon, and so causes the leakage. Other failures may be attributed to this and similar causes. There are a number of patent plugs, all of which have their advantages and disadvantages. The "Smith's" double-cone and "Smith's" siren-cone, the "Bailey," "Allen-Harrison," and "Saxon" being among the best known. One defect is, difficulty in renewing the alloy, so that they are used another three months, and on again another three months, before they are sent to be refilled. Another defect in one plug, is being able to renew by placing a piece of common sheet-lead over the holes in seating, which is sometimes so thin that it will not stand the boiler-pressure, and so the metal is forcibly blown through the holes. It is surprising to see anyone ask why they should be above the crown of the furnace, for to fix it at level of furnace-crown would be the height of folly, as the crown-plates would be overheated, and probably collapse at the very moment the plug could be expected to give warning; and so the warning would be too late. If "Manufacturer" can make plugs (patent, of course), and with each plug give a guarantee that it will be efficient and reliable, and not change its nature, as it were, for three years, it would be a good stroke of business for him to introduce them, and it would be a benefit to the steam-using public, and, with all the patents now out, there is still room for a better; for, as "L. O. V." states, they all invariably lose their nature after being in use a few months, and although loose, spare caps are supplied with most plugs, they are neglected; and I should much like to see the question taken up by someone qualified to deal with it, and tell us plainly what causes the change of nature; or, if there is no change, why will not patentees guarantee their own make of plugs for longer than six to twelve months?—BOSWELL.

[48840.]—**Thermopile.**—There are several thermopiles described in back volumes; but as to demonstrating the heat produced by the contraction of muscle, would you not be putting yourself under the Vivisection Act? However, some physiological experimentalist must answer that part of the query. You will find directions for making the thermopile on p. 119, Vol. XXXIV.—S. M.

[48849.]—**Rack and Pinion.**—My way of setting a rack to a pinion is simply to plane up the piece of wood I intend to make the rack out of; then I take my pinion and rub a little black oil (or ink will do as well) on the edge of the teeth all round: then roll the pinion on the piece of wood rather hard, and you will have your rack marked out exactly to match the pinion ready for cutting, from the indentation the pinion has left.—W. H. TOYE.

[48852.]—**Dyeing.**—"Amateur" should state the material of which his canary-coloured stuff is made, for it makes all the difference whether it is of vegetable or animal origin. There is a process for black or mixed fabrics in No. 840; but if "Amateur's" stuff is silk or wool, he can easily dye it a brown by means of the aniline dye of that shade. The old-fashioned methods of dyeing require so much in the way of plant and dye stuffs that are not readily procurable in small quantities, that it is always cheapest to send the material to the dyeworks, for there, working with large quantities, they can do the actual work at about one-tenth the cost of the dye-stuffs to the amateur. —P. D. W.

[48864.]—**Electric Signs.**—You will find a description of these in No. 790, p. 239. Perhaps you do not allow swing enough, or have not sufficient battery power. The special cell used was illustrated on p. 454, No. 799. See an illustration on p. 41 of last volume, which will show the method of arranging the parts.—E. G. M.

[48872.]—**Saw Table.**—There is an illustrated description of a machine on p. 362, Vol. XXVIII., which has a table so arranged that the wood can be cut square or to any bevel. I think you might get a hint from that.—T. P.

[48883.]—**Air-Gas for Gas-Engine.**—Very doubtful if it could be done with benzoline. Petroleum is used in the Brayton engine. Will not the Dowson system suit you? It was described in No. 891.—ESSAR.

[48914.] — **Tea and Coffee after Meals.**— The simple explanation of the unadvisability of taking these drinks soon after dinner, or of using animal food at the usual tea-time, is that the tannin which is contained in the theine and caffeine, has not a softening (digestive) effect on flesh meat; but, on the contrary, a hardening one—just as the tannin of oak-bark hardens leather.— H. O. B.

[48942.]—**Telegraph Instrument.**—To MR. LANCASTER.—I am sorry to again trouble you; but I do not understand what sort of fork is to be used, or where placed. Kindly excuse my obtuseness and explain more fully.—REGINALD HANNEN.

[48951.]—**Drawing.**—There are several contrivances made to obtain copies of drawings; the one perhaps that you refer to is a piece of plate-glass placed vertically on one side of a drawing, through which the drawing may be seen by reflection apparently upon the piece of plain paper; but this is not a truthful means of reproducing outlines, even of photographs. The best method you can adopt is to take another photo, the size you want, and print from that; or, if you wish to make an enlarged drawing, then the best method is to take a lantern transparency, and with a lantern enlarge it on to a screen on which your paper or canvas may be stretched, and you can draw with pencil or crayon just as much of the image as you may require.—W. J. LANCASTER.

[48984.]—**Street Medical Coil.**—The rotating-wheel is old; put on your machine something new. You can, with little trouble, make a swing, or you could arrange an attractive small racecourse, with horses running round, or make a see-saw, or again a dancing clown. The public have become used to mere rotating-wheels, even if they ring bells. You might put on a peal of eight bells, and have a barrel to make contacts to play a tune on the bells. There are a lot of things very attractive that you might apply.—W. J. LANCASTER.

[48993.]—**Yellow and Red Timber.**—All the replies given to this query are more or less incorrect. Especially so is "Shipwright" when he says that "Dantsic or Memel fir is often called red pine." The woods are nothing at all like each other, and belong to different species. "Yellow pine" has been correctly described by both "G. J. H." and "Shipwright." "G. J. H.'s" mistake lies inconfounding yellow pine with what the querist means by "yellow deal," which are also totally different woods. "Timber Merchant" is incorrect in saying "these are identical." If "Timber Merchant" had said that what "the Swedish and Russian shippers call redwood contains two species, which are not distinguished in some parts of this country," I could have borne him out. I suspect that the difficulty which "Devoniensis" has encountered is to know whether "yellow deal" and "red pine" are one and the same wood. They are not. Now, as seeing specimens of these woods is a much better guide to their discrimination than any description could be, and as I have large quantities of them in the saw-mills under my charge, if the querist or any of your correspondents care to address me, I would send them specimens of one or all of the following: fir timber, red pine timber, red pine deal, or yellow deal.—W. J.

[48993.]—**Yellow and Red Timber.**—I am afraid the inquirer in this case will have some difficulty in gleaning the information he wants from the apparently contradictory answers given. If the "timber" he refers to comes from America, it is called pine. Yellow and red pine are "perfectly distinct kinds of timber." If the timber he inquires about comes from the North of Europe, it is in this country called yellow deal; and in the countries from whence we receive it it is called redwood. Thus yellow and red pine are two distinct woods; but yellow and red deal are not distinct, but identical. "G. J. H." is mistaken in supposing that yellow pine is now scarce; it is the wood in general use in the United States and Canada for housebuilding, and several millions of pieces are yearly imported into this country. The present enormous consumption will, no doubt, cause scarcity at some future time; but there are ample supplies at present. "G. J. H." says red pine is invariably used for window-sashes and frames. The wood is, no doubt, well adapted for such purposes; but I have never known it so used in the South-East of England, where sashes and frames are made of yellow deal—a very suitable wood, and cheap. I may say that I do not, in the flooring trade, know of the distinction "G. J. H." refers to. The red flooring bought in Norway and Sweden is sold in England as yellow flooring, the only difference being in the name. I ought, perhaps, to mention, that the woods we call yellow pine and red pine are, in Canada and the United States, known respectively as white and yellow pine. Both are, of course, quite distinct from pitch-pine.—TIMBER MERCHANT.

[48999.]—**Electric Light.**—Forty Bunsen cells will light two 20-candle Swan lamps, or four 10-candle lamps. You can have lamps of much lower resistance than Swan's. I have a lamp which, when white-hot, has a resistance of 6·7 ohms only, and with this I have obtained 25-candle power with one dozen cells. Jablochkoff's candles you could only light one with 40 cells, and even then not satisfactorily.—W. J. LANCASTER.

[49006.]—**Bichromate Battery.**—You can light a five-candle Swan with eight bichromate cells, made up of carbon and zinc plates, not less than 5in. by 3in.; the carbons should be about ⅜in. thick, and the zinc $\frac{3}{16}$in. Such a battery of eight cells could be made up at a cost of about 12s. for carbons and zincs, and salt or jam-jars would do well to contain them.—W. J. LANCASTER.

[49010.]—**Hardening Plaster Casts.**—"Auld Reekie" asks what sort of casts? Well, casts used for models, sometimes large and sometimes small. I have only used plain water in mixing the plaster, and oil the moulds with soft-soap thinned down with water, and put on with a brush, largest cast being about 4lb. to 5lb. of plaster. Thanks for other replies, which I will try.—ALFONSO.

[49021.]—**Exposure.**—There is no method of making any accurate table as to the exposure required by any lens. All this must be ascertained by experience. I have made some thousands of lenses, and any two may be taken out of precisely the same glass, and worked to the same curve, and they will not work at precisely the same speed: one may be a little thicker than the other; but, of course, it is possible to select two that will work in unison.—W. J. LANCASTER.

[49024.]—**Stains or Dyes for Woods.**—Try Crawshaw's dyes, dissolved in water, allowed to dry, and varnish.—DUCROW.

[49024.]—**Stains or Dyes for Wood.**—Many thanks to "S. M." for his reply. I will try permanganate of potash, which I think is likely to answer. Stephens' stains are effective when varnished, but readily wash off if unprotected. A weak solution of sulphuric acid bleaches the wood rather than darkens it. Since inserting the query I have been reading Dr. Ure on dyeing, and think it probable some of the processes used in dyeing calico may be successfully applied to wood. The simplest browns appear to be decoctions of oak-bark and walnut husks.—DANDIE DINMONT.

[49026.]—**Geological Query.**—You must have mistaken the words spoken by the lecturer. It is both contrary to common sense and geological data. That land rises, and consequently suffers denudation is true; that land sinks, and receives the products of denudation is also true; but that denudation begins first is quite too absurd. The cause of elevations and depressions are due, not to alteration of the surface stratum, but to alteration of strata more or less below the surface.—W. J. LANCASTER.

[49029.]—**Parallel Beam from Lantern.**— "C. R. T." seems to have two mistaken ideas. In the first place, a strictly parallel beam can only be got from a point of light, and an approximate one from a small source, such as the limelight; in several places I state that it cannot be got from a gaslight. The light is adjusted just in the principal focus of the condensers, where the rays of the sun would be condensed to nearly a point. But, secondly, even a nearly parallel beam, or the sun's rays, will not, after passing through a slit, produce a sharp image of that on a screen. The illuminated slit must be "focussed" by a lens, like the slides in the lantern, as I clearly explain and show by diagrams. "C. R. T.'s" three-wick light must, anyhow, produce diverging rays; but he can, nevertheless, get his slit sharp on the screen, and do spectrum work—which, I presume, is his object—with a focussing lens, which is used in all such work. The position of the light (with a jet and lime cylinder), for parallel beam is a very little nearer the condenser than what gives an image of the lime surface on the screen with condenser alone.—L. WRIGHT.

[49029.]—**To Mr. L. Wright or Mr. Lancaster.**—The easiest method of obtaining a parallel beam from a three-wick lamp is to use one lens for the condenser, and a second condenser just beyond the focus of the larger condenser. Thus a 4in. condenser, 6in. focus, would be used in lanterns, and after the rays have crossed, a 2in. or smaller diameter lens of 4in. focus will give you a parallel beam. As I do not know the distance your lamp is from condenser, I cannot give distance of front condenser from 4in.; but the lamp must be sufficiently back to give a convergent cone from condenser, which, having crossed, is made parallel by the smaller lens. You may use the double condenser; then lamp would be nearer; but the parallelism would not be so perfect.—W. J. LANCASTER.

[49030.] — **Locomotives.** — Many thanks to "Essar" for his reply. What I wished was more of a table, giving, for the sake of comparison, something like the following particulars for a few of the principal lines (say, for example, L. and N.W., M.R., G.N.R., and G.E.R.), or sections of these lines:—1. Average consumption for express passenger trains. 2. Class of engine working this traffic. 3. Average load. 4. On the whole, what sort of road is this result obtained on? In fact, any important conditions, for or against, that are likely to influence the consumption to any extent.—McK.

[49033.]—**Electro-motor.**—You will find lots of information about motors in back numbers. Thinking about the Portrush and Giants' Causeway electrical railway, which is practically the first electrical railway, it has struck me that we must have some readers residing somewhere on the route who could give us a full account of the whole thing; in a few short years such an account would be read with as much interest as that referring to the Darlington and Stockton railway. The Portrush experiment has the elements of success in it. A short distance, under seven miles I believe, a capital of £45,000, several excellent rivers to drive the turbines, in turn to drive the cars, a good three feet steel rail laid on a ready made road, no heavy gradients—all this promises well, and I, as a reader of the MECHANIC, should be very pleased to read the contributions of anyone in the locality. I, of course, have seen several short lengths of electrical railways, but nothing that has been laid down as a permanency. The car in Paris, which in two months carried 82,000 passengers, was a very pretty experiment; but, of course, we have no data of the cost. The Portrush railway is to cost 1d. per mile for working; this compared to 7d. per mile for steam, and 11d. for horses, is a great reduction in working expenses, but no return of cost has yet been published. We shall look out for the first report with pleasure. —W. J. LANCASTER.

[49037.]—**Kaleidoscope.**—You can, of course, make a kaleidoscope of any size; but it is not well to have any great difference between the bottom and top, especially when the length is short. I would not have the larger and lower end more than twice the diameter of the upper end. You must obtain the best glass you can get, and blacken the back, or you will have a lot of extra reflections.— W. J. LANCASTER.

[49039.]—**Incombustible Paper.**—Use paste made with a fair supply of alum. The addition of alum causes the paste not to thicken so well, and requires much more flour.—F. M.

[49047.]—**Solder for Iron and Brass.**—Tin the iron with the following amalgam: Rub in a mortar a little sodium and mercury, till they unite with flame, then add a little tinfoil. This amalgam readily adheres to any kind of iron or steel. The sodium should be washed out with water before soldering. Any solder will then adhere. I find microcosmic salt better than borax in many cases. —J. HARGREAVES.

[49047.]—**Solder for Iron and Brass.**—Use hard, long-grained, tin-solder, say one of lead to two of long-grained tin, using killed spirits of salts as a flux. This, if well done, and properly "sweated in," is remarkably strong; but both must be thoroughly clean, and first tinned with a well-heated iron.—Ajax.

[49049.]—**Burnt Sugar.**—If "J. M. S." will filter his spirit after he has added the burnt sugar to it, he may find that the spirit has retained sufficient colour to suit his purpose; but of course I don't know what depth of colour he requires. I found that methylated spirit (60 o.p.) retained sufficient colouring matter to make it about the colour of brandy; but I have no doubt I could have made it still deeper.—E. G. T.

[49050.]—**Pumps.**—Would "Brakesman," p. 438, kindly give me the number of revolutions per minute his pumps work at, and the length of his suction-pipe, and oblige—Engineman?

[49058.]—**Medical.**—Judging from the description of symptoms, sent in your issue of Jan. 5th, by "Anxious Father," I am inclined to think the case parallel to one that came under my notice some years since. The daughter of a friend of mine, aged 17 years, suffered from St. Vitus's dance. After unsuccessful treatment from various medical men, her father decided to take her to St. Bartholomew's Hospital. I should state that the fits had increased daily in number and violence. The day after she was received in the hospital they reduced number of fits, and after being in that fine institution six weeks, she came out perfectly cured, and has never had a return of that illness. She is now a perfectly healthy woman.—Willing Subscriber Hospital Fund.

[49060.]—**Vice for Bench.**—Acting upon the suggestion of "Parallel," I have much pleasure in furnishing the sketch and particulars asked for as to the American double-jawed vice. It is not a novelty, having been patented in 1875, though it is certainly not so well known in this country as it deserves to be. It consists practically of three parts. That marked A comprises the two front jaws, with the draw-bar in one piece, with the screw passing very loosely up a cylindrical hole, which is bored through the draw-bar from end to end. B is the back pair of jaws only, with oblong hole through the centre accurately fitting the draw-bar; the back portion of B is turned down so as to form a solid shoulder with a nozzle, which fits quite true in a circular socket turned out of the front face of C. C forms the base, by means of which the vice is fixed to the bench; a portion of its upper surface is planed off flat, forming a useful anvil for riveting, &c., whilst the back portion carries the nut or screw-box. This nut may be described as a long tube, the external portion of which is nicely fitted to enter the hole in the draw-bar, and its internal surface carries a strong square thread fitting the screw of the pin. B turns quite freely in C, of course carrying A round with it. To keep B from dropping out of its seat, a small deep groove is turned in the rim of its back nozzle, and a long screw is passed through the corresponding portion of the socket in C, entering the groove, and, whilst effectually securing B in its proper relative position, allows it to rotate freely. Twelve holes are drilled in the back face of the shoulder of B, and a small spring bolt, fitted inside the anvil, and drawn by a knob projecting from the side of it, D shoots into whichever of these holes happens to be opposite to it; so that the jaws can be set in any of these positions 30° apart, and will not shift unless the bolt is drawn for the purpose. The jaws can, however, be placed in any intermediate position, and are perfectly rigid as soon as they are screwed up so as to grip. One pair of jaws has the inner face smooth, and the other pair is roughed in the usual way. In addition to the great advantage of being able to use either pair in any position, it is possible, in many instances, to grip the work with both pairs of jaws at once; the result being that a very firm hold is obtained with a remarkably slight degree of pressure, to the obvious advantage of the article under operation, be it of metal or of wood. I can speak of these vices from some experience, having had two of them in constant use for about five years. One of these, with 3in. jaws, has been subjected to the rough usage which such things meet with in a smith's shop, and beyond the knocking off of the knob of the spring-bolt, it is still in good order; the other, a small one, with 2in. jaws, I fixed upon the end of the bed of my lathe, and find it invaluable. Many others have passed through my hands during this period, amongst which some very large ones—4in. jaws—were fitted in a brass foundry for the use of the hinge-finishers, and the only complaint I ever heard was that the men in other departments became dissatisfied with their ordinary bench vices in consequence. I need add no more, except, perhaps, to mention that the vice is known as "Penfold's" patent, and that, no doubt, it may be obtained without difficulty through any of the now numerous importers of American hardware.—R. T. Lewis.

FIG. 1.

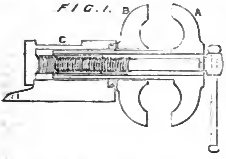
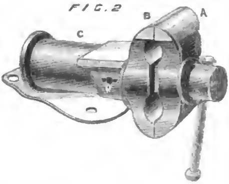


FIG. 2



[49061.]—**L. and N. W. R. Engines.**—The Ida class were built at Crewe from about 1852 to 1857, designed by Mr. Trevethick, and are known as "large Trivies," to distinguish them from a similar but older class called "small Trivies."—W. P. B.

[49063.]—**Manganese Batteries.**—I use, as a rule, either three or four pint cells with each coil, and these work well for a long time without requiring any recharging. I prefer a couple of pints, rather than one quart cell. More is got out of the two pint cells for medical purposes. The agglomerate cells work well; but I have not had them in use so long as the ordinary manganese cell.—W. J. Lancaster.

[49068.]—**Induction Coil.**—I can only say that "Sigma" is quite correct as to the silk-covered wire. No one would believe the difference between silk-covered and cotton-covered primary. I should prefer 36 wire for secondary all through; keep the remnants you have for other apparatus, and buy 1½lb. to 1¾lb. of 36 silk-covered wire. Solderings are never effective; that is, they always impair the work of a coil, and while you are making, you had better do the work well.—W. J. Lancaster.

[49071.]—**Induction Coil.**—You shall have them. I did not want to send first until I knew I could go on with them. The busy lecture season is nearly over, and I hope to have a few evenings to spare very soon to commence and go on with the articles. I am sorry I have been unable to write them before now; but there is a limit to one's output. My friends tell me I am burning the candle at both ends; but I tell them I have never met with a case of death from hard work—plenty from no work at all. How I envy the men who have nothing to do—men who curse their fate, with means, but without brains. I don't want their money, only their time. A friend of mine was buying some books; the seller brought out volume after volume, until my friend asked this pertinent question: "Do you sell time?" He would have bought heavily, so would I.—W. J. Lancaster.

[49073.]—**Electric Clocks.**—"Progress" wishes to make his long pendulum actuate the train of wheels in his clock, instead of the wheels operating upon the pendulum; then, providing the escapement wheel can arrange upon friendly terms with the pendulum, let him adopt the idea of the late Alexander Bain, and make a coil of about 4lb. of 22 or 24 copper wire, covered with silk or cotton; this must be fixed just over the bob on the staff, and arranged to closely vibrate over poles of the same name of 2 steel magnets. A break half-way up the pendulum staff will establish and disestablish the current. This contact-break must be of pure gold to be of any use. Some rough carbon clinkers, imbedded a few feet in moist soil, at a short distance from a zinc plate, 2ft. square, also buried in the ground, will constitute a galvanic cell that will drive such an electric pendulum if delicately suspended on 2 springs. I suppose this is what is referred to as earth battery, which cannot be obtained for any tension effects. If this is not sufficient, I will send sketch of my electric clock, with sizes, etc. But I question if the outlay will repay "Progress" for his trouble. Mr. Bain, the inventor, did not make a fortune over his discovery.—Electra.

[49074.]—**Stained Glass.**—You can make a good imitation of stained glass with plain collodion containing Judson's dyes. Dissolve the colours you want in separate bottles of collodion, and allow the undissolved portions to settle, then paint with a brush on the glass. Of course these dyes will bleach more or less when exposed to the sun's rays.—W. J. Lancaster.

[49081.]—**To Poultry Breeders.**—Choose the eggs which are blunt at each end, and you will find you will be all right; the eggs which have a sharp end and a blunt one will be cocks, the other eggs will be pullets.—M. P.

[49083.]—**L. and S.W.R. Goods Engines.**—Anglia, 226; Scotia, 224; Hibernia, 225; Cambria, 222; Medea, 54; Montrose, 151; Giraffe, 22; Bison, 49; Stonehenge, 16.—Clyde.

[49087.]—**Equatorial Circles.**—"Tyro" must first attend to the mechanical fittings and adjustments of his equatoreal. The optical axis of his telescope must first be made to coincide with a plumb-line, then the cradle intended to carry the telescope must be fitted to it, so that the two bearings on the declination axis (attached to the cradle at right-angles) are perfectly level one with the other, and these should preferably be of equal diameter. The decl. axis must, in fact, be fitted square to the tube in every way. Next, the polar axis must be put in a lathe, the bearing-collar turned up true, and perhaps slightly coned, the disc fixed on the upper end, turned flat on the edge and flat on the upper side, but the under side dished, so that the outer ¼in. zone only makes a bearing on the lower disc; if these be of wood, a polished plate of brass or zinc should be between to diminish friction. He will require to know his latitude, in order to approximately fix his polar axis at the proper angle, that the disc on it may revolve in the plane of the celestial equator. When he has the mechanical adjustments correct, he will find in Horne's "Hints," mentioned before, ample directions for completing the celestial adjustments; also in Browning's and Calver's books, but more fully described in the first. The bearing-collars on the decl. axis must work in V-bearings, one of each placed at opposite sides of and upon the disc on the decl. axis; so adjusted that on levelling the disc the collars shall be level, and still be so when the decl. axis is reversed end for end. Hinged metal straps and thumbscrews must be fixed over the V-bearings to keep the declination axis in its place. These screws and straps can also be used for clamping. If the stand be a tripod, he must fix at three points in a circle, a level stone pier let in the ground, so that No. 1 shall be south of the other two, which must be east and west of it. If a wooden or iron block stand, three equi-distant screws can be used; when in position, the south one will elevate or depress the polar axis a few degrees, and the others adjust E. and W., as required. As regards any little point which is not clear to him "Tyro" must write again; or, if he will advertise his address, I will write to him. I am simply an amateur like himself, but I feel a pleasure in helping any querist if I can. I would lend "Tyro" two numbers of Vol. XV., which contains articles by our esteemed correspondent, "F.R.A.S.," with a subsequent correction.—J. C. L.

[49093.]—**Making Pencils.**—The manufacture of lead-pencils is a more intricate process than the novice would think. The lead is first pulverised by means of crushers, similar to those builders use. It is gradually worked up into a paste, then placed into a case with a small, square aperture at bottom, through which it is pressed by means of a lever. The composition or lead is nipped off in lengths as required, placed in a grooved shelf, after which it is put into a furnace or oven, and subjected to a great heat. The lead is then ready for insertion into the grooved wood.—Greta.

[49093.]—**Making Pencils.**—Pencils are made either by sawing the blocks of plumbago into squares of the size to fit the grooves in the wood, or else by mixing powdered plumbago with an equal quantity of pure washed clay, and then moulding into desired shape, and finally tempering by heating, surrounded with charcoal or sand, in a covered crucible. Crayons are made in a similar manner, using pipeclay and omitting the tempering process; using the requisite colouring mattter instead of plumbago.—E. G. T.

[49105.]—**Artificial Leg.**—In reply to this, if I knew your address in London, I could get a friend of mine to call on you before he leaves the City next week, and who could give you a good deal of information. Not having seen the description mentioned, I cannot get him to state what I might say just now regarding it; but, from his directions, give the following, as I am answering other queries:—"There are a multitude of designs, which it would take pages of the 'E. M.' to contain; but," he states, "out of all, there are only three or four any use." He states that "the steels cannot be got, unless from a maker, and the price of same range from £2 to £5 per set, according to the pattern and make. Steel rivets are best; but iron might do for plain work." His suggestion is, "you had better buy one made, like secondhand or a misfit; in latter the steels are as good as new, and are often sold very cheap. They could be taken off and 'reset' to suit. This would be the cheapest means for you to get the steels, and are seldom anything the worse, even in secondhand work, if well made at first. But if you could afford to go to the expense of a new article, made by a really good hand, of great experience, would be best, cost of same being about £5 and upwards; but practical makers sell much higher if they make a speciality of this particular branch."—CHAS. THORPE.

[49108.]—**Voss Induction Machines.**—The hole in the plate should be cut by a glazier on a proper centring-table. If the circle is cut with the diamond, and two or three cross-cuts made, the piece will come out in an instant. The Leyden jars could be made of test-tubes, say 1in. by 5in., and about an inch and a half near the bottom covered with foil. They should be kept well away from the glass plate, but their position is of no moment. A detached jar connected inside to one conductor, and outside to the other by wires, would answer just as well. The arms for the brushes are formed with double ends to grip the plate, and cemented to it; they are connected to the neighbouring foil disc.—SIGMA.

[49108.] — **Voss Machine.**—Whilst leaving other questions to those to whom they have been specially addressed, the following description of a simple glass plate boring machine that I have seen may be of service:—Take a piece of quartering 2in. by 2in. and 2ft. long, and another piece 2 by 2 and 9in. long; screw or bolt the two together, leaving about 3in. of the 9in. piece projecting; on the part where the two pieces are in contact, erect a spindle to carry a driving wheel; on the end of the 2 by 2 piece fix at top and bottom a piece of iron or brass plate with a ½in. hole in each to carry the spindle of the cutter, which spindle may be of ½in. iron; at the bottom end of the spindle cut a thread for about a ½in., fix a sheave on the upper part of this spindle, and at the bottom screw on a cutter, which may be for a ⅜in. hole a piece of brass tube of ⅜in. diameter; in some convenient place in this tube a hole is made, so that it may be fed inside with emery and water; a few weights are required to be placed in the spindle above the sheave to give the necessary pressure; a driving band is added, and the affair is complete. This machine will cut holes up to 2½in. in diameter or more, according to the size of the tubular cutter. The machine being together and secured to a bench by the 3in. projecting piece of the 9in. piece, secure the glass-plate to the bench so that the place of the required hole is exactly under the cutter; put some emery and water inside the cutter, work away at the driving-wheel, and in about a quarter of an hour a clean hole is cut in the plate. The arrangement being fixed in position, the only care required in working is to keep plenty of emery and water supplied to the inside of the cutter.—H. B. T. S.

[49113.]—**Minima of Algol.**—I append a list of those visible during the night hours of the first quarter of this year.

	h.	m.	s.
January 25	18	20	45
" 28	15	9	40
" 31	11	58	35
February 3	8	47	30
" 17	16	52	5
" 20	13	41	0
" 23	10	29	55
" 26	7	18	50
March 9	18	34	30
" 12	15	23	25
" 15	12	12	20
" 18	9	1	15

If "More Light" wishes to extend the above list, he can very easily do so in the following manner:—To the last minimum given add 2 days 20 hours, 48m. 55s., which is the exact period which elapses between two successive maxima of Algol. Repeating this process *ad libitum*, he will get a long list of minima, a large proportion of which occur during the daytime. He can then pick out those which occur during the night hours, and, knowing the times at which Algol sets in his latitude, those which he can observe.—A YOUNG ASTRONOMER.

[49112.]—**Crest.**—All legitimate male members of a family are entitled to bear the crest of the family. Widows and unmarried women are not allowed in strict heraldry to use crests.—KENNET WEBB.

[49112.]—**Crest.**—All the sons of a family are at liberty to use the family crest, but there are certain special marks (I forget what they are called) which are used to distinguish the younger branches of a family. Heraldry is rather an interesting study, and I would advise "E. R." to read an elementary work on that subject; he will have no cause to regret it.—OS.

[49112.]—**Crest.**—A father's crest is borne by all his sons as well as his coat-of-arms. The crest is the same for all, but the coat has a "difference" for each son. I have heard it stated, but am not sure of the fact, that as a "difference" would not be distinguishable at a short distance, say, on a field of battle, the different sons were wont to take different crests. In this case, very probably, the eldest son would take the father's. The "differences" borne in the shields by the different sons are as follows:—1st son, a label; 2nd son, a crescent; 3rd son, a mullet; 4th son, a martlet; 5th son, an annulet; 6th son, a fleur-de-lis; 7th son, a rose; 8th son, a cross moline; 9th son, a double quatrefoil.—THE FESTIVE INFANT.

[49115.]—**Gasometers for Limelight.**—A 6ft. gas-holder may be made the following size:—The inner chamber, 21in. in diameter, 30in. high; the outer holder double the height, or nearly so; the best material is zinc: it is what I always use.—A. PUMPHREY.

[49116.]—**Celluloid Collars.**—I have never found any smell from these. I obtained some in Liverpool, and some at Coln, in Germany.—R. HANNEN.

[49116.]—**Celluloid.**—Camphor is one of the ingredients of celluloid. Free exposure is the only way by which the objectionable odour can be removed.—OS.

[49116.]—**Celluloid Collars.**—The camphor appears to be an essential ingredient of the composition used for collars; but I have seen the excellent celluloid keys for pianos and organs sent from America, and there is no smell of camphor from them. Probably the smell goes off on exposure to the air, especially if they are warmed. The most potent objection to them I have heard is that they turn yellow in a few weeks after wear, I believe, and the smell of camphor is scarcely an objection, for it is very much of a disinfectant.—S. M.

[49116.] — **Celluloid Collars.** — The camphor smell objected to in these collars is only temporary, and will be all gone in a day or two, or may be removed at once by washing in tepid water and soap. But these collars have a greater and more serious fault than the smell of camphor, and that is their inflammability. Some months ago I saw one of my yoke-fellows wearing one of them, and I was so much taken with their appearance that I invested in several for my own use. One of them being, what I considered, done, I took a new one, and tossed the old one in the fire, when it at once burst into a fierce flame. Struck with this, I experimented, and found that the touch of a flame sets them in a blaze, or even a red-hot surface without flame. If I was wearing one, and lighting a cigar or pipe, and the fusee was to fall out of my fingers on to collar, or ash from pipe, or a gas-flame was to get at it, or any one of a dozen quite possible accidents were to happen, my neck would be surrounded with fire before I could even, perhaps, know that the collar was aflame. Have nothing to do with them; they are dangerous. Besides, you cannot keep them white; they soon assume the "duck's-foot" colour, and are more expensive than linen collars.—SCOTUS.

[49117.]—**Thermometer.**—Have had registering (minimum spirit) in use several years, and it never separates. They must be hung bulb end ½in. lower than the other. If not, when the temperature is high the spirit vaporises, and when it cools it will condense and run to the other end. When this is so, or when the spirit has separated from being shaken, it can be got together by swinging the thermometer sharply, bulb end downwards. Any quantity of spirit can be got back in this way, a little at a time, of course.—W. G. T.

[49120.]—**Violin-Bow Cleaning.**—Cold water and soap. You can have it rehaired for a shilling. —FIDDLER.

[49120.]—**Violin Bow.**—To clean this, try a little methylated spirits; but don't let it get on the woodwork, or it will remove the polish. I presume the querist wants to clean the hair.—OS.

[49120.]—**Cleaning Violin Bow.**—Nothing is necessary except a hard tooth-brush, with soap and water; but, unless the rosin is bad, the hair ought not to want cleaning until it needs renewal.—LEWIS WRIGHT.

[49120.]—**Cleaning Violin Bow.**—I know very little about violin-bows or their treatment; but should think that the most rational way would be to wash off the superfluous rosin with methylated spirit, and then, if necessary, repolish the wooden part, and when quite dry, rub more rosin on the hair.—E. G. T.

[49121.]—**Hairsprings.**—This is a subject upon which, shortly, I propose to have something to say in as full a manner as I possibly can; so in my reply to you I will be brief. Respecting the adjustment of the hairspring between the pins, a little difference of opinion is to be expected. The position is often governed by circumstances peculiar to the watch in hand. When properly set, and the watch has been brought to correct time, the hairspring should have free play between the pins. It should not, however, when the springs are set wide, be allowed to have impact with both of them: the inner one, i.e., that nearest the staff, should be the one. The spring should actually touch the pin, or, for the purposes of regulating, the index and pins are useless. In effect, it makes only little difference whether the spring touches the outer pin in expanding, or the inner in contracting, providing the pins are *not* set wide. As, in the case of a very open-set spring, the second coil would be free of the inner pin; but where the pins are wide apart, such freedom for the first coil would bring the second in contact with the inner pin, retard its freedom, and so make the watch gain time. In the Waltham watches, likewise the Elgin's, the regulating pins are set so close generally, as to allow only the barest freedom for the play of the spring; and this I hold to be the correct way to set them. In such a case the spring would touch each pin in succession. It often happens that a very slight alteration is needed in getting a watch to time, and advantage is taken of the effect produced by a little opening or closing of the pins, to make the watch gain or lose. Opening the pins and giving more freedom to the spring causing it to lose, and *vice versâ*.—ALFOJOE.

[49123.]—**Electricity in Horse Training.**—If he is already fretful and anxious at starting, I should say that the electric shock you propose would, probably, prevent him from starting at all. That is not the kind of horse on which to experiment with electric shocks.—OS.

[49123.]—**Electricity in Horse-Training.**—Fretfulness may result either from a desire to be off or, not uncommonly in harness, from a badly-fitting collar. Flogging or punishment is seldom of any use in such a case; the best thing is to speak to the horse—nearly all horses like being talked to—and gently touch him with the whip. If this occurs in the saddle, a touch, not a dig, with the spur will sometimes stop it. Electricity has, I believe, been used with success in one or two cases of very troublesome horses, one of the wires from a shocking machine having been connected with the bit. It is said that on the machine being put in action the horse was at once subdued, but in the case now mentioned it would be worse than useless. It is quite impossible to lay down any fixed rules for the treatment of horses—some seem to be managed easily by kindness, and some require constant severity. A horse fidgetty in harness can often be stopped by speaking to and just touching him with the whip, almost rubbing him with it, and in saddle a slight touch of the spur, sometimes only the pressure of the leg, is often sufficient; what is required being merely to divert the horse's attention.—H. B. T. S.

[49126.]—**Huyghenian Eyepiece.**—"Dorkey" has been supplied with glasses for a Ramsden instead of Huyghenian, and he will find it much the easiest to construct. Those he has, however, are too long focus. Two of ½in. focus, placed a fraction less than ⅜ apart, with the convex sides turned towards each other, will just give the power. For Huyghenian, the ¼ and ¾ will answer, placed ½in. apart, and the flat side of each lens towards the eye.—W. G. T.

[49126.]—**Huyghenian Eyepiece.**—For an eyepiece of this description, the focus of the lenses should be pretty nearly in the proportion of 1 to 3. To obtain a power of about 80 diams. with an object-glass of 30in. focus, the focus of the field lens should be $\frac{9}{16}$in., and the eye-lens $\frac{3}{16}$in. These should be placed with the flat sides next the eye, at a distance of ⅜in. from each other, with a diaphragm between them at the focus of the eye-lens. The construction of such an eyepiece would be exceedingly simple if the lenses were of the same diameter; but as this varies almost in the same degree as the focus, some care will be necessary to get the plane sides parallel with each other. Perhaps the simplest way of doing this would be to get one end of a piece of brass tubing—just wide enough to admit the field lens—trued in a lathe. Some brown paper may then be pasted round a pencil until it just fits the tube, when each end should be cut while it is in the tube and on the pencil by using the trued end of the tube as a guide. This inner tube will serve as a stop for each of the lenses to rest against. The eye-lens being of a smaller diameter should be kept from shifting by slightly countersinking the brown-paper tube and pasting a perforated card over it. The brass carrier tube may be thicknessed to fit the telescope with similar rolls of brown-paper. An exceedingly simple and effective micrometer for a Huyghenian eyepiece can be made by fixing threads of spun glass across the aperture of the diaphragm. The lenses described by "Dorky" as being each of 1in. focal length would be useless for an eyepiece of this description; but they would make a capital Ramsden eyepiece, and, with his object-glass, would magnify about 40 linear. They should be placed with the convex sides facing each other, and rather less than ¾in. apart. Such a combination would not require a diaphragm, and would give a very flat field, though not so free from colour as the Huyghenian. The theory of eyepiece construction requires, amongst other things, that the axes of its lenses should be coincident with that of the object-glass. This has rather a formidable sound, and to an amateur not accustomed to lathe-work would appear so difficult that very few would venture to attempt it. It is a rule, however, that will admit of so liberal an interpretation that it may be practically disregarded. Some time ago I was permitted to examine the highest power of Mr. T. E. Espin's 5in. refractor, with which, as I understand, he has made many valuable discoveries in double stars. Naturally, I expected to see a very expensive and well-finished piece of workmanship, and I am sure our readers will appreciate my astonishment when I mention that the body of the eyepiece consisted of a cork bung, with a hole for the lenses, cut with a penknife, and yet with this "rough and ready" eyepiece, Mr. Espin informed me, he could separate stars of less than 1″ apart. Surely, after this, no amateur need be discouraged because he does not happen to possess a lathe, or other tools generally supposed to be indispensable for even rudimentary work.—Aldebaran.

[49128.]—**Screwing.**—I send a sketch of the required tool. Fig. 1 is the plan; the cylindrical part should be as large as possible, and the tooth no longer than is necessary. Fig. 2 is the front view of point; the clearance required depends on the diameter of the hole and the pitch of the screw, and may be found thus. Draw a line equal in length to the circumference of the hole, and a perpendicular to it equal to the pitch of the screw (*i.e.*, for four threads to the inch, ¼in. in length); the hypothenuse of the right-angled triangle so formed gives the clearance; this should be a little exceeded in practice. Fig. 3 is the end view; do not give too much upward set, as it weakens the point; if the screw is in brass, none is required. With ¼in. and coarser pitches, it is well to make a small tool to start with, and finish with one the exact size, at any rate in iron and steel. In large shops, I believe, twist drills are ground in a machine; the larger drills generally have a centre line, and may then be ground pretty easily by hand; but with the small ones, I know of no way except by grinding them experimentally until they drill the smallest possible hole, when the point will, of course, be central.—E. C. A.

FIG. 1.

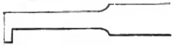


FIG. 2

FIG. 3.

[49130.] — **To "F. W.," or "Alfojoe."** — Either you have broken the verge, by allowing the escape-wheel to catch against it, as you were taking it from its position; or, in like manner, the inner pivot of the escape-wheel is broken off. Which is it? In either case the remedy is obvious. From what you say, I imagine the escape-wheel pivot is broken. Instructions were given by me to a querist last week upon this particular repair; but I advise you, unless you have had some experience in the work, and recovered from the inevitable heart-breakings of the "tyro" days, to let it alone, and send the job to a practical man for the necessary repairs.—Alfojoe.

[49131.]—**Steel Wire Rusting.**—Plate it with copper or nickel.—Os.

[49131.]—**Wire Rusting.**—If "Farmer" gives his wire a coat of varnish or boiled linseed oil, letting it dry hard, it will prevent it rusting.—Nomen.

[49131.] — **Steel Wire Rusting.** — To keep steel wire from rusting get some powdered chalk lime and well dredge the wire with it and roll in paper and keep it in a dry place.—W. H. Toye.

[49131.]—**Steel Wire Rusting.**—Would it spoil the steel wire for the purposes to which "Constant Reader" wishes to apply it to coat it with copper, by passing the wire through a solution of sulphate of copper?—Walter H. Ince.

[49131.] — **Steel Wire Rusting.**—Take your steel wire to any coppersmith's shop, and get it dipped in their pickle-tub for one moment; then have it rinsed in cold clean water, and dried with sawdust. You will find this will answer your purpose.—Thos. Clarke.

[49131.]—**Steel Wire Rusting.**—If "Constant Reader's" wire is not subject to much friction, the best plan would be to cover it with a thin coating of collodion (thinned by addition of an equal quantity of ether). This plan has been recommended for the protection of silver plate against tarnish, and it seems to answer admirably; it can be readily removed by washing with warm water.—E. G. T.

[49132.]—**Silver.**—If the mixture is dissolved in acids and precipitated with hydrochloric acid (salt is wasteful of silver) pretty well all the metals will be got rid of except lead, and this will be removed by repeated boiling in water and decantation while hot, as long as long as the water takes any chloride of lead away, which can be tested for by sulphuretted hydrogen or any soluble sulphide.—Sigma.

[49132.]—**Silver.**—First you would have to find out with what metals the silver is alloyed—whether it be lead, tin, or brass (zinc and copper), or all three. To ascertain this, the following analysis must be performed. First dissolve in nitric acid, then add hydrochloric acid (HCl), which precipitates lead and silver; filter; wash the precipitate with boiling water, which dissolves the chloride of lead, which may be precipitated by sulphuric acid, leaving the silver as chloride; take the filtrate from the first operation, and pass sulphuretted hydrogen through it. This will precipitate the copper (of the brass) and the tin in a black powder; filter: digest the precipitate in sulphydrate of ammonium, which dissolves out the sulphide of tin, but leaves the copper; add hydrate of potassium, which will precipitate the tin. Take the filtrate from the sulphuretted hydrogen, and add ammonium hydrate and chloride, which will precipitate the zinc. The following operation will be more easily seen from the table:—

Add HCl

<table>
<tr><td rowspan="3">Ppt.
Pb and Ag
Boil with water
Ppt. Filt.
Ag Pb
Add H_2SO_4 Lead will be again precipitated.</td><td colspan="3">Filtrate.
Cu Sn Zn.
Pass through H_2S.</td></tr>
<tr><td colspan="2">Ppt.
Cu Sn
digest with AmHs</td><td rowspan="2">Filt.
Zn
Add AmHO and AmCl
Zinc ppt.</td></tr>
<tr><td>Ppt Cu</td><td>Filt.
Sn
add KHO Sn will be precipitated.</td></tr>
</table>

N.B.—The copper may be more easily detected by the blue colour of the solution. Having ascertained the composition of the alloy, the next thing is to isolate the silver. If the alloy is simply lead and silver, the silver may be isolated by cupellation—i.e., by putting the alloy into a cupel made of bone earth, and heating in the oxidising flame of the blowpipe; then the lead oxidises and sinks into the cupel, leaving the silver as a pure button. If the other metals be present, dissolve in HNO_3 and add H_2SO_4, which will precipitate the lead; then filter and add to the filtrate HCl, which precipitates the silver as chloride; shake the chloride, and heat with sodium carbonate, potassium carbonate, and a little borax; a bead of silver will result. Another method is to precipitate the silver and lead by HCl, and washing the precipitate with ammonium hydrate, which dissolves the silver chloride, but not the lead; filter, evaporate the filtrate to dryness, and treat with K_2CO_3 and Na_2CO_3, and the NaB_2O_7 as before.—Walter H. Ince.

[49132.]—**Silver.**—"Anon" must first dissolve his alloy in nitric acid diluted with a little water, and using that if necessary; secondly, add to this solution hydrochloric acid, or common salt, until it ceases to form any precipitate, then filter, and wash the precipitate; thirdly, boil the precipitate—which contains the silver and lead, if any—in distilled water, and again filter, and wash the precipitate with boiling distilled water; the precipitate then consists of chloride of silver, which may be reduced with carbonate of soda in the usual way. —E. G. T.

[49132.]—**Silver.**—"Anon" need not specially test for lead, tin, and brass, if he only requires to separate the silver. Dissolve the alloy in nitric acid (as strong as possible); copper, zinc, silver, and lead will dissolve: the tin remains behind as a white powder, which must be filtered off. Hydrochloric acid to the filtrate will throw down the silver as AgCl, and part of the lead as $PbCl_2$. Wash the precipitate by decantation with boiling water; $PbCl_2$ will be removed, it being readily soluble. Dry your AgCl and transfer to clay crucible, and reduce with borax and carbonate of soda.—M. M. S.

[49132.]—**Silver.**—If you want to refine silver, don't melt it with borax. Borax prevents the impurities from being oxidised, and it causes the silver to melt at a lower temperature; the higher the temperature the more likely you are to get rid of the lead, tin, &c. I should fuse it for about half an hour, occasionally dropping in a little nitrate of potash (I prefer what druggists call sal prunel, which is fused nitrate of potash), and, towards the end, I should drop in a little bichloride of mercury. After this treatment it will be, probably, pure enough for your purpose; if not, let us know. Don't bother with acids if you can help it. Crucibles for silver refining should be large enough to contain the silver at the bottom, as the nitrate of potash may cause it to spatter about. What are called skittle-pots are the best.—Os.

[49132.]—**Silver.** — Dissolve the metal in hot nitric acid; dilute to four times the volume with cold water, and filter. To the filtrate add: hydrochloric acid diluted with an equal volume of water, or a solution of common salt (chloride of sodium), as long as a ppt. is formed. Allow to settle; wash by decantation with hot water until the washings are tasteless: drain and dissolve the ppt. in dilute ammonia; add an equal volume of cold water, and filter. To the filtrate add an equal volume of water; afterwards hydrochloric acid in excess. Again wash by decantation until the washings are tasteless; drain and dry the ppt. Weigh roughly; add double the weight of bicarbonate of soda; mix thoroughly in a porcelain mortar; place in a plumbago crucible; cover with a thin layer of borax, put on the lid and place in the fire, heating gently at first up to redness, then increase the heat almost to whiteness for ten minutes; remove from the fire, tap the crucible gently, and allow it to cool. Break the crucible and remove the flux from the silver button; boil in water; brush with a hard brush until all adherent portions of the crucible are removed; then boil in dilute hydrochloric acid, and finally in distilled water.—D. H. W.

[49135.]—**Elastic Moulding.**—Take 4 parts of glue, soak in water till it is quite soft, and then add 1 part of treacle, and mix well together.—Walter H. Ince.

[49135.]—**Elastic Moulding.**—Procure some gelatine in sheets, about 1s. 3d. per pound; soak this in water till soft, and press out the water by twisting the gelatine in a towel; place it in a jug, and to every pound of gelatine add a pound of glycerine. This will make a very nice elastic composition. If too hard, melt up and add more glycerine. It must be greased before the plaster is poured into it.—Os.

[49139.]—**Glazed Tiles, to Cut.**—Chip a deep mark across each side with a hard chisel; now hold it in both hands and strike it on some hard, sharp edge (e.g., a stone wall), and it will, or ought to, break in the line of your mark. Fasten them to the wall with Portland cement; both tiles and wall should be wet.—Os.

[49140.]—**Model Cutter Yacht.**—Best yellow pine, without knots.—Amateur Canoe Builder.

[49140.]—**Model Cutter Yacht.**—If the model is of small size, and the frames not more than 1¼in. apart, blind-laths will do very well for the planking; but otherwise they would be rather weak. Honduras or cedar ¼in. thick, which may be bought for about 2½d. a square foot of most timber merchants, would be better. Some of the streaks which are sharply curved may require steaming or boiling. They may be easily boiled in a length of zinc-piping, plugged at each end with a bung, and with a small hole on the top for the escape of steam. A spirit or petroleum lamp, or a Bunsen burner would be sufficient furnace. They would have to be temporarily fitted into their places while hot and flexible, but as they would shrink a little, would require perhaps a little trimming before being permanently fitted. A little red-lead and boiled oil may be put on the edge of the last-fitted streak when the next streak is being fitted down on it. The deck, whether made of separate planks or of one piece, should be saturated with a mixture of boiled oil and turpentine to fill the pores of the wood and prevent subsequent shrinking. The whole model should be painted inside and out with a mixture of red-lead and good copal varnish, and externally-finished with any colour desired. The varnish may be thinned, if necessary, with a little turpentine. A very hard and elastic varnish called "boat copal" may be got from any builder of pleasure boats. A pint would cost about 2s. 6d. —Robinson Crusoe.

[49141.]—**Electric Motor.**—I cannot say what power a double-ring motor 6in. long and 6in. diameter would develop. In these matters one cannot depend upon calculations; trial only can be relied on. I should advise "McIntosh" to try a motor 6in. in diameter, but only 2in. long; such a motor, wound with two layers of No. 18 wire and the current divided between the two halves of each ring, would absorb the current given out by from six to ten quart Bunsens, according to the work done; for it should be remembered that electricity will not do work twice over, and that an electro-magnet motor will, when doing work, absorb a current that would burn the coils when the work is taken off. Three of these motors, 6in. by 2in., might be mounted on one shaft, and one commutator would work them all. The inner faces of the pole-pieces on the outside ring should not be more than ½in. wide, and the outer faces of the pole-pieces on the inner ring should not be more than ¾in. wide; these rings and pole-pieces may be cast and cemented; and if the patterns of the rings are cut in two, thus, along one side of the pole-pieces to the middle, then across the middle of the pole-pieces and down along the other side, it will be seen that the bolt through each pole-piece will hold the rings, and the brass or gun-metal uprights carrying the shaft bearings firmly together. "McIntosh" need not trouble about resistances; all that is necessary is to see that the magnetism produced in the inner ring by the action of the current is greater than the magnetism induced by the outer ring in the inner ring when all four pole-pieces are together; and two layers on each ring appear to be good proportions. The motor is not, to my knowledge, patented; and if it were I believe the patent would not be valid.—H. B. T. S.

[49143.]—**Printing on Tin.**—The Tin Decorating Company, Neath, would, no doubt, provide you with boxes as required.—R. HANNEN.

[49143.]—**Printing and Lacquering on Tin.**—"B. and M.'s pat.," frequently seen on tin boxes treated in the manner "Young Tinman" describes, I believe stands for Bryant and May's Patent, the makers of the safety match, who, no doubt undertake the kind of work.—R. A. S.

[49146.]—**Limelight Apparatus Without Bags.**—In reply to "Lantern," the scheme is not, I consider, a good one, as you have to make a supply of oxygen during the exhibition if it last over an hour: otherwise the apparatus will be inconveniently bulky. You will see it advertised now and again in "our" paper.—A. PUMPHREY.

[49148.]—**Bevelled-Edged Photo. Mounts.**—Being an amateur bookbinder, I am aware from experience that a plane is about the worst cutting instrument that could be used for paper or millboard. To make a good clean cut there is nothing like a rough edge, that is to say, an edge prepared by stropping tool on a fine, hard, closed-grained sand-stone. Moreover, a broad-edged tool, like the "iron" of a plane is quite useless. The tool must be lozenge-shaped. What "Country Photo." wants is a bookbinder's cutting-press and plough, which he could easily modify to suit his wants. These tools can be procured from any bookbinder's furnisher for about 50s. If he cannot be supplied easily in his own district, let him send six stamps to "Frederick Ulmer, Cross-street, Hatton-garden (leading into Farringdon-road), London," when he will receive by return post a most comprehensive catalogue, wherein he will see tools which will just suit him, and some more besides, which won't.—SCOTUS.

[49149.]—**L. B. and S. C. Engines.**—47, Cheapside; 156, Munich; 146, Havre; 124, Bayonne; 250, Hoathly; 238, Lindfield.—W. B. P.

[49150.]—**Sampling Benzoline.**—Procure a hydrometer and take the specific gravity. First get the sp.gr. of paraffin-oil, that is, such an oil as you would wish to use or sell—say, a pint. Now add successive portions of benzoline, mixing well after each addition, taking the sp.gr. each time. A rule-of-three sum will calculate the percentage of benzoline after each addition. Arrange the percentages in a column, and in another column place the sp.gr., and preserve this table for future use.—Os.

[49151.]—**Brittle Brass.**—If copper chains are really as serviceable as is hinted, I have no doubt they can be had of Evered, Drury-lane; but I also think that brass chains properly lacquered will be proof for many years against all the sulphur thrown off by London gas. If not, I should imagine makers would go in for nickel-plating.—NUN. DOR.

[49153.]—**Skeleton Skulls.**—The preparation of skulls and bones is a very long and unpleasant business. The way that I have succeeded very well is by placing the objects in water and leaving them exposed till the flesh drops off, and then placing the bones in the sun to bleach. Nearly the same result may be obtained by boiling the objects, but this leaves the bones yellow and greasy. Never try to bleach the bones by chlorinated lime, as it spoils the texture of the bones and renders them very brittle.—WALTER H. INCE.

[49157.]—**Roller Skates.**—I think that Plimpton and other complicated skates are a mistake, and that it is perfectly possible to make a skate with three or more wheels in line. I think I should not make the edges of the wheels flat, but slightly rounded, and I would place them so that a line extended on them would form a curve. When the body is balanced on the centre of the skate, one wheel alone will touch the ground. I should prefer to make the wheels all one size, and arrange them in a curve.—Os.

[49158.]—**Traversing Mandrels.**—Yes. I hope that the French mandrel and collar will shortly be made for sale. I am in correspondence about it with a lathe-maker. "Nemo" knows where to get the Ironbridge one at a high figure—so do I; but it can be well made for much less. By last report, however, the firm he probably alludes to has ceased to make them; and it is easy to understand the reason.—O. J. L.

[49162.]—**Horehound Beer.**—It is almost impossible to tell why it has gone sour without you describe the process. If you use malt you will have to take out a license and pay duty. If a so-called non-intoxicating drink has more than a certain percentage of spirit, the Excise will deem a license to be necessary, and duty will have to be paid supposing the beer for sale. 3 per cent. of alcohol is the maximum allowed by the Inland Revenue authorities.—W. L.

[49164.]—**Metal Bending Rollers.**—You will find it more easy and convenient if you convert your wringing machine as you originally intended, by making your back roller to screw up and down. This is the principle of all tinsmiths and light iron rollers.—THOS. CLARKE.

[49167.]—**To "Fiddler."**—I have made two "cellos," but they do not please me, although they had a good tone. I can't send dimensions, because the idea is not perfected. A violoncello should be 4ft. long from scroll to tail button, the strings from 28in. long up to 30, or perhaps 32 the outside, which would be extreme; the soundboard 14in. wide. You might proceed on these data; but as a rule make the soundboard the same length as the strings. When I have time I will make another; at present I can't get away from the violin; nevertheless, I am much obliged to "East Anglian" and others. With respect to tenors, they must also wait their turn. As to holding a "cello," I conceive it would suit a lady admirably, as it should be held by the right side, instead of the present ungainly method; the fingering, thus held, is not so far reaching.—FIDDLER.

[49171.]—**Model Locomotive Boiler.**—"W. R." does not say what size he intends making his boiler. I don't see any difficulty whatever (that is if he has proper facilities) in brazing the parts together. I have done one with 38 tubes in every part brazed. The coppersmith was wrong in saying that soft solder would answer as well as hard solder, even if the proper height of water was kept up, for if it was properly brazed it would last as long as the copper. The seams, if brazed, will stand the heat up to about 4,000° Fahr. But if "W. R." will send sketch of what he wants, I will try and give him a few simple instructions as to the *modus operandi*.—THOS. CLARKE.

[49172.]—**Ethoxo Limelight.**—"J. C. E." had better write the original inventor, Mr. Broughton, dentist, Manchester.—L. WRIGHT.

[49172.]—**Ethoxo Limelight.**—When this is properly understood it is at once the most simple and satisfactory form of the limelight. The conditions of success are to have one bag of oxygen gas to saturate one part as it passes from the bag with the vapour of ether, and carry this to the hydrogen tap of the jet, to carry another part of the oxygen without any alteration to the oxygen tap of the jet, being certain that no vapour of ether returns into the oxygen bag. The oxygen, which is charged with the vapour of ether, will light and burn in all respects the same as hydrogen, providing it is fully saturated with the vapour of ether. In this condition it is not explosive, and will not produce an intense light. Perfect combustion is secured by turning on a requisite amount of oxygen-gas. I find by testing it with the photometer that 400 candle-power is easily obtained, and can discover no difference in power between hydrogen and vapour of ether. I shall be glad to send sketch of my plan and full instructions, which will enable it to be used with safety and ease.—A. PUMPHREY.

[49173.]—**Fan Mounting.**—I don't know anything about folding a fan; but the best cement is white glue or gelatine—used, of course, very sparingly. I think there is a kind of glue called "fish-glue," used for this purpose.—Os.

[49178.]—**Velocity of Electricity.**—From a most reliable source I find that electricity and light have the same velocities—viz., 193,750 miles per second, and in "Ganot's Physics" I see the velocity of sound given as 1,092ft. per second. The velocity of electricity here is reckoned independently of any conductor.—E. M. P., Bristol.

[49178.]—**Velocity of Electricity.**—"288,000 is correct—this is only of the discharge, not of electric action."—Chambers's *Encyclopædia*.—I believe it was discovered by Wheatstone. (Sound.) "In 1823 Moll and Van Beck, the celebrated observers, carried out careful experiments. The result of the research shows the velocity of sound in dry air at 32 deg. Fahr., to be 1,092ft. per second; the velocity is increased about 1·14ft. for every 1 deg. Fahr. rise in temperature. (Light.) By the most recent experiments (1879), the velocity of Light is 186,616 miles per second."—*Mechanics and Science*.—T. E. L.

[49179.]—**Glass Sweating During Frost.**—"Down" may prevent this by keeping his shop at freezing-point, or a degree or two below. If he ever discovers any other plan, perhaps he will kindly publish it for the benefit of—W. G. T.

[49179.]—**Glass Sweating During Frost.**—This can be readily remedied by boring a few holes, ⅜in. in diameter, through the bottom sash, say, one hole for every 3ft. in length of window, and having corresponding holes in the top sash. This secures sufficient ventilation to keep the window cool. In summer time, the holes may be corked, to keep the dust out. Fortunately, dust in winter is a rarity.—M. M. S.

[49179.]—**Glass Sweating During Frost.**—As a matter of course, during frost the temperature outside is rather low, and at night, when the gas is lighted, the temperature is comparatively high inside. Heated air dissolves more moisture than cold air, and an excess of moisture is formed by the combustion of the gas. This moisture is condensed on the cold glass much in the same manner as it would be condensed in the cool receiver of a still. It is hardly possible to keep the glass at the same heat as the inside of the shop, but much can be done by ventilation at the top of the shop, fanlights over windows, &c.; but in very cold weather I think it can hardly be prevented altogether. The electric light would, however, go a long way towards it.—Os.

[49181.]—**Laboratory Table.**—I think it is perfectly impossible to stain a deal table to resemble walnut or any other wood in such a manner that neither acids nor caustic alkalis will affect it. Caustic soda will take off any polish whatever.—Os.

[49181.]—**Laboratory Table.**—"D. B." would probably effect his purpose best by staining the table to taste with a water stain, such as Stephens', and then saturating it with (solid) paraffin, by means of a hot washerwoman's iron and plenty of elbow-grease.—FABER.

[49181.]—**Laboratory Table.**—"D. B." will find it much better to work on a plain deal table than a stained one. He may get a stain to withstand dilute acids and alkalis, but no wood polish I have yet seen will stand even dilute alkalies. A varnished table is a nuisance in a laboratory.—M. M. S.

[49181.]—**Laboratory Table.**—You will find it very difficult to stain with anything that will resist both the action of acid and alkali. Most of the stains turn white with alkali, and blacken or turn yellow with acids. Melted paraffin wax rubbed into the wood would help it to withstand the acids and alkalis, but would not stain it to look like mahogany. The laboratory benches of the large laboratories, such as those of the Pharmaceutical Society, are made of huge slabs of slate.—WALTER H. INCE.

[49191.]—**To Flautists.**—"Flautist" will find the "Siccama" model to be all that he desires. I use, professionally, an "Improved Siccama," by Boosey, London, on which the extension of the fingers is very slightly more than on the piccolo. The extra keys are duplicate B flat, C natural, and shake keys, and sometimes a thirteenth key, reaching first B below the line, rarely made but to order.—OUVRIER.

[49194.]—**Salt in the Fire.**—The purplish colour seen when salt is thrown into the fire is no doubt due to the presence of potassium chloride in the salt.—E. G. T.

[49194.]—**Salt in the Fire.**—The explanation of the blue colour witnessed when salt is thrown on a clear fire is simply this: The vapours from the sodium keep out the oxygen from the incandescent carbon, and leave the carbonic oxide to burn as a blue flame, which would be invisible if there were free access of oxygen, when the carbon would be completely consumed to carbonic acid. If your correspondent will refer to back volumes, I think he will find a full explanation of the cause of the blue flame, and if my memory serves me, I have given the pith of it. Anyhow, what I have stated above is the cause.—NUN. DOR.

[49194.]—**Salt in the Fire.**—This is not generally known; some ascribe it to hydrochloric acid, or to the chlorine produced by the decomposition of the salt. I prefer to think this beautiful blue colour is due to some compound of carbon and chlorine, or carbon and hydrochloric acid, produced only in a strong reducing atmosphere in the presence of ignited and glowing carbon. The chlorides of the alkali metals all yield this blue flame. Ammonic chloride is the best salt for producing it, whilst the chlorides of the alkaline earths only yield it after some time. This coloured flame cannot be reproduced in the Bunsen flame. Chlorides, and their allied salts, act peculiarly on the flame; many yield colours readily distinguishable from the bases they contain.—M. M. S.

[49195.]—**Brake Failures.**—The collision to which your correspondent refers between a Midland Company's express train and the buffer-stops at Bradford took place on the 27th June, 1882:

the train was drawn by engine No. 174, fitted with a steam-brake upon the coupled and tender-wheels, and all the vehicles had the Clayton two-minute modification of the Sanders Vacuum Brake. The cause of the accident was that the brake failed to stop the train when required, the result being that the engine struck the buffer-stops with considerable force, many of the passengers being severely shaken. It has been frequently pointed out in your columns that the Midland Company's returns are very incorrect, and the Bradford Accident adds another case to the very long list of "Unreported Accidents and Brake Failures." Collisions with buffer-stops at Portskewet Pier and Liverpool Central formed the subjects of official inquiries, yet the one at Bradford (which was quite as serious) does not appear in the "Returns of Accidents during the six months ending June 30th, 1882," nor is the failure of the vacuum brake recorded in the continuous brakes return for the same period. Of course, as the case was not reported, no inspecting officer of the Board of Trade held any inquiry into the circumstances. I do not know if it is now too late for an inquiry to be held, but I may mention that a strong feeling exists at Bradford in favour of petitioning the Board of Trade to open an investigation with a view to the prevention of similar collisions in future by placing a limit of speed upon all trains entering the Midland station, and by the adoption of efficient continuous brakes.—CLEMENT E. STRETTON, Saxe Coburg-street, Leicester, January 15th.

[49197.]—**Velocity of Electricity.**—If electricity could be transmitted across space it seems pretty clear that its velocity would be the same as that of light—viz., about 188,000 miles per second. But all the so-called experimental measures were delusive, because the actual velocity with which transmission occurs depends on the induction conditions of the experiment. It would be quite different in a wire carried backwards and forwards a long distance, and in the same wire wound up singly on a coil.—SIGMA.

DOMESTIC MEDICAL HINTS.

Cough Medicines.—A few simple receipes for expectorants, useful for winter coughs. The first is particularly suitable for young children:—

Syrup of squills............	1 fl. drachm.
Gum acacia, powdered......	½ fl. drachm.
Ammonium chloride........	8 grains.
Peppermint water, enough to make two fl. oz.	

Dose for a child, a teaspoonful every two hours. Another formula, for older children and adults consist of

Syrup of ipecac.	2 parts.
Syrup of squills	4 parts.
Paregoric	1 part.

Dose, half to one teaspoonful, repeated as often as necessary. The following was a favourite prescription of Prof. C. A. Lee, of Peekskill:—

Syrup of ipecac....................	1 ounce.
Syrup of tolu	1 ounce.
Paregoric..........................	½ ounce.
Syrup wild cherry..............	1 ounce.

For hoarseness, Dr. Eichelberger gives the following, which he says is very good for hoarseness:—

Tinct. chloride of iron.........	2 drachms.
Glycerine........................	4 drachms.
Water	4 drachms.

Dose, half a teaspoonful *pro re nata*.

Headache. — Dr. Haley says (*Australian Medical Journal*) that, as a rule a dull, heavy headache, situated over the brows and accompanied by languor, chilliness, and a feeling of general discomfort, with distaste for food, which sometimes approaches to nausea, can be completely removed, in about ten minutes, by a two-grain dose of iodide of potassium dissolved in half a wineglassful of water, this being sipped so that the whole quantity may be consumed in about ten minutes.

Diet for Night-workers.—For night-workers the best plan includes a hearty breakfast when they rise, which is generally from twelve to three o'clock; some out-door exercise and relaxation should precede a good dinner, partaken between six and nine o'clock at night, before beginning work. If the work is to continue until four or five o'clock in the morning, a light but nutritious repast should be eaten shortly after midnight, in order to fortify the system for labor during the hours immediately following, when the vital powers are most enfeebled. When the work is done, and before retiring, a very simple lunch should be taken in the form of good hot broth or beef tea, or a glass of light wine and a couple of biscuits. This will generally insure sleep by withdrawing blood from the brain, where it has been concentrated by mental effort. In ordinary cases of sleeplessness, not confirmed by long continued habit, a light meal of this kind will generally prove a remedy.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last W. L. has replied to 48492; Ploni Almoni 48607.

48508. Stains in Sulphur Bleaching, p. 236.
48514. Bichromate of Potash, 236.
48518. Painting on Enamel, 236.
48519. Gearing, 236.
48529. Vacuum Lamp, 236.
48534. Copper Boiler, 236.
48539. Electric Indicator for Tank, 236.
48547. Cording Machine, 237.
48551. To "A. S. L.," 237.
48559. Dynamo, 237.
48562. Cartridge, 237.
48568. Lantern Dissolver, 237.
48570. Circular Bellows Making, 237.
48571. Magic Lantern, 237.
48572. To Mr. Evans, 237.
48577. Microscope, 237.
48582. Granule Cells, 237.
48583. Indicator, 237.
48585. Oil and Fat, 237.
48587. Extracting Copper, 237.

48817. Restoring Silk and Woollen Goods, p. 327.
48823. Roman Candle Stars, 327.
48826. Bench Lathe, 327.
48828. Gas Engine, 327.
48833. Henry's Solution of Salts, 327.
48836. Continuous Brakes, 327.
48854. American Iron Planes, 328.
48863. Voss Multiplate Machine, 328.
48870. Symme's Theory, 328.
48871. Subsidence near Maidstone, 328.
48875. Coals, 328.
48878. Air Currents, 328.

QUERIES.

[49199.]—**Burnishing and Polishing Electro-Plated Articles, &c.**—Would some of "our" clever friends in this line, help inexperienced amateurs to the best and easiest way to put that beautiful polish one sees upon spoons, cruetstands, dishcovers, &c.? I have tried and failed? I can coat articles (some) very well with silver, but I find Britannia metal very troublesome, sometimes like patchwork. I should be glad if one of ours would give a recipe for a copper solution (by simple immersion, or otherwise) that Britannia metals, &c., would take more than one electro.—ELECTRO.

[49200.]—**To Dr. Edmunds.**—Can a varicose vein be cured? I have been told that it can be reduced with iodine, and can be cured by the use of a truss, in from 6 to 12 months.—H. J. F.

[49201.]—**Analysis of Pig-Iron.**—Will Mr. Allen, or some other chemist, kindly say if there is any better method for estimating sulphur, phosphorus, silicon, and manganese in pig-iron, than that given in "Thorpe's Quantitative Analysis"?—J. E. H.

[49202.]—**Workmen's Exhibition.**—I shall be much obliged if some one will say when the next Workman's Industrial Exhibition is to be held in London.—J. B. R.

[49203.]—**Gas and Paraffin.**—Will some of your readers kindly give a few particulars on these subjects, as to which is the best for use in ordinary size private house? Are the hanging lamps for paraffin superior to gas? Which is the cheapest? And which is best for health? Does the gas spoil the rooms much?—O. B. A.

[49204.—**G.W.R. Engines.**—Wanted dimensions and numbers of the engines working the expresses between Plymouth and Penzance.—J. L. F.

[49205.]—**L. & S.W.R. Engines.**—Wanted particulars of the engines working the Exeter and Plymouth fast trains.—J. L. F.

[49206.]—**Lynn and Fakenham Railway.**—Wanted particulars of the engines on this line, especially those working the fast trains to Norwich.—J. L. F.

[49207.]—**Gas-Engine Queries.**—I would feel much obliged if some of your correspondents would give their experiences as to the best oil for gas-engine cylinders and valves. I am much troubled with excessive wear of the piston-rings, for which I can see no cause. If they would also give the time that "Ramsbottom" rings should wear in a 4in. cylinder, 6in. stroke, at about 200 per minute, I should be thankful.—J. M. G.

[49208.]—**Paint for Model Boilers.**—Will some reader tell me how to mix paint that will not be affected by the heat, similar to that used on the bought models? Also the best packing for plungers in small cylinders?—DRAUGHTSMAN.

[49209.]—**Chemical Charcoal.**—Some time since I bought a package of charcoal which would take fire on the application of a lighted match. Do any of your readers know how it was prepared? It appeared to have been soaked in some sort of chemical solution, and then thoroughly dried. It went by the name of "Brais Chemique," and is used in Catholic churches for igniting the incense.—D.

[49210.]—**To Mr Wetherfield.**—Will you kindly say (1) if I am obliged to pay Income-tax on my cottage—my income being less than £100 per annum? (2) There being a narrow lane between my garden and the opposite field, with a hedge which has not been cut within my memory, and which is injuring the garden. Can I compel the owner to cut it?—ONE IN THE SHADE.

[49211.]—**To Mr. J. H. Evans.**—Perhaps Mr. Evans would be kind enough to give us drawing and description of bed, wooden framework, treadle-motion, and overhead suitable for the traversing mandrel lathe described by him in No. 869.—TRAVERSING MANDREL.

[49212.]—**Expansion of Steam.**—To "L.O.V." or MR. FRED. WALKER.—What per cent. or mechanical duty shall I derive by having three expansions over no expansions at all? Supposing an engine with no expansion consuming 20 tons of fuel per week, what fuel shall I consume by having three expansions?—FIRER.

[49213.]—**Ice.**—Does Todhunter (in his "Natural Philosophy," Part I., p. 308) mean (when he speaks of "the ice as it is formed rises to the surface") that ice is formed beneath the surface, and if so, which is right—he, or Roscoe, who says, "ice is formed only on the top"? Is ice formed under the surface of sea-water, or at the top?—J. E. HOULT.

[49214.]—**Water Analyses.**—Would some one of your able chemical contributors kindly tell me the best plan for evaporating water cheaply for water analysis? I am without gas, and hitherto have used a spirit-lamp; but it is very expensive, evaporating water by this means. I do not think a paraffin or petroleum lamp would do, as it smuts the evaporating dishes. Perhaps charcoal might do, if it would give off sufficient heat to evaporate pretty rapidly, say about a litre of water in two hours, and it would not be too expensive. I should be glad of the experience of your contributors to assist me in this. I should also be glad to know which is the best plan for estimating lime. Is it best to precipitate it by ammonium oxalate, and ignite it and weigh it as carbonate or caustic lime? Could I reduce it to caustic lime by means of common spirit-lamp? Also, could I produce magnesium pyrophosphate by a common spirit-lamp?—CaO.

[49215.]—**Mange in Dogs.**—I have an Irish setter who is suffering from red mange. I have applied paraffin oil to the parts affected with good results; but what medicine should I give the dog to cure him? Is sulphur the only remedy? The dog is old—over twelve years. He is fed carefully twice a day, but is out of condition, and has a constant thirst.—J. B.

[49216.]—**Renovating Papier Mache Goods.**—I have a papier-mache tray, and should be glad if any reader of the "E. M." will tell me how to renovate it, as it has become rather dull? Would it do to use varnish? If so, any particular kind?—G. G.

[49217.]—**Testing Strength of Bleaching Solution.**—Into a tank full of water is put a certain quantity of chloride of lime, and well stirred up; after the lime held in solution is settled, the clear liquor is drawn off into another vessel. Will some of our chemical or other practical contributors kindly say how I am to measure the strength of the chlorine or bleaching property of the liquor thus made? The object is, having once attained a certain standard of strength in the solution, to be always able to repeat the same.—ENQUIRER.

[49218.]—**Plain Malt Spirit.**—Can any reader of the "E. M." inform me what plain malt spirit is, and how it is made?—BARLEY-BREE.

[49219.]—**L. N. W. R. Locos.**—Could any correspondent oblige me by telling me the respective weights of the "Standards," "Ramsbottom's Express," Bloomers, Webb's Side Tanks, and Trevithick's Tanks?—H. BILL.

[49220.]—**Mechanics.**—How do you calculate power to be employed at the end of long arm of a lever to balance a given weight at short arm?—H. BILL.

[49221.]—**Ornamental Turning.**—Can any of our amateur turners inform me why an accurate and light 5in screw-cutting lathe by Whitworth should not be as suitable for high-class ornamental turning as a traversing mandrel lathe by Holtzapffel or Evans? The workmanship would certainly not be inferior, the price slightly in favour of the first named lathe, and if the cost of a spiral apparatus for the ornamental lathe was taken into account, the lathe by Whitworth would not cost much more than half the price of the other. Can anyone inform me what advantages double frames of mahogany, as used for ornamental turning lathes possess, or are supposed to possess, over strong and well proportioned iron standards?—WHITWORTH'S THREADS.

[49222.]—**Dyeing.**—Can any of ours give me a hint on the above, so as the sun or rain will not affect? I want to dye some woollen coats dark blue.—M. P.

[49223.]—**Ventilation.**—Will any subscriber please describe an efficient means of ventilating an ordinary small room, about 15ft. square, with ordinary fireplace, and one outside wall with bedroom above? When gas is burning it becomes very close and unhealthy. A ventilating brick near ceiling to outside admits a little cold air; but does not mend matters much. This subject of ventilating ordinary rooms where no provision is usually made, is one of importance, and I trust will elicit some valuable replies.—PURE AIR.

[49224.]—**Studio.**—I have a space 20ft. long from the back of the house to a workshop 12ft. high. One side is open to the east, the other has a wall 8ft. high. The sun shines on the back all day. What kind of a studio could I put up?—BATH.

[49225.]—**Nettle Rash or Similar.**—When cold winds and frosts set in and give us "the shivers," soon after many experience, more or less, itching sensations, and occasionally apparent heating of the skin in places, which, when rubbed, breaks out instantly in scores of swellings like mosquito-bites, and directly go away, but with frequent repetitions of same effect. Is it only cutaneous, or in the blood? Purgatives stop it for the time; but are there no effective and less objectionable means? Suitable diet would do it, but some of us only go to eating-houses; hot baths would be useful, but some of us can't conveniently get such. The cause and the curative remedies would, I am sure, be useful information for many and oblige one often thereby—TORMENTED.

[49226.]—**Linoleum.**—Can any reader tell me what to apply to linoleum to give it permanently the freshness it has when washed?—R. D. H. B.

[49227.]—**Induction Coil.**—To. MR. LANCASTER.—A battery is connected to the primary of a properly proportioned induction coil. Is the current from the secondary capable of doing more work than the battery?—A. F. M.

[49228.]—**Bookbinding.**—I cannot succeed in properly rounding the backs of books when binding, and shall be glad if any fellow-reader will give me any hints that might be useful?—Binder.

[49229.]—**Wooden Tobacco Pipes.**—Where are the habitats, and what are the botanical and local names of briar-root, Sweet-scented cherry, and Australian miall wood? Has the sweet-scented cherry been cultivated in England? What is the best way to prevent wooden pipes from splitting?—Philonicotine.

[49230.]—**Softening Steel.**—Can any correspondent help me out of the following difficulty? I have some sheet-steel that is so hard and brittle that it will not work up. I have tried to soften it by annealing; but although that improves it, yet it does not make it soft enough. The steel is not burnt, but of a brittle nature.—Hallamshire.

[49231.]—**Polishing the Edges of Leather Straps, &c.**—Can any of our readers describe the process of finishing and polishing the edges of leather straps at same time closing and smoothing the grain of the leather, and making it round after being cut? Also state what kind of tool is used for putting the margin or lines along the edges, and is there any means of making the leather more firm and hard, or will wetting it several times and stretching it make it hard and stiff? If there is any better means of doing this, I would be glad to know.—Carbon.

[49232.]—**Eyes Glowing in the Dusk.**—Most people have seen this effect in the cases of cats and dogs. Is it generally known that under certain conditions the human eye exhibits the phenomenon? I noticed it once in the case of a young lady sitting in front of a fire in such a position that the firelight entered her eyes from one side. I have also occasionally seen my own eyes aglow when before a looking-glass with a candle near. The entire coloured part glows as though a lamp were shining through a reddish-brown glass. Can anyone tell me the necessary conditions? Though I have several times noticed the effects momentarily, I have never been able to reproduce them at will.—Glatton.

[49233.]—**To Dr. Edmunds.**—Will Dr. Edmunds kindly give his consideration to the following case?—The water of the neighbourhood in which I live runs chiefly over limestone, and is so hard that all kitchen boilers and kettles become rapidly coated inside—or, as cooks call it, furred—with a deposit as hard as stone. Observing this, and being a sufferer from inherited gout, I have for many years abstained from water in its natural state, drinking it only with tea and coffee. I should mention that it is my habit to take no water, or very little, during meals, and no spirit, wine, or beer at any time. Since reading the important letter of Dr. Edmunds "On Drinks" (48782), I have come to the conclusion that in abstaining from water I may have been creating those evils which I was most anxious to avoid. I now, therefore, take regularly from the breakfast and tea-table a tumbler of the water which has been boiled, giving it time to deposit its sediment at the bottom of the jug. One tumblerful I keep for day use, if required; the other I drink as soon as I awake in the morning, and I should be much obliged to Dr. Edmunds if he will tell me whether water drunk in this manner after it has been boiled is as powerful a solvent as before, and whether, by the act of boiling, it loses its injurious constituents?—E. C.

[49234.]—**Locomotives.**—Would some reader of the "E. M." kindly inform me as to the following?—The h.p. nominal of an average goods engine on the G.W. Railway, the h.p. of an express engine with a 7ft. flywheel (or rather driving-wheel), and the h.p. and size of driving-wheel of the largest G.W. Railway engine?—E. M. P., Bristol.

[49235.]—**Old English Black-Letter Bible.**—I have an old folio black-letter family Bible (English) in my possession, of which I cannot determine the date, as its title-page is missing. It was found in a loft of an ancient country house. It is bound in cardboard, covered with thin oak veneer (much worm-eaten), with double brass clasps, slightly engraved. The book contains Old Testament, New Testament, and Apocrypha. Many chapters bear an initial letter, some of which are very quaint. The Bible is divided into parts, the commencement of each part being embellished with elaborate woodcuts, which appear to be of a very early state of the art. The introduction to the Psalms gives a prologue by S. Basil the Great. Following on the story of "Bell and the Dragon" is "a necessary table for the knowledge of the State of India from the beginning of the Greek Monarchy." Most of the books have initial letters at the end of them—viz., E.W., A.P.C., &c. The book throughout is interspersed with marginal notes, and is printed in double columns. The type is of several sizes. Can anyone fix the date of publication, or give me an idea how I should be able to do so?—Harriot Elizabeth Tabor.

[49236.]—**Screw Propulsion.**—Will some reader kindly reply to the following?—(1) I wish to ascertain how many cubic feet of water a canoe and cargo weighing 2cwt. would displace, or what rule is there by which I can calculate floating displacements in fresh water? (2) I am wanting to use two screw propellers for her, and should like to get five miles an hour speed by manual power. What would be the best size for two propellers for the canoe mentioned? How many revolutions would each need per minute, and would two or three blades be best? (3) Should I obtain better results from one paddle-wheel?—R. A. S.

[49237.]—**Cleaning Parchment.**—Will some one tell me a way to remove ink-stains from parchment? I have a large sheet of it, on which I wish to write; but it has a large blot in the centre. I do not know if it is Indian or common ink?—H. C. B.

[49238.]—**Pendulum.**—I have an old-fashioned eight-day clock. I accidentally lost the pendulum. How can I put another pendulum to the clock? I have the weight for the bottom, having only lost the rod.—Pendulum.

[49239.]—**Incandescent Lamps.**—To Mr. W. J. Lancaster.—Would you kindly tell me about what E. M. F. I should require to light 6 incandescent lamps; each displaying about 1¼in. of platinum wire (about the thickness of No. 12 white cotton). I have 3 Bunsen cells; ought they to be sufficient to render the whole 6 lamps incandescent?—E. M. P., Bristol.

[49240.]—**Mining.**—Will any reader kindly inform me of some of the best methods of working flat and inclined seams of coal, and the advantages one has over the other?—A. B.

[49241.]—**Belting.**—What kind of solution is best to put on to flax or cotton belting, to resist the atmosphere? A grey colour preferred, also mode of putting on? I have tried grey paint, but it makes the belt too stiff, and putting it on with a hand-brush is rather a slow process.—A. N. J.

[49242.]—**Testing Machine.**—I shall be glad to know of a good machine for testing the strength of yarn; one that is thoroughly reliable and not likely to get out of order, probable cost, etc.—A. N. J.

[49243.]—**Legal.**—To Mr. Wetherfield.—The water from the house next to mine overflows during a heavy rain, the pipes not being large enough, and does considerable damage to my house. The landlord refuses to do anything. How shall I proceed to make him?—Doubtful.

[49244.]—**Quick-Drying Varnish.**—Kindly give me the recipe for a quick-drying varnish, not soluble in alcohol or in essential oils; if in ether or chloroform, so much the better; and of a cement, quickly hardening, which is not dissolved by heat nor by water?—J. F.

[49245.]—**Packing Pumps.**—I have two plunger pumps (for sewage) 14in. diameter, and I pack them with the best spunyarn and tallow, and in two weeks they begin to leak, and the more I screw the gland down gives the engine more work and don't stop the leaks. Can any of our readers who are in charge of sewage-pumps, tell me where I fail in keeping my pumps from leaking?—Plunger.

[49246.]—**Steam Cock.**—Will any of our readers tell me how to grind my blow-off cock in boiler? I have done the small cocks on front of boiler and made a good job of them; in the blow-off cock, should I turn it right round, or just half-way? What should I use to grind it with? I used bath-brick and oil for the small cocks.—J. C.

[49247.]—**Resistance.**—Will "Sigma" kindly let me know the approximate resistance of 1lb. each of Nos. 20, 22, and 18, B.W.G. wire (cotton covered). By doing so, he will be conferring a great favour on.—O. H. M.

[49248.]—**Wimshurst's Influence Machine.**—Can any reader kindly give me the following information? Must the two pairs of brushes of this machine be in metallic connection, or, should they be insulated from each other? As the brushes are attached to the ends of the horizontal spindle, if the spindle be of metal, then the brushes will be connected—should this be so? What kind of cement is used to fix sectors to glass?—also, what varnish is used for the discs?—A. Thomson.

[49249.]—**Magneto-Electric Lighting.**—To "Sigma."—I thank you for reply to my last query respecting revolving coils of magneto light machines, and I have now wound four of them for one disc; but before I proceed to wind the wire on the other four bobbins for second disc revolving in same direction on the opposite sides of the same inducing steel magnets, will venture another question if I may be pardoned for doing so once more. Should the bobbins of both discs be wound alike, or in an opposite direction? In arranging the coils of the two discs for tension—the four bobbins on each of them pass the F. M. batches of 8 horseshoes simultaneously (on the opposite sides); but I notice in transferring a bobbin from one disc to the other, the direction of the spirals is reversed. I fancy, therefore, the winding should be reversed in the second disc—to make it right. A spiral of wire held in the left hand pointing to right, and then vice versa will explain my meaning.—Electra.

[49250.]—**Cuts, Wounds, and Bruises in the Workshop.**—To Dr. Edmunds.—May I venture to remind you of the promise you made in the "E. M." of the 2nd of June, last year, with reference to a paper on this important subject?—Waiting Patiently.

[49251.]—**Microscope.**—To Mr. Lancaster.—Will you kindly refer to query No. 48966, page 368, and give me the help thus asked? The stand I have almost finished, but do not understand properly the lever, fine adjustment—so cannot get on; will you make a sketch of one for me, for a 1¼ tube, and explain its mode of action, for which kindness I beg to thank you in advance?—Julius.

[49252.]—**Lime-Juice.**—Dr. Edmunds mentions lime-juice in one of his replies. Would it be injurious to take it continually as a beverage—say once daily? I was told that it "impoverished the blood." Is that true?—Nomen.

[49253.]—**Marking-Ink.**—Is there any more simple way of making indelible marking ink than what has appeared in this journal, either with or without nitrate of silver?—Juno.

[49254.]—**L. & S.W.R. Engines.**—Will anyone kindly inform me if the following are all goods engines, and what their names are—viz., Nos. 8, 12, 14, 50, 56, 60, 104, 105, 107, 109, 112, and 161?—W. B. P.

[49255.]—**Flat Mirrors and the Colour Test.**—"Prismatique" in No. 903, expressed a wish that Mr. Brashear should give us some more hints on the above; may I supplement it? I have been working a set of 3¼in., and get plenty of colours—purple, violet, pale green, yellow, red, and blue—in broad bands, sometimes curved, sometimes circular, occasionally two or three colours only in very broad patches of irregular form. What I would like to know is this. Are the plates to be gently pressed together with a little to-and-fro movement, or slid together from edge to edge with gentle pressure? Sometimes when I have slid two together with a little more pressure than usual, I suppose I have sprung the plates, for I have known two grasp each other so forcibly at the edges that no pulling or pushing with the hands would separate them, even after hours had elapsed, and I have had to make them hot to get them apart: these showed slight concavity by the test. Sometimes a pair will stick at some one place with gentle sliding pressure, and at that place there is no apparent colour, but plenty elsewhere. I find holding the plates level, but about 6in. below the eye-level shows the colours well; but they generally all disappear when they are raised about 4in., and usually the last colour to be seen in a concave is a purple violet which develops into the usual colour of the spectrum as one continues to gently lower the glass. I can assure Mr. Brashear, his letters are highly appreciated on this side of the water.—J. C. L.

[49256.]—**Handiness of Steamers at High Speeds.**—About a year ago, a friend of mine who lives at Queenstown, was watching one of the White Star vessels entering the harbour. As a rule the ocean steamers take up a position in the middle of the harbour; but on this occasion the White Star liner came up near the railway terminus, and in doing so, had to describe a curve very sharp for such a long vessel. My friend was amazed to see her dash round the bend at full speed. The agent of another line, who was standing by, was also surprised, and remarked that he would not permit any vessel belong- to his company to be navigated in such a manner. My friend was afterwards informed that the speed was put on to make the rudder act more efficiently. We had often before observed engines to be slowed in turning a bend. I should be glad to know whether the general opinion of captains is changing upon this point, and any other information on the subject would much oblige.—Moon Light.

[49257.]—**Overhead Motion.**—I have a 5in. back-geared lathe to which I want to add an overhead motion. Can any of our readers suggest a simple and cheap, yet effective, method of doing so, giving manner of fixing roller above? The lathe-bed is 4ft. 6in. long.—Aurelius.

[49258.]—**Electrolysis.**—When a solution of common salt is electrolised between copper electrodes a yellowish-green tinge is imparted to the liquid around the anode. Can any chemical explanation be given of this appearance?—Thoroton.

[49259.]—**Evaporation of Steam.**—Has the chemical condition of the atmosphere any influence upon the evaporation of steam? Would evaporation take place quicker in a clear atmosphere than in the neighbourhood of cotton factories?—New Subscriber.

[49260.]—**Wimshurst's Influence Machine.**—To Mr. Lancaster.—I wish to make one of these machines as described in last week's "E. M." (1) What varnish is used for varnishing the plates, and how is it applied? (2) Would not a condenser formed of alternate sheets of tinfoil and paraffin paper, as in the induction coil, do instead of the Leyden jars to be attached to the electrodes, providing it exposed an equal surface of tinfoil?—Eodillin.

[49261.]—**Compensation Pendulum.**—Would any reader of the "E. M." say what kind of compensation pendulum is generally acknowledged to be the best for English regulators, and describe how they are made, with sketch, if necessary, and say where wheels may be had in sets ready cut for making English regulators, and what would be about the price? By so doing I shall be greatly obliged.—An Amateur.

[49262.]—**Locomotives.**—Would any reader kindly give particulars (excluding dates and dimensions) of the following engines?—G.N.R.—310, 92, and 563. S.E.R.—79. G.W.R.—211, 2015, 1651, and 2214. N.E.R.—194 and 1326. L. and Y.R.—56, 423, Holme and Stuart. C.R.—79 and 75. N.B.R.—479. G. and S.W.R.—11. M.R.—78, 608, 980, and 813.—E. F.

[49263.]—**Locomotives.**—Would any reader kindly explain the meanings of the different lights in front of the goods engines of the M.R., G.W.R., and L. and N.W.R. companies?—E. F.

[49264.]—**Magnetic Effect.**—It is stated in last week's issue of "ours" that a current passing through the coils of an electro-magnet is affected by the approach and withdrawal of a keeper to and from its poles. If a portion of a current were shunted off to work an electro-magnet, would the main current be affected in a like manner by approach, &c., of a keeper at the poles of of magnet?—Electro.

[49265.]—**Cement for Fastening Cloth on Iron Rolls.**—I have a mangle with cast-iron rolls about 6in. diam. which require recovering with some sort of cloth, but am quite at a loss to know what cloth would be most effectual, or what cement would properly fasten it on to resist the constant wear. Perhaps some readers could help me?—An Ironfounder.

[49266.]—**Telephonic Communication.**—Can any reader give me any information as to the telephonic communication belonging to Messrs. Coleman and Co. (mustard manufacturers) between London and Norwich, which, I believe, is the longest telephone line in England. What transmitters, receivers, wire, distance, and if battery or magneto currents are used for call signals, &c., length of line up, and if working satisfactorily?—Iolanthe.

[49267.]—**Working Model Steam Hammers and Water-Pressure.**—What are the smallest size of steam-hammers made; or how could I make one? Would some kind fellow-reader insert drawing and scale of valve, and explanation of how to work? How many square inch of pressure (not blow), and what pressure per square inch does it require to make a proper weld of, say, ⅛th and ¼th inch iron respectively?—Aberdonian.

[49268.]—**Engine Query.**—We are about fixing an engine for drawing trucks up and down a railway line. The engine is a stationary one—Tuxford's portable engine, without the boiler. We thought of having a steam pipe laid from our boiler, which is 7½ft. from engine. Would some kind reader tell me if 1½in. pipe would do with a common tap to open to start engine? Also, how to stop condensed water from going in cylinder?—Bend Ora.

[49269.]—**Photo Lens.**—Will Mr. Lancaster give a simple mode for determining the proper distance between front and back combinations of a photographic lens? Also how to regulate the proper distance between glasses of back combination? If Mr. Lancaster will avoid using mathematical terms, and give the mode of regulation in inches, and parts thereof, he will confer a great favour on.—Ouvrier.

[49270.]—**Comets.**—During last autumn, several allusions have been made in ours, to "the great comet of 1812." Will "F.R.A.S." or any other writer kindly tell us where we can find its history? (I have searched for it unsuccessfully amongst my own books), and at the same time say why none of our learned folk have mentioned the bright and unexpected comet of 1811, to which The Ettrick Shepherd has addressed some very beautiful stanzas. I was living then, though I cannot carry my recollection to the point of having seen it; but a playfellow of mine, born the same week as myself, assures us in some rather superior doggrel verses, that

> "In that year a comet, large and curious,
> "Shone o'er the world with tail most fiery furious."

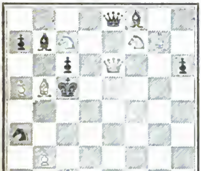
When shall we see it again.—H. O'B.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCXVII.—By J. B., of Boxford.

Black.



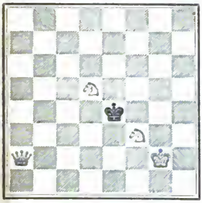
White. (8+8)

White to play and mate in two moves.

PROBLEM DCCCXVIII.—By H. F. L. MEYER.

(From the *Boy's Own Paper.*)

Black.



White. (4+1)

White to play and mate in three moves.

This problem resembles one in S. Loyd's "Strategy," but was composed and published before that work appeared.

SOLUTION to 813.

White.	*Black.*
1. B to Q sq	1. K to K B 4 (a)
2. B to Q B 2	2. K to K 4
3. Q to K Kt 5 (ch)	3. K moves
4. Q mates	
	(a) 1. K takes P (b)
2. Q to K Kt 5	2. P to K 4
3. B to Q Kt 3	3. P moves
4. Q mates	
	(b) 1. K to K 4
2. Q to K B 4	2. P to K 3
3. B to Q Kt 3 (ch)	3. K moves
4. Q mates	

To make this problem correct the Ps on K Kt file should be removed.

SOLUTION TO 814.

White.	*Black.*
1. R to Kt 3	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

Correct solutions to 813 and 814, by J. B., of Boxford; to 813 by D. Mackay; to 814 by T. Bayne and Stanley Follwell. That by A. E. Wheeler is wrong, as if 1 $\frac{}{\text{K-B 3}}$ there is no mate.

Problems received with thanks from Sergt. Major Mc Arthur and W. Mead.

Our readers will be pleased to hear that Miss Beechey's forthcoming *Chess Blossoms* will contain the prize problems of 1882.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 17, and unacknowledged elsewhere:—

H. VAN DER PLANCHE.—W. Hume.—W. T. Underwood.—Rev. W. J. E. Rooke.—Dr. Mantell.—C. Anthony.—R. McCowen and Co.—V. Buhot.—W. P. Kelley.—H. Lees.—G. B. Scott.—R. Pattison.—Baley and Co.—Barnett, Son, and Forster.—Cassell, Petter, and Galpin.—Albo.-Carbon Light Co.—E. R. Morris.—Rev. J. A. Campbell.—W. Wray.—An Amateur.—Puzzled One.—P. Hall.—A Moulder.—John Norman.—J. B., Miles Platting.—A. R. Molison.—Subscriber.—Miner.—Injector.—P. K. M.—Chromio.—Dilemma.—Gerard.—H. Boswell.—Power.—Springbok.—Jambo.—Sol.—A Reader.—M. S. M.—Molo.—J. H. Gartrell.—W. A. Besant.—J. C. King.—Rev. J. Pearson.

MR. E. J. R. WELLS. (No rates; but as to the surveyor, it depends on the local by-laws. 2. A good recipe for chutney on p. 41, No. 340. 3. Spectacles.)—BYSTANDER. (Watch replies to query 49108. Mr. Wimshurst lays the glass on a turntable, which revolves beneath an arm carrying a diamond. Circles of any desired size are cut by this means, as the length of the arm can be varied. The round hole in the centre he makes by running a line with the diamond, then he drills a small hole through the centre and enlarges it by means of a hammer and an iron stake fixed in the vice. The glass is, in fact, crushed by a few blows of the hammer, and the line once reached the remaining pieces are easily removed. The operation takes him about two minutes.)—ANXIOUS ONE. (Both queries have been replied to by Dr. Edmunds at length: one so recently as the number for Dec. 15. The other on p. 329, last volume.—J. L., Glasgow. (You want a carbon-block of the proper size and shape. 2. Copal or oak. 3. Enough to make the wax fluid. The spirit will evaporate, however much you use.)—NERO. (There are many recipes in back volumes, and an article on the subject in No. 905, p. 467.)—F. T. (We gave the description of Prof. Barff's boroglyceride preservative on p. 367, No. 874. It is not a mere mixture of glycerine and boracic acid.)—E. M. (How can any one say what to put in without knowing what is already in? Several recipes for marking-inks in back volumes. See p. 224, No. 864; or p. 178, No. 683.)—STEEL. (If you want a varnish, Brunswick black or japan. If merely colour, try a chemical black. See pp. 231, 277.)—GRETA. (Trichord means three strings in treble, and check action means that the hammer is checked and its rebound controlled. See Mr. Davies's papers "How to Make a Pianoforte," in Vol. XXVII.)—IGNORAMUS. (Remove the weight and place thumb over the short leg; then invert so as to run all the mercury into long leg. By gently tapping the end on a soft pad, you will probably get the bubbles out; then run back again. If that is not effective, better empty and clean tube. See p. 169, No. 839; and p. 146, No. 812.)—WORCESTER. (You can bend it by heating it carefully over a clear fire; but it will require repolishing, and that must be done with whiting and water, taking care to stop directly the amber begins to feel warm. 2. They are magnetised by drawing a permanent magnet over them, or, preferably, by placing in a coil and passing a current through that. 3. A Bunsen cell consists of a porous-pot containing a rod of gas carbon immersed in strongest nitric acid. The porous-pot is placed in an earthenware jar, and surrounded with a split cylinder of zinc. The solution in the outer jar is dilute sulphuric acid.)—A SHEPPARD. (We must refer you to back numbers. See p. 554, No. 908; p. 65, present volume; p. 16, No. 850; p. 477, No. 878; p. 39, No. 886, and so on through many back volumes.)—W. H. HARTNOLL. (See pp. 81, 544, Vol. XXXIII. You must consult the advertisement columns for where to buy.)—FOXGLOVE. (Dressing skins has been given many times. Scrape off all flesh and fat, and put on a coat of wheatmeal made into a paste with hot alum solution as strong as possible. Leave on for a day, then wash off, grease, and work the skin about to make it soft. To preserve, rub in arsenical soap. That is the simplest process; but you will find others in back numbers.)—J. W. FISHER. (You had better search carefully at the Patent Office before taking out a patent. It is very probable your ideas have been forestalled.)—DUPLEX. (A capital series of letters on Painting Magic-Lantern Slides appeared years back in this journal, and were afterwards published in pamphlet form by Mr. W. C. Hughes. See his advertisement for address.)—W. H. BAILEY. (Why do you not buy it of Mr. Lancaster himself? If you have appreciated his instructions, you may reasonably try his goods. See his advertisement.)—C. C. (He is the same.)—W. HOSKEN. (We have no more space to spare just now for discussion of untried suggestions in that direction.)—PATENT AGENT'S CLERK. (No license is required. Anybody may practise as a patent agent.)—J. RAPSEY. (You can summon him for the damage done to your own photograph in the county-court, and also for the cost of the second photograph, if it is as badly executed as you say. Of course, it will all depend on the truth of your statements as to whether you get a verdict; and if you do not, you will have to pay his costs.)—PRARIEBAD. (Very contradictory, and neither quite true. Weakness of nerve is a term used with reference to condition, not size.)—EGYPT. (Why not advertise for a translation in the "Wanted" column? Some competent reader would, doubtless, do it for you for a few shillings.)—AN OLD SUBSCRIBER. (Yes.)—LEATHERWORKER. (You are entitled to your share of the personal property, if there was any. You had better consult a solicitor as to further action.)—TOLTOL. (A variety in recent volumes. See p. 253, present volume, and the indices issued since 1877.)—IOLANTHE. (Probably an American system. We do not know it by that name.)—E. W. L. (We really cannot spare the time to work sums for our readers. Surely there are some schoolboys in your part of the world. Lockwood and Co., Stationers' Hall-court, E.C., publish a cheap book on Mensuration, and there are plenty of others.)—B. S. (The perforated card passes between the wind and the reed. When the perforations reach the holes leading to the reeds the wind rushes through and the reeds sound. The principle was fully illustrated and described in No. 687. One of those you mention, we believe, has lever-opening pallets. The main features of that will be found described in No. 751.)—G. HARDY. (See p. 633, No. 676, but if you obtain Pauer's "Art of Pianoforte Playing" (Novello and Co.), you will have a good guide. 2. Give it two coats of hot logwood decoction, allowing each to dry; then give a coat of acetate of iron solution, or a solution of the common sulphate of iron will do.)—CRAYON. (Boxwood, willow, and alder; but you will require an iron tube that can be sealed up air-tight. When packed full, it is raised to a red heat. It is usual to cut the pieces of charcoal to the shape required, and let them soak in melted wax for an hour. Then drain and place on blotting-paper to dry.)—BASSOON. (The best comes from San Francisco, we believe; but we are not aware there is any difference in hardness, &c., except that one piece from the same tree may be better than another. Timber, from a variety of trees, is sometimes sold under the name. 2. Cocus, box, ebony, &c.)—P. O. V. (We have given so many that we cannot remember the one specially referred to.)—ELECTRON. (They are true. Is there any difficulty?)—J. T. C. (See a medical man at once. When a man has "taken dandelion, sarsaparilla, and all kinds of herb drinks, and vegetable pills, pulled out all the hair on his face regularly, and dusted his face with burnt oyster-shell dust," there is no wonder if he has aggravated an outbreak of pimples, common to lads of twenty, into a troublesome skin affection.)—JAY AITCH. (1. Yes. 2. We know the first lantern mentioned does all its maker claims for it. We have no personal experience of the others. 3. There is no "Average." 4. Yes, many methods described in back vols. 5. If you are simply going to show pictures, get Stanley's list and lectures, and those of Mr. W. C. Hughes (see advt. pages). If you are going to do real work with the lantern, get Mr. Lewis Wright's treatise on "Light," published by Macmillan. 6. No.)—MASSENA. (From any bookseller's, from 2s. 6d. upwards.)—JUMBO. (How is "a bachelor of 38" to prepare the "various kinds of foods which produce certain effects on the human system"? Hundreds of recipes for such may be found in former vols., and many discussions on the subject—a good deal in this and recent numbers; but the best cure for all "Jumbo's" ailments would, we suspect, be a good wife. Other query next week.)—DABBLER. (Don't "dabble" with bismuth for any such purpose as your letter indicates. Any chemist will answer the rest.)—J. A. BRASHEAR. (In type.)

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

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	s.	d.
Sixteen words	0	6
For every succeeding Eight Words	0	6

*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid, no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

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⁂ Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the Post Office prevent their transmission through the Post.

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Capital Pleasure **Boat,** 32ft., beam 4ft. 6in., copper-fastened, £3.—M. H., Sprotbro, Doncaster.

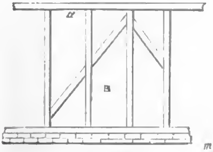
10in. centre back-geared **Lathe,** overhead motion, slide-rest. Wood bed, iron plated, 7ft. metal standards. Working order, £11.—M. H., Sprotbro, Doncaster.

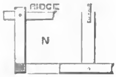
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 26, 1883.

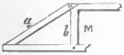
HOME CHIPS.—VII.

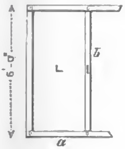
(Concluded from page 420.)

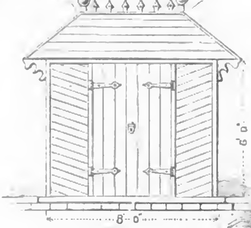
I HAVE given a sketch of such a summer-house as I have described in its completed state. I made it in sepia, but no doubt the engraver will duly translate it. It will be seen that I have left open part of the two side spaces, which are boarded only half-way up; and this is the better plan, unless the house is in an exposed situation. The boards I have purposely drawn not meeting at their extremities, in order to show the effect of nailing them so as to leave exposed the greater part of the upright posts. This can be done by nailing on a fillet to each post, for the boards to rest against, and skew-nailing them into the posts. Fillets an inch square in section will do for this, as the nails are not driven into them; otherwise they must be somewhat larger. The boards *can* be put on without any such fillet if attached to the posts at any point outside the diameter or axial line; but the posts must be trimmed to a true surface, and each end of the boards bevelled to fit nicely. It is, however, difficult to nail them on in a neat manner, because driving the nails will, here and there, force a board further in than its neighbour for want of an efficient support at the back. A fillet put on truly will insure each board lying flush and even with that above and below it. If it is preferred to give an entirely rustic appearance to the summer-house, the front boards ought to be sawn outside slabs of Scotch fir, the posts being of the same. I have not represented it in the sketch, but the open windows should have a flat sill nailed on above the last board, to conceal its edge, and give a finish to the work. With respect to the floor, the easiest kind perhaps to make is asphalte—a layer of pebbles first of all, or coarse gravel, covered with finer stuff, saturated with hot tar, and evenly spread. Over this, while the tar is still soft (add more if needed), sift fine gravel or sand. This makes a splendid floor, always dry; and I may add, makes the best of garden-paths, for no weed will ever grow in it, and it will be always dry, and, when worn, is easy to patch or renew. Cinder-dust or coarse ashes will also answer if gravel is expensive. Let the floor of the summer-house be raised about three inches, and edge it in the doorway with a row of short piles of fir, to form a step, and protect the edge of the asphalte from chipping. If a wooden floor is preferred, it can be wholly made of such short piles, a foot long, driven nine inches; or of sleepers of fir, sawn lengthwise, with inch board nailed on. But I think asphalte is easiest to lay down, and quite as effective.

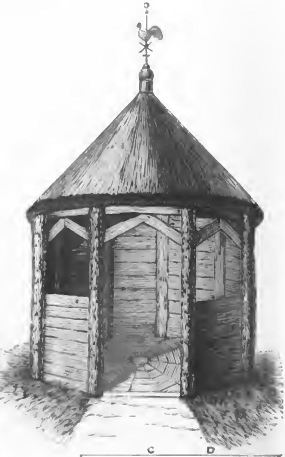


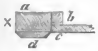


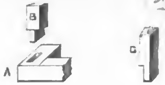


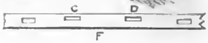












The prettiest and withal warmest summer-houses, framed as before as regards the main timbers, are only attainable in regions of heather and moss. In Dorsetshire, in good old days of large open commons, where snipe abounded, and countless rabbits burrowed in the sand, these summer-houses were wont to be built. After the frame was put up, wattled hurdles were fitted, or some rough bars nailed on, and heather was then tied on, both outside and in, much as thatch is secured, and the roof was not unfrequently made of the same material. Sometimes, for appearance sake, the whole inside was lined with moss; but this, after a while, fell to pieces, and is not desirable. The heather, rich in colour, gave such a warm appearance as no other material could. But here in the cold clay districts of the Eastern Counties, heather is almost unknown, and even furze or gorse lives despondingly, and rhododendrons, so peculiarly suited to embower a summer-house, and which, in suitable soil and climate, attain a height of 10ft. and upwards; no persuasion will cause to prosper, and Scotch fir, too, is nowhere.

I will now go on to speak of bicycle-sheds and similar structures in which sawn stuff is alone used. The material for the framework of such buildings as these is called quartering, and is in section 3in. square, as it is sawn out of plankwood 3in. thick. But of course for sills or corner posts, or wall-plates where 3in. would not be wide enough; sawn stuff 4 by 3 or 5 or 6 by 3 can be cut out of the same plank wood. A deal, as it is technically called, is 12ft. to 20ft. long, 3in. thick, and 9in. to 11in., or sometimes 15in. wide Planks and boards are thinner stuff. The 9in. deal cuts into three pieces of 3 by 3 quartering. On a cold, frosty morning, using a rip-saw or even a newly-sharpened hand-saw, it is no such terrible job to saw up a deal. Still, it costs hardly more to have it sawn at the pit or saw-mill, and the better plan is to calculate as nearly as possible how many feet will be needed, and to buy all the quartering and board ready prepared. I may mention here that a quantity of nicely-planed tongued and grooved, or rebated board, is imported both from Norway and America, saving, amongst other advantages, the labour of planing, a saving most amateurs will be ready to pay for. If it comes to buying stuff at a village carpenter's, all work of Home Chips will be costly; much more so than material bought in quantity at a large timber-yard. The difference in cost will often be sufficient to pay carriage by rail. The sketch is of such a bicycle or tricycle-house as asked for, or it will do as well for a fowl-house of simple, but slightly ornamental, character. There will, of course, be as before, the main posts at the angles; but these are now to be of squared stuff, 4in. each way. These are not to be driven or sunk into the ground, but mortised into a sill resting on one or two courses of brick, to keep it clear of the damp earth. This sill may be 4in. wide and 3in. thick, the width being that of a brick laid flat. The corners will be joined by half-lap, as shown at A, the tenon of the upright fitting into at B. The door-posts and similar intermediate ones are to be tenoned into the sill in the same manner, but need not be of such large scantling; 3in. by 3in. will suffice. But in setting out the mortises for these, care must be taken that the outside face of each smaller post is flush with that of the large ones, as the boards have to be nailed to both. If this is not done, it will become necessary to nail on a strip to each small post subsequently, and in that case it is plain that a 4in. post might as well have been used. There is no reason against this size, or 4in. by 3in., but the other will do as well. Each post should be tenoned at the top as well as at bottom, to receive the wall-plates, which will be precisely similar to the sill below, only stuff 2in. thick will suffice. It will be as well to mark this and the sill at the same time, to insure perfect similarity in the position of the several mortises.

K shows part of the framework and diagonal braces, which are essential to keep the building stiff and unyielding. L is part of the top frame, consisting of the wall-plates, *a*, corresponding to the front plate at K similarly lettered. The cross-piece, *b*, is not merely a tie beam, but is intended to support an upright post seen at *b* of M. This post is again seen at N, where the ridge pole is notched into it. There is a similar one at both ends, and they stand at *m* of the summer house where the angle timbers of the hipped roof meet, of which *a*, of M, is one. A hipped roof is not quite so easy to set up as a gable end, but this is the best way to accomplish it. The cross timbers *b* of L may be merely notched down on the longitudinal wall plates or tenoned into them. The first is easier because it does not necessitate, all the frame being put together at once. The order of work will then be:—1. Fit the sills on the brickwork. 2. Set up the upright corner-posts and intermediate ones. 3. Put on the wall-plates, and peg all together with oak trenails. 4. Nail on the diagonal ties so as to complete the framing, which will then be quite firm, and without shake. 5. Notch-on the two cross timbers with central mortises, and nail them securely. 6. Set up the uprights with notched ends; and, 7, in these notches lay edgewise the ridge-piece, 1¼in. thick, and 4in. wide, and pin it through, allowing about 4in. of it to project at each end. Then fit and nail to the ridge in the angle made by the ridge-piece and its post, the corner rafters, notching their lower ends nicely upon the wall-plate. The posts will then stand perpendicular, and the building will at once look workmanlike. Confidence and pleasure in the work will be the natural result, and tend more than anything else to its satisfactory termination. There will be no great difficulty with the rafters nor with the boarding. The roof-boards must be what are known as feather-edged, so as to overlap properly; but the front and sides should be filled in with ¾in. board, tongued, grooved, and planed on one side, and this will look best if it is laid on diagonally, as shown. Cut the boards so as to leave about 1in. of the upright corner-posts uncovered, thus forming an angular recess, to which afterwards nail fillets to hide the ends of the boards, or else nail on strips, to which the boards can be attached, so as to bring them level with the outsides of the corner-posts, and, as the latter are not planed, it will then be well to nail on moulded fillets, or a bit of round beading to give a finish to these parts. At X, as shown on a larger scale, *a*, the corner-post in cross section on plan; *b*, the fillet to which the board will be nailed; *c*, the boards; *d*, an outer fillet with bevelled edges, nicely planed to put a finish to the work. This will be a very easy method, and will look well when done. The doorway is 4ft. wide, admitting easily a large double tricycle. The doors, of the same stuff as the rest of the boarded part, are made with ledgers at the back in the ordinary way, and call for no special notice. Hook and rider hinges are stronger; but ordinary stout T-hinges will look the best, and will last, probably, longer than the house itself.

O. J. L.

CONTROLLED COMBUSTION.

IN the "Scientific News," on page 181, we mentioned that Mr. Mallett had, according to a newspaper paragraph, invented a method of dispensing with "all chimneys, and the prevention of any smoke whatever," and at the same time stated the fact that the Control Combustion Company of New Jersey were prepared to apply Mr. Mallett's system to locomotive, marine, and stationary boilers. Steam-engine furnaces are unfortunately not the real offenders, in the case of London at least, and the system is scarcely applicable to domestic chimneys, at all events as at present arranged; but in view of the Bradford disaster, and the expense of erecting lofty shafts, it may be of advantage if we describe the system proposed by Mr. E. J. Mallett, jun., in a paper read at a recent meeting of the Franklin Institute. Without some device for drawing or propelling air through a furnace, it would be impossible to consume the required quantity of fuel to convert water into steam in such volume as is needed by an engine, and the simplest device is obviously a tall chimney. As we have recently explained this part of the subject (see p. 373) we shall take it for granted that every reader understands that tall shafts are built primarily to create a draught, and secondarily to carry the vapours high up into the atmosphere; but we may as well repeat that they are not altogether economical, and hint that it is possible they may be dispensed with. According to Mr. Mallett, the actual loss of heat varies with the rate of combustion; but may amount to as much as 35 per cent., caused in four ways—(1) by the large volume of air entering the furnace, which has to be heated to get rid of it; (2) by the unburnt hydrogen and hydrocarbons distilled from the coal and passing away unutilised; (3) by the furnace being asphyxiated, as it were, owing to the admission of too little air where it is most required; and (4) by all the air necessary entering through the ashpit. Mr. Mallett, indeed, specifies 13 different "fuel losses," as he calls them; but they are all really connected with one of two causes: the escape of unutilised combustible gases, and the manner and quantity of the air supply—if we except his twelfth cause, which is the accession of steam to the combustion furnace. He, however, gives us, as an explanation of the principle of his system of controlled combustion, 12 "experimental principles," as he calls them, the most important of which are—(1) hydrocarbon fuel tends to burn with less carbonic oxide and smoke, proportionately as its environing atmosphere diminishes in tension; (2) hydrocarbon fuel tends to evolve carbonic oxide and smoke, if burned in a furnace, until the temperature of the fuel reaches a certain elevation; (3) the tension of fuel gases within a furnace is never less than that produced by the burning of the fuel itself by natural draughts, and is never sufficiently low, when compared with the rate of combustion, to prevent the origination of smoke; (7) hydrocarbon fuel, freshly charged into a furnace, must not be supplied with air to initiate its burning until the temperature of the fuel is sufficiently elevated—that is, the fuel must begin to distil before it begins to burn; (12) to burn fuel rapidly, without creating a too high localised temperature, it should not be supplied with sufficient air to burn it at once to carbonic acid only, but considerable carbonic oxide should be produced to be afterwards burned in the combustion chamber. There is little to be said about these "principles," except that No. 7 takes no note of the efforts made to introduce mechanical stokers with fuel of such a character, and fed in such quantities, that it is in a state of combustion almost directly it reaches the furnace. It is, however, with the proposed application of the principles that we are more immediately concerned, and to meet the conditions of the first three, Mr. Mallett adopts the following devices:—He incloses the ash-pit, but fits the door with openings, which can be closed by a sliding cover worked by a lever, and at some convenient place he arranges a fan which continually exhausts the furnace gases. As, then, with the openings in the ash-pit door completely closed, no air can enter the furnace between the bars, fresh fuel cannot burn, but merely distils as it would in a gas-retort. When the temperature of the fuel is sufficiently raised its burning is allowed to begin by the admission of air through the ash-pit, but as this air is throttled, the atmosphere within the fire-box is kept at a lower tension than is possible with chimney draught. By this means it is said that the coal burns without originating carbonic oxide and smoke, and the demands of principles 1, 2, and 7 are met, which may be, but it is not quite clear how smoke is prevented, nor how principle 12 is met, which demands the production of "considerable carbonic oxide." According to Mr. Mallett, it is impossible to burn hydrocarbons without the production of carbonic oxide and smoke unless more air environs and dilutes them than is theoretically necessary for their combustion, and that proportionately as the density of the environing atmosphere decreases, within limits, so will the amount of air required to burn fuel without smoke diminish and approach nearer to the amount theoretically required for perfect combustion. The object, then, is to endow air with greater molecular mobility by reducing its density, and to do that the tension of the air must be lessened in a greater ratio than is possible by increasing the rate of combustion. A chimney draught, depending as it does upon the rate of combustion, can be increased only in a fixed ratio, therefore, Mr. Mallett employs a suction-fan, which, he says, requires only 3 per cent. of the total fuel power to actuate it. To obtain a complete mixture of the gases from the fuel with hot air, instead of a bridge the furnace is isolated from the combustion-chamber by a septum, or wall, through openings in which nearly at the level of the top of the fire the gases are drawn to meet hot air flowing in through tubular grate-bars, which are continued through the wall to an iron box, whence air is delivered in fine streams to mix intimately with the hot gases from the furnace. The tubular grate-bars have their fronts brought out flush with the boiler-casing, and are closed or opened by means of a slide, or register, attached to the same lever by which the openings in the ash-pit door are regulated. One motion of this lever closes the ash-pit register and opens that of the grate-bars. Thus when fresh fuel is put on, the access of air between the grate-bars is shut off, while it is freely admitted through them to meet in a highly-heated condition the gases distilled from the coal, which are thus consumed in the combustion-chamber. After a lapse of time, depending on the quality of fuel, the registers of the air-pit are opened and the real burning of the fuel begins. It will be seen from this description that the action of the exhaust-fan is to create a partial vacuum in the fire-box when the ash-pit register is closed, while it induces rapid currents of air through the hollow bars. It is known from Tyndall's experiments that air entirely freed from moisture permits of the passage of heat rays through it without absorbing them, while air saturated with moisture is a rapid absorbent of radiant heat, and is also capable of radiating its own heat in proportion to its power of absorbing it. Mr. Mallett takes advantage of this principle, and compels the fuel gases before reaching the fan, but after they have given up "70 per cent." of their heat to the boiler, to pass through an "athermous superheater" (really a feed-water heater), which consists of an air-tight vessel, containing pipes through which cold water flows in an upward direction. At the top is a fine water-spray, which, like the fan, is worked by the exhaust steam from the engine. The gases from the combustion-chamber, after passing through the tubes or flues in the boiler, enter the athermous superheater at the top, where they are thoroughly moistened, and, passing downwards to the exhaust fan, are discharged comparatively cool, having parted with much of the heat they possessed on leaving the boiler to the water contained within the tubes. So much heat is imparted to the feed that Mr. Mallett provides a "separator," a steam-tight cylinder which separates the superheated water into steam and boiling water—the latter being forced into the feed-pipe of the boiler, while the former enters the steam-space. The superheater is really, it seems, an auxiliary generator, "the pressure of which is always slightly above that of the steam boiler itself." Without further details than we have at present, this portion of the arrangement cannot be explained; but it would appear to be really that a tubular boiler heated by what would be termed the chimney or waste gases, is made to supply water and steam to the main boiler. The system is applicable to locomotives in the following manner:—A small engine placed at the front end of the smoke-box drives the fan, which draws the gases through the boiler-tubes; the firebox is divided by a wall as previously explained, and the grate-bars are hollow tubes, delivering air just behind the wall, so that it mixes intimately with the gases from the coal. No chimney is necessary, as the invisible products of combustion are expelled by the fan through an opening in the periphery of the boiler-casing, and the exhaust is dispensed with, thus relieving the engines of some back pressure, and avoiding the noise. The exhaust steam is conducted to the tender where it is condensed by means of air which is subsequently used for heating and ventilating cars. The feed is heated by the athermous superheater; but as we suppose few, if any, locomotives have been fitted with the "controlled combustion" system, details are wanting. The paper, when read, led to an animated discussion; but it is obvious that a practical trial of the system would teach more as to its merits than any amount of discussion; but it may be said that if chimney-shafts are to be dispensed with, it will be by some such system as that proposed by Mr. Mallett.

SIMPLE PROCESSES IN QUANTITATIVE CHEMICAL ANALYSIS.—IV.

Analysis of Iron and Copper Pyrites.

A. PULVERISE a small portion of the sample to an impalpable powder, weigh out 2 grams, transfer to a flask, cover with fuming nitric acid, heat gently on sand-bath to dryness; add more fuming nitric acid and re-dry. Moisten the residue with hydrochloric acid, add water, and boil gently for about ten minutes; filter and wash with boiling water. Dry and ignite filter and contents; × 50 = per cent. of *silica*.

B. Make up the solution and washings from A to a measured quantity, mix thoroughly, and divide into two equal portions.

C. First portion from B—heat, add ammonia in excess, filter and wash well, dry ppt., ignite and weigh in a tared porcelain crucible; × 100 = iron, as Fe_2O_3, calculate into metallic iron thus:—

Fe_2O_3 2Fe Fe
160 : 112 : : weight found : x
x = per cent. of *metallic iron*.

D. Evaporate filtrate and washings from C to about 100cc., acidulate with hydrochloric acid, pass a stream of dihydric sulphide (H_2S) through the solution (see note), till precipitation ceases; heat gently, filter and wash, dry and ignite ppt. and weigh; × 100; calculate into metallic copper thus:—

Cu_2S 2Cu
158·8 : 126·8 : : weight found : x.
x = per cent. of *metallic copper*.

E. Filtrate from D.—Determine the lime as in limestone; × 100 = per cent. of *calcium carbonate*.

F. Filtrate from E.—Evaporate to dryness, and determine magnesia exactly as in limestone; × 100 = per cent. of *magnesium carbonate*.

G. Take the second portion of the solution from B, heat, add a slight excess of ammonia, and afterwards an excess of hydrochloric acid; add a solution of barium chloride, boil well, filter and wash with boiling water; dry and ignite filter and contents and weigh; × 100, calculate in sulphur:—

$BaSO_4$ S
233 : 32 : : weight found : x.
x = per cent. of *sulphur*.

The results may be stated as follows:—

IRON PYRITES.

Sulphur	46·29
Iron	42·26
Copper	1·22
Calcium carbonate	2·41
Magnesium carbonate	1·08
Silica	6·34
	99·60

Note.—Dihydric sulphide, H_2S. This reagent is prepared in a glass generating bottle—an ordinary pickle-bottle answers the purpose very well.

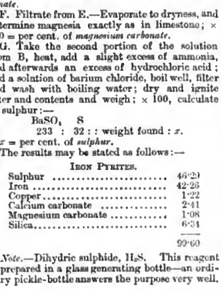


FIG. 8.

Fig. 8 shows the arrangement. The gas is disengaged in the bottle A by acting on ferrous sulphide with dilute sulphuric acid. A few fragments of the sulphide are put into the bottle, covered with water, and a little sulphuric acid poured down the funnel-tube *d*. The gas is washed by passing through water contained in *b*, and is thereafter conducted into the solution to be acted on in the beaker *c*. The corks and connections must be perfectly tight.

Estimation of Copper Volumetrically by Standard Solution of Potassium Cyanide.

To prepare standard solution, dissolve some pieces of potassium cyanide, 20 or 30 grams, in water, and make up to about half a litre in a stoppered bottle.

Weigh 1 gram of perfectly clean, pure copper foil, dissolve in dilute nitric acid on sand-bath in a beaker, allow excess of acid to evaporate, make up with water to 250cc. Measure out 3 portions of 50cc. each of the copper solution into separate beakers, add some water and an excess of ammonia, in each case using the same measure of water and ammonia.

Fill a Mohr's burette from the solution of potassium cyanide, then setting one of the beakers on a sheet of white paper, drop in the cyanide solution cautiously with constant stirring, pausing at intervals till the deep blue of the ammoniacal solution *nearly* disappears. If, after standing at rest a few minutes, a slight colour still remains, add another drop or two; stir well, and let stand once more. When the colour is quite discharged and replaced by a very faint lilac tint, observe and note the number of cc. used. Titrate the other two portions of the copper solution in the same manner. The mean of the results is then taken: suppose it to be 30cc., then every 30cc. of the cyanide solution equals ·2grm. of copper.

Method of Assay.—Weigh one or more grams of the finely-powdered sample, according to the quantity of copper it is supposed to contain, into a small flask, moisten with strong sulphuric acid, then add nitric acid, and digest on sand-bath for 20 minutes; add a small quantity of water, and boil gently for 15 minutes. Transfer the solution to a beaker without filtering, add water and an excess of ammonia, using as near as possible the same quantities as when standardising the cyanide. Titrate with cyanide solution as before. From the quantity of cyanide taken, calculate the percentage of copper in the sample.

The solution of potassium cyanide does not remain constant, and if kept for any length of time, must be titrated before using. The presence of zinc interferes seriously with this process.

Estimation of Iron Volumetrically by Standard Solution of Potassium Bichromate.

Prepare a standard solution of potassium bichromate by dissolving 4·92 grams of the pure salt in water and diluting to one litre, 1cc. of this solution = ·0056 gram of iron.

Prepare also a solution of potassium ferricyanide—about 1 of the salt to 40 of water.

Method of Assay.—Weigh one gram of the finely-powdered substance into a small flask, add hydrochloric acid and water, digest on sand-bath for about 15 minutes. If the iron is not wholly present in the dyad state, it must be reduced by means of small pieces of pure zinc added cautiously to the solution; when it becomes nearly colourless the reduction is complete. Transfer the liquid to a porcelain basin, rinse out flask thoroughly, and observe that there are no floating particles of zinc left undissolved. Fill a Mohr's burette with standard bichromate solution, place basin underneath, and run in solution from burette with constant stirring. When the fluid begins to assume a green colour, take out a drop from time to time on the point of stirring-rod, and bring it in contact with a small drop of the potassium ferricyanide, several of which have been previously spread on a white plate. When a blue colour ceases to be produced the operation is ended. The number of cc. of the bichromate solution required × ·0056 = amount of iron in one gram of sample.

Analysis of Solder.

A. Weigh 1 gram of the solder previously cut in small pieces. Treat with a mixture of equal parts of strong nitric acid and water, heat on sand-bath and evaporate very carefully to dryness; add water boil and filter, wash, dry and ignite filter and contents, weigh; calculate into metallic tin thus:—

SnO_2 Sn
150 : 118 : : weight found : x = *Metallic Tin*.

B. Filtrate from A, evaporate to small bulk, allow to cool, mix the solution with sulphuric acid in slight excess, and add to the mixture twice its volume of alcohol; allow to settle filter, wash precipitate with alcohol, dry, detach as completely as possible from paper into a porcelain crucible, add filter ash, ignite and weigh, calculate into lead thus:—

$PbSO_4$ Pb
303 : 207 : : weight found : x *metallic lead*.

Estimation of Potassium—Analysis of Pearl-Ash.

A. Preparation of platinum tetrachloride solution:—Weigh 5 grams of scrap platinum, which has been previously boiled in hydrochloric acid, and subsequently washed with water, and dried, into a flask; cover the platinum with hydrochloric acid and half the quantity of nitric acid, evaporate to dryness on the sand-bath, add more hydrochloric acid, evaporate again to dryness, moisten the residue with hydrochloric acid, add water, and boil; filter the solution, and make up to 125cc. with water.

B. Weigh ·5gram of pearl-ash into a beaker, dissolve in about 15cc. of water, and filter; wash thoroughly; then, to the filtrate and washings in a porcelain basin, add a slight excess of hydrochloric acid; heat the basin on the sand-bath till all the carbonic acid is expelled; add 25cc. of the platinum solution, and evaporate nearly to dryness. While still warm, pour over the pasty residue about 25cc. of alcohol, cover the basin with a glass plate, and let stand for half an hour; filter through a filter which has been dried in the water-bath and weighed; wash with alcohol till washings are quite colourless. Dry filter and contents in water-bath for an hour and weigh; deduct weight of filter, × 200 and calculate into K_2CO_3, thus:—

K_2PtCl_6 K_2CO_3
488·46 : 138·26 : : weight found : x
x = per cent. of *potassium carbonate.*

C. Weigh 4 grams of the powdered ash into a weighed crucible, heat for half an hour over the reduced flame of a rose-burner, reweigh; the loss in weight × 25 = per cent. of *moisture.*

D. Dissolve the dried ash from C in hot water, filter, and wash; dry, burn, and weigh, × 25 = per cent. of *insoluble matter.*

Good pearlash contains about 95 per cent. of potassium carbonate **Esthos.**

ASTRONOMICAL NOTES FOR FEBRUARY, 1883.

The Sun.

Day of Month.	Souths.				At Greenwich Mean Noon.								
					Right Ascension.			Declination South.			Sidereal Time.		
	h.	m.	s.	p.m	h.	m.	s.	°	′	″	h.	m.	s.
1	0	13	48·63	,,	20	59	13	17	6	33	20	45	24·27
6	0	14	18·50	,,	21	19	26	15	37	33	21	5	7·04
11	0	14	28·34	,,	21	39	18	14	1	54	21	24	49·81
16	0	14	18·61	,,	21	58	51	12	20	29	21	44	32·58
21	0	13	50·66	,,	22	18	6	10	34	11	22	4	15·35
26	0	13	6·53	,,	22	37	5	8	43	49	22	23	58·11

The Method of finding the Sidereal Time at Mean Noon for any other station will be found on p. 373.

Solar Activity continues, and its well-known indications are perceptible at frequent intervals on the Sun's disc. At the end of the month the Zodiacal Light may be looked for in the W.S.W.

The Moon

Is New at 6h. 10·1m. p.m. on February 7th, enters her First Quarter at 9h. 55m. a.m. on the 14th, and will be Full 18·1 minutes after midnight on the 21st.

Day of Month.	Moon's Age at Noon.	Souths.		
	Days.	h.	m.	
1	23·3	6	31·8	a.m.
6	28·3	10	58·7	,,
11	3·7	3	30·8	p.m.
16	8·7	8	5·0	,,
21	13·7	12	6·6	,,
26	18·7	2	56·4	a.m.

The Moon will be in conjunction with Venus at 5 a.m. on the 4th; with Mars at 7 p.m. on the 6th; with Mercury at 1 o'clock in the afternoon on the 7th; with Saturn at 1 a.m. on the 14th; and with Jupiter at 8 a.m. on the 16th.

Mercury

Is an Evening Star (in the sense of southing after the Sun) until the 5th, at 11 o'clock at night of which day he comes into inferior conjunction with the Sun, and subsequently rises before him. He has considerable and increasing South Declination, and is by no means favourably placed for the observer. His diameter, which is 10″ about the time of his conjunction, diminishes to 7·4″ by the end of February.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
15	B.A.C. 1563	5½	10 5 p.m.	Dark	107	143	11 10 p.m.	Bright	247	288
16	χ^2 Orionis	6	5 59 ,,	Dark	139	109	6 49 ,,	Bright	220	200
19	B.A.C. 2872	6	5 30 ,,	Dark	106	65	6 29 ,,	Bright	230	191
19	A^1 Cancri	6	†11 51 ,,	N.N.E.	158	175				
20	A^2 Cancri	6	1 53 a.m.	Dark	95	130	2 53 a.m.	Bright	222	260
20	ω Leonis	6	9 6 p.m.	Dark	56	29	10 23 p.m.	Bright	259	246
25	χ Virginis	5	2 20 a.m.	Bright	78	78	3 40 a.m.	Dark	230	246
25	B.A.C. 4259	6	2 27 ,,	Bright	74	76	3 48 ,,	Dark	235	251

† A near approach.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	21	31·6	11	37·1	0	46·1	p.m.
6	21	5·4	12	49·1	0	4·9	,,
11	20	49·1	14	11·3	11	24·4	a.m.
16	20	39·1	15	42·5	10	54·7	,,
21	20	41·4	16	39·2	10	37·4	,,
26	20	53·2	16	56·2	10	29·5	,,

The path indicated above carries the planet from Aquarius into Capricornus, through a region in which there are nothing but small stars. Mercury will be in conjunction with Mars at Noon on the 13th.

Venus

Is a Morning Star during the entire month, and, low down as she is, is a splendid object before sunrise. She attains her greatest elongation West (46° 45′) at 6 a.m. on the 16th. Her angular diameter steadily diminishes from 29·4″ on February 1st to 21·6″ by the 28th.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	17	44·6	19	4·6	8	59·7	a.m.
6	18	3·8	19	26·5	8	59·2	,,
11	18	24·1	19	41·1	8	59·8	,,
16	18	45·2	19	46·4	9	1·1	,,
21	19	7·0	19	41·0	9	3·2	,,
26	19	29·3	19	23·8	9	5·8	,,

Starting from Serpens, Venus will thus travel through a considerable part of Sagittarius during February. She will be conjunction with π Sagittarii (1° 30′ North of it) at 10 a.m. on the 28th.

Mars

Is invisible. The minor planet

Vesta

Is now in a favonrable position for the observer who may care to regard a seemingly small 6th magnitude Star. Her position at intervals of 10 days is

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
11	10	34·6	18	12·4	1	11·6	a.m.
20	10	25·4	19	36·3	12	23·1	p.m.

Her path lies in that very blank region to the S.E. of γ Leonis.

Jupiter

Is an Evening Star, and is still the leading object in the night sky; but he is approaching the West, and although, on account of his great North Declination, he does not set until 3 or 4 o'clock in the morning, he should be looked at as soon after dark as possible to be observed to the greatest advantage. His diameter continues slowly to decrease, from 41·2″ at the beginning of the month to 38″ at the end of it.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	5	23·7	22	57·2	8	36·9	p.m.
6	5	22·9	22	57·3	8	16·5	,,
11	5	22·5	22	57·8	7	56·4	,,
16	5	22·4	22	58·6	7	36·6	,,
21	5	22·7	22	59·6	7	17·3	,,
26	5	23·4	23	1·0	6	58·3	,,

Hence Jupiter will remain sensibly stationary to the north-west of ζ Tauri.

Saturn

Is an Evening Star, and the observations which we have made with reference to observing Jupiter early apply with increased force to him, as he now souths and sets considerably sooner than the giant planet; in fact, after this month he will approach the West so rapidly that we shall cease to furnish an ephemeris of him until his return in the early autumn. His diameter very slowly decreases from 16·6″ on the 1st of the month to 15·8″ by the end of it. No perceptible change has taken place in the opening of his ring system. He will be in (so-called) quadrature with the Sun at 4 p.m. on the 8th.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	10·2	15	32·3	6	23·7	p.m.
6	3	10·7	15	35·9	6	4·6	,,
11	3	11·4	15	40·2	5	45·6	,,
16	3	12·3	15	45·1	5	26·9	,,
21	3	13·3	15	50·7	5	8·2	,,
26	3	14·5	15	56·8	4	49·8	,,

This path lies wholly in the blank region to the south of δ Arietis.

Uranus

Is a Morning Star, in so far that he does not south until nearly 3 a.m. at the beginning of February, and about 1 o'clock in the morning at the end of it. Inasmuch, though, as he rises about 8h. 29m. p.m., at the former date, and about 6h. 45m. p.m. at the latter one, it will be seen that he is fairly well placed for the observer during a good part of the working hours of the night. His angular diameter remains at 4″ during the entire month.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	11	34·9	3	34·8	2	51·0	a.m.
6	11	34·4	3	38·6	2	30·8	,,
11	11	33·8	3	42·7	2	10·6	,,
16	11	33·1	3	47·2	1	50·2	,,
21	11	32·4	3	51·9	1	29·8	,,
26	11	31·6	3	56·7	1	9·4	,,

The retrograde path indicated by the above ephemeris carries Uranus, roughly speaking, along the Ecliptic towards that wide double star τ Leonis.

Jupiter's Satellites.

Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.
1	II	Sh I	2	14	A.M.	10	I	Oc D	11	9	P.M.	19	I	Ec R	10	55	29 P.M.
1	II	Tr E	3	1	,,	11	I	Ec R	2	3	46 A.M.	20	*I*	*Sh I*	5	58	,,
2	I	Oc D	2	52	,,	11	II	Sh I	6	11	P.M.	20	II	Ec R	6	20	36,,
2	II	Oc D	7	8	P.M.	11	II	Tr E	6	41	,,	20	I	Tr E	7	0	,,
2	II	Ec R	11	52	4,,	11	I	Tr I	8	26	,,	20	I	Sh E	8	14	,,
2	I	Tr I	12	9	,,	11	II	Sh E	8	57	,,	21	*I*	*Ec R*	5	24	23,,
3	I	Sh I	1	10	A.M.	11	I	Sh I	9	34	,,	23	III	Oc D	8	8	,,
3	I	Tr E	2	24	,,	11	I	Tr E	10	41	,,	23	III	Oc R	10	52	,,
3	I	Sh E	3	26	,,	11	I	Sh E	11	50	,,	24	III	Ec D	1	14	14 A.M.
3	I	Oc D	9	19	P.M.	12	*I*	*Oc D*	5	37	,,	24	*II*	*Oc D*	2	27	,,
3	I	Ec R	12	35	7,,	12	I	Ec R	8	59	45,,	25	*I*	*Oc D*	2	52	,,
4	II	Sh E	6	19	,,	13	III	Tr I	2	36	A.M.	25	II	Tr I	8	58	P.M.
4	I	Tr I	6	36	,,	13	*I*	*Tr E*	5	9	P.M.	25	II	Sh I	11	28	,,
4	I	Sh I	7	39	,,	13	I	Sh E	6	19	,,	25	II	Tr E	11	44	,,
4	I	Tr E	8	51	,,	16	III	Oc R	7	3	,,	25	I	Tr I	12	8	,,
4	I	Sh E	9	55	,,	16	III	Ec D	9	13	20,,	26	I	Sh I	1	24	A.M.
5	I	Ec R	7	4	5,,	16	III	Ec R	11	54	13,,	26	*II*	*Sh E*	2	14	,,
5	III	Tr I	10	58	,,	16	II	Oc D	11	58	,,	26	*I*	*Tr E*	2	24	,,
6	III	Tr E	1	39	A.M.	18	I	Oc D	1	0	A.M.	26	I	Oc D	9	21	P.M.
6	III	Sh I	3	13	,,	18	II	Tr I	6	26	P.M.	26	I	Ec R	12	51	15,,
8	II	Tr I	2	42	,,	18	II	Sh I	8	50	,,	27	*III*	*Sh E*	6	6	,,
9	*III*	*Ec D*	5	12	45 P.M.	18	II	Tr E	9	11	,,	27	I	Tr I	6	36	,,
9	III	Ec R	7	52	23,,	18	I	Tr I	10	16	,,	27	I	Sh I	7	53	,,
9	II	Oc D	9	32	,,	18	I	Sh I	11	29	,,	27	I	Tr E	8	52	,,
10	I	Tr I	1	58	A.M.	18	II	Sh E	11	36	,,	27	II	Ec R	8	56	0,,
10	II	Ec R	2	27	30,,	18	I	Tr E	12	32	,,	27	I	Sh E	10	9	,,
10	I	Sh I	3	5	,,	19	I	Sh E	1	45	A.M.	28	I	Ec R	7	20	9,,
10	*I*	*Tr E*	4	14	,,	19	I	Oc D	7	28	P.M.						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Neptune

Is now approaching the West so rapidly that, in the course of another month, he will be lost in the Sun's rays. Hence he should be looked for as soon after dark as possible. He will be in quadrature with the Sun at 4 a.m. on the 5th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 56·4	14 57·1	6 10·0 p.m.
6	2 56·5	14 57·9	5 50·4 ,,
11	2 56·6	14 58·9	5 30·9 ,,
16	2 56·9	15 0·1	5 11·5 ,,
21	2 57·1	15 1·5	4 52·1 ,,
26	2 57·4	15 3·2	4 32·7 ,,

Thus Neptune will describe an almost imperceptible path to the East and slightly to the North of σ Arietis.

Shooting Stars

Are rare in February. The most likely dates on which to look out for them are the 10th and the 19th.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of February 1st, 1883.

Star.	Souths. h.	m.	s.	
α Ceti	6	9	46·02	p.m.
α Persei..	6	29	32·34	,,
Aldebaran	7	42	34·10	,,
Capella	8	21	19·04	,,
Rigel	8	22	9·94	,,
α Leporis	8	40	46·25	,,
α Columbæ	8	48	35·54	,,
α Orionis	9	1	59·10	,,
Sirius	9	53	0·00	,,
Castor	10	40	9·42	,,
Procyon	10	46	2·65	,,
Pollux	10	51	0·80	,,
α Cancri	12	4	44·35	,,
α Hydræ	12	34	24·44	,,

The Method of ascertaining the Greenwich Mean Time of Transit of either of the Stars in the above List on any other night in February, as also that of finding the Local Instant of its Southing at any other station, will be found at p. 375.

SOME NEW DOUBLE STARS.*

THE juxtaposition of two stars must mean that they are connected with each other, and therefore are both about the same distance away from us, or there is no connection between them, and so one is a great deal nearer to us than the other. Now, we have no means of determining whether a double star belongs to the first class or to the second class, except by observations carried through a number of years. How are the observations made? By measurements of position, and by determinations of distance. First, as regards the measurements of position. The field of view of an eyepiece is circular, and we may consider it as a circle, and consequently divided into 360 degrees. Now, if a star passes through the field of view, a line at right-angles to its movement will give us the N. and S. points of the circle. Position-angles are measured from the N. round by the E., through the 360 degrees. The astronomical telescope inverts, and, hence, the bottom of the field of view, instead of being S., is N., and the apparent W. side is really E., and so on. So, then, position-angles are reckoned from the bottom of the field of view. Suppose, then, we have two stars in the same field of view, close enough to lead us to believe that there is some connection between them; let us first find out what is the angle between a line joining them and a line drawn from the biggest star to the N., or bottom of the field. That angle is called the "position-angle" of the double star. Now, if it happens that one of these stars revolves round the other, one of two things will occur: either that our line of sight is at right-angles to the plane of the orbit, or that the orbit is inclined to the line of sight. In the first case, the one star will change its position-angle year after year, until it has completed its circle, keeping almost the same distance from the other star. In the second case, the distance between the two stars, as well as the position-angle, will alter. If, however, the plane of the orbit is parallel with the line of sight, the distance alone will alter, and the companion star will, at one time, appear on one side of the big star, and, after a certain period, will be found on the other side the star. So that the position-angle is not sufficient; but we must know the distance as well. This distance is the number of seconds of arc between the two stars on a great circle going all round the heavens, and through the two stars. It is measured by a distance micrometer, which mainly consists of a screw with a divided head, and by which a second of arc can be divided into a very great number of parts. The screw moves a frame carrying a wire. The principal star being brought to one wire, the screw is turned till the second star is bisected by the movable wire, and the distance between the two wires is read off in revolutions and parts of revolutions of the screw. The value of one revolution is found by allowing a star near the equator to transit from wire to wire, and the interval of time, multiplied by 15, gives the distance of arc. The two necessary measures of a double star are the position-angle, or the angle between a line joining the two stars, and a line drawn from the centre of the field to the N. point; and, secondly, by the distance between the two stars measured in seconds of arc on a great circle drawn round the heavens, and passing through the two stars.

The term "double star" is one of great latitude, and may mean any two stars lying near each other. Sub-divided into physical and optical doubles, we have (1) stars of approximately the same distance revolving round their common centre of gravity; (2) stars which lie in the same line of sight, but one an infinitely greater distance away than the other.

The number of double stars considerably exceeds 10,000. Sir John Herschel's discoveries in this branch of astronomy amount alone to many thousands. Having made a rough micrometer, I set to work some time ago to measure some of Sir John Herschel's pairs which have at present received no attention. In doing this, some new ones came to light, some of which I now have the honour of communicating to the Society. The one which Mr. Burnham has measured was the first detected, and is a wide, but very beautiful, pair. The small companion was detected with a metallic reflector of 13in. aperture, and the same night I found it double, though two trained astronomers and two other gentlemen who are telescopists could not see a trace of its duplicity. On the same night I saw the companion to 16 Aurigæ, though, at the time, I was unaware of its distance or position. I have since seen it and the companion to my double star with my 5in. refractor. The distances in the following pairs are estimations:—

	P.	D. ″	Mags.
(1) Near 16 Aurigæ..	10½° 145	10½ + 2 +	A 8, B 9 C D 13, 14
(2) 55s. P. ε Crateris, 22′ S.	345	5 +	10, 11
(3) 1m. 35s. F. ε Crateris, 14′ N.	334·3°	25 +	9, 9½
(4) 3m. 45s. P. 27 Hydræ, 12′ N........	83·7	4	10, 10½
(5) 5m. 21 R.A. — 2° 9 decl...............	357·7	14·5″	8·7, 10½
		A third star at 300″.	
(6) 5m. 21 R.A. — 2° 9 decl...............	49·1	4·8″	8·5, 10·3

No. 1 is the star measured by Mr. Burnham.

No. 2 found March 13, 1882; only two measures of position were obtained.

No. 3 found March 15, 1882, and measured on three nights.

No. 4 found March 15, 1882, and measured on two nights.

Nos. 5 and 6.—The place is given from Mr. Perry's observations. The positions, distances, and magnitudes are those of Mr. Knott. It is uncertain whether one of them is not already known.

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* Abstract of a lecture delivered by Rev. T. E. Espin, B.A., F.R.A.S., Vice-President of the Liverpool Astronomical Society.

ON TELESCOPES OF SHORT FOCAL LENGTH.*

By Prof. H. L. Smith.

IN No. 28 *Science Observer*, I have given an account of the excellent performance of an achromatic telescope of short focal length made by Mr. R. B. Tolles, of Boston, Mass. I desire again to call attention to the advantages of such telescopes over those of the ordinary focal length to same aperture. Many years ago when the reflecting telescope, in the hands of Short, Watson, and others, was brought to a considerable degree of perfection, many excellent "dumpys," as they were called, were made—e.g., a Gregorian by Watson of 4in. aperture was only eleven inches focus, and this short telescope showed ε Bootis neater than a 46in. achromatic. The difficulty however in correcting short focal length telescopes, a difficulty much increased in the case of the achromatic, and the consequent extra cost of production, prevented their general adoption, and many of the earlier achromatics had focal lengths twenty or twenty-five times the aperture of the objective. The first (then considered) large achromatic brought to this country—before we had a single artist competent to construct an achromatic telescope, was the "Dollond" 5in. at Yale College, and which had a focal length of ten feet. This telescope had a triple object-glass full of bubbles and specks, but still sufficiently homogeneous to make a really capitally well corrected object-glass, and probably, for its day, unrivalled. In modern times the accepted ratio between aperture and focal length has been adopted as 1 : 15. Any increase of this ratio has been thought inadvisable, as it necessitates not only thicker discs, but requires far more skill in the artist for proper correction of the spherical and chromatic aberrations. The first-named objection is of slight moment, the last is more serious and necessitates a discrimination between a really good and an indifferent artist. To-day we have constructors of achromatic telescopes who are fully capable of dealing with the problem, and in the hands of these men, telescopes as perfectly corrected of short focal lengths can be made as those of the old form—nay, in many respects, as I hope may appear, better. I am not aware that the Clarks, of world-wide reputation (outside it may be of the construction of a comet searcher, which was not intended to do what is expected from the same aperture of the larger focal length upon close double stars), have made what we may call a telescope of unusually short focal length. Steinheil in Europe and Mr. Tolles in Boston have both devoted considerable time, and with no little success, to the construction of such telescopes, and more recently Mr. John Byrne, of New York, has shown himself fully equal to the task of producing such instruments, of the very highest grade of excellence, and I am induced to give the following account of the performance of one lately received from him, not only for the sake of making better known the merits of Mr. Byrne as a telescope-maker, but also to show more clearly the advantages of the shorter focal length. In the division of close double stars, highest excellence of figure and consequent corrections are not alone sufficient; the magnitude of the spurious discs set a limit to the separating power. I have not Airy's treatise on the undulatory theory by me at present to refer to, but I am pretty certain that he gives the extreme diameter of a star disc, in seconds of arc, to the first black ring, $\frac{5\cdot52}{\text{aperture}}$; i.e., for 4in. aperture 1″·38. We all know that the stellar discs are larger for brighter stars, and that the limit of resolving power to the aperture is much smaller than Airy's formula would give. Mr. Dawes, as the result of observation, has given $\frac{4\cdot6}{\text{aperture}}$, and Dallmeyer, $\frac{4\cdot32}{\text{aperture}}$; now all of these depend more or less upon relative focal length, for the longer the focus in proportion to the aperture, the larger will be spurious discs and stars, which with a given aperture and focal length appear in contact, may show a distinct sky-line between, with same aperture and shorter focal length, and this even with less magnifying power and less trouble therefore from tremor and atmospheric disturbance. With a very high power the star flits through the field with rapidity, and if one does not have the luxury of a pretty good driving-clock, and which could hardly be applied to a portable instrument, the constant necessity for movement by hand is detrimental to perfect vision. Some time ago I was looking at the minute double *s.f.* Procyon (31 Bode Canis Minoris), and with the power I was using, the two stars were in contact at the time the aperture of the object-glass was considerably contracted by a cap, on removing which, and using full aperture, the discs were so diminished in size that now a distinct sky-line was visible between them. In other words, I could, with same power, now separate a closer double than before. This fact, however, is well enough known to observers, and I would only call attention to another which appears pretty evident to me from actual experiment—viz., the stellar discs are not only more minute, but are apparent with far less magnifying power. I believe that, with the ordinary telescope, having ratio of aperture to focal length—say, 1 : 15—the discs are not well discerned with a less power than about 30 to the inch of aperture. Some have put it even 35 times the aperture. Now with the Byrne telescope of 4¼in. aperture and 38in. focal length, I get very beautiful stellar discs, without rings or rays on a fine night, with a power of 60, and even with a power of 40, which clearly separates the components of the quadruple star, ε Lyræ. Of course to do this with so low power requires a good eye, but the power of 60 is quite sufficient to show them far apart, and to indicate clearly the duplicity of π Aquilæ, and with same power I have seen repeatedly ι Cassiopeiæ triple. Of course, with all these stars a power of 110 is better, and one scarcely ever needs, except for the very closest doubles, more than 150. With the latter power, produced by a very excellent one-fourth solid eyepiece by Tolles, there are no diffraction rings, or but a mere trace, and the clean shaven discs are really lovely. With 275 we get one or two diffraction rings, but even now faint; with this power ζ Herculis is shown, though at the present time this rapid binary is almost too close for a telescope of this aperture; λ Ophiuchi is readily seen with a power of 150. Of course, the telescope is all one could ask upon planets. The solid eyepiece giving power 150, has shown to me Saturn with not a trace of the marginal blue light so often seen in the Munich telescopes, and most exquisitely defined, the shading of the outer ring, the crape ring, and the belts, in a manner that I have never seen surpassed, and rarely equalled in any telescope.

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* From the *Sidereal Messenger* (Northfield, Minnesota, U.S.A.)

I do not unhesitatingly affirm that I have yet (under the most favourable circumstances) seen closer doubles than same aperture of ordinary length would show, but I am certain I have seen them with *less magnifying power*, and that I can handle the whole instrument with far more ease than if the tube had been the normal length; in fact, for the right ascension screw, no arm with universal joint is needed, the milled heads are within easy reach, and nothing can be more agreeable to use than this instrument with the star diagonal, and I have rarely used it without this. Neither can I say that more minute points of light are discernible with the "dumpy" for some aperture. The companion of α Lyræ, best seen with about 60 is steadily visible, when there is still enough daylight to see the second's hand of the watch, though after all, it was not much more easily visible when the sky was darker owing to increased brilliancy of the larger star. The two faint stars (debilissima) between four and five ε Lyræ are of course, easy enough any clear night, and the companion of Polaris I have seen with a power of only 22. I dare say there are numerous telescopes of 4¼in. aperture and ordinary focal length which will show all I have named, but I have yet to see one that *with so low powers* will do this, and therefore am pretty certain that if I had been able to use the instrument on a more firm foundation, and with still higher powers, I could have readily separated stars less than 1″ distance, and I am pretty certain that Mr. Byrne could make a telescope say of 9in. aperture and 7ft. focal length, that would separate any double star now known, and prove a fair match for some of the gigantic, and necessarily more or less unwieldy instruments, bending under their own weight, if only some patron would give him the order.

In calling attention to the shorter telescopes and referring to Mr. Byrne's success, I only desire to state facts. I have already named Mr. Tolles's success with a telescope of same size; that telescope is now doing good service in China, where it was taken by one of my pupils, who, after long experience with the use of it, and abundant comparison with others of ordinary focal length, selected it as far preferable—so far, that price was altogether a secondary consideration. Confident that Mr. Byrne could duplicate this telescope I parted with it, and have only been confirmed in my opinion of the superiority of the shorter focal length telescopes from my experience with the one which he has sent me and to which I have alluded in this article.

DRY-PLATE DEVELOPMENT.

We mentioned in the "Scientific News" last week that Mr. Bashford, the hon. sec. of the Edinburgh Photographic Society, had sent us a photo. taken by moonlight, and we have now to acknowledge the receipt of several taken by gaslight. One of these, a parlour interior, with a gaselier of three lights, is as full of detail as if taken in the daytime, and another of a girl blowing a fire in a kitchen range, taken by the light of one burner, is remarkable, considering the illumination. We make the following extracts from Mr. Tamkin's paper, read before the above Society:—The developer I have found most reliable is similar to that recommended for Wratten's plates, only I find that a two grain solution in place of a three grain solution of pyro is sufficient in portraiture to give all the density required, and our mode of working may not be exactly what is prescribed with their formula, but it is simplicity itself.

It is as follows:—In an easy-stoppered dropping-bottle we have a solution prepared thus—

Ammonia	5oz.
Bromide of potassium ..	5 drachms.
Water	10oz.

and that is the only solution we need for ordinary work. Of course we have separate solutions at hand of bromide and ammonia in case they are required.

To develop a plate we put it into a dish with sufficient water to cover it, and then measure the pyro into the cup, and pour the water from the dish upon the pyro and back again; the ammonia-bromide is then dropped into the cup, and the solution from the dish poured upon it and returned to the plate, when the image soon makes its appearance, and if rightly exposed is fully developed in about two minutes, sometimes less.

This formula appears to suit other plates than those it was specially intended for, but with Wratten's (which are the plates I have done most of my dry-plate work with) I find it not only suitable for all kinds of work, but equal to almost any emergency. But we are occasionally (now that instantaneous photography is thought to be so simple) asked to take a sitter when the light is so far gone that focussing is pure guesswork, or we have to take an instantaneous picture of a child on a very dull day, and even though ordinary methods fail, our resources are not at an end, for, by dispensing with the restrainer in the developer, and using pyro and ammonia alone, you may give one-third the exposure you would give for ordinary treatment, and get very good results. I have developed plates with three drops of pure ammonia to the ounce of pyro solution without fog, and with the ordinary developer fogging is of rare occurrence with us.

I find that most good plates will stand a considerable quantity of ammonia-bromide if applied at first with the fresh pyro. You may take a half plate, knowing it to be under-exposed, and develop it with thirty or forty drops right off, and get a good clear negative; but begin a similar one with ten drops, and then add other twenty or thirty when the developing has proceeded some length, and the probability is you will get a thin, foggy negative.

In reference to these photographs taken by gaslight, I may explain that they were taken with a single lens. No. 6, "Girl Blowing the Fire," was taken by the light of one ordinary gas-burner, exposure about 7½ minutes. In this case the stop was removed to try how the lens would act without it. In one of the other interiors, No. 7, you will see that the negative has been as well exposed as if done in daylight. These were all developed with the ordinary formula, as also No. 8, "Part of a Street by Gaslight." There being no light but what came from the shop-windows, this is under-exposed; but I obtained a better exposed negative, which is unfortunately still in the printing-frame. This one, No. 9, was taken by moonlight, by Mr. Frank Moffat, and developed without a restrainer.

In one of the interiors in which Mr. Tamkin is shown, seated in an easy chair, it should be explained that it was exposed altogether about 40 minutes. Mr. Tamkin sat 31 minutes, then left his seat, removed the white objects, and allowed the exposure to proceed for a short time. In the fully exposed interiors the same plan was adopted; about three-quarters of an hour's exposure was given, the supper-table was then cleared, and other prominent white articles removed or obscured, and the exposure continued for other three-quarters of an hour. There were here three gas-burners lighted, and a total exposure of 30 minutes, according to Mr. Tamkin's calculation, would have been sufficient had an unrestrained developer been used. The moonlight view taken by Mr. Moffat, which we mentioned last week, was done with Dallmeyer's rectilinear.

DYNAMO-ELECTRIC MACHINERY.—IV.*

By Prof. S. P. Thompson, B.A., D.Sc.

(*Continued from p.* 447.)

The Dynamo in Practice.

It was pointed out, at the conclusion of the former lecture, that none of the four fundamental methods of exciting the field-magnetism of a dynamo was perfect in theory, since none could enable a machine either to generate a constant current, or to maintain a constant electromotive force, whatever the resistance of the external circuit for the time being. Now, as the first function of a dynamo in practice is to feed with sufficiency and regularity a system of lamps, and as those lamps are always in practice arranged either in series or in parallel, it is clear that in the former case a constant current, and in the latter a constant electromotive force, is required.

Combination Methods.

As this matter promises to be of utmost importance in the future practice of constructing dynamos, a summary of the principal methods may be worth tabulating.

(1.) *Series and Separate (for Constant E.M.F.), Deprez.*—This method, illustrated in Fig. 13, can be applied to any ordinary dynamo, provided the coils are such that a separate current from an independent source can be passed through a part of them, so that there shall an initial magnetic field, independent of the main-circuit current of the dynamo. When the machine is running, the electromotive force producing the current will depend partly on this independent excitement, partly on the current's own excitement of the field-magnets. If the machine be run at such a speed that the quotient of the part of the electromotive force due to the self-excitement, divided by the strength of the current, is numerically equal to the internal resistance of the machinery, then the electromotive force in the circuit will be constant, however, the external resistances are varied. M. Deprez has further shown that this velocity can be deduced from experiment, and that, when the critical velocity has once been determined, the machine can be adjusted to work at any desired electromotive force, by varying the strength of the sepatately-exciting current to the desired degree.

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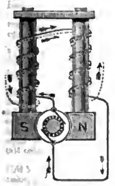
* Extracted from the Cantor Lectures, delivered before the Society of Arts.

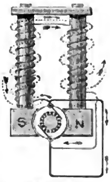
(2.) *Shunt and Separate (for Constant Current), Deprez.*—When cases arise, as for a set of arc lamps in series, it is desired to maintain the current in the circuit at one constant strength, the previous arrangement must be modified, as indicated in Fig. 14, by combining a shunt-winding with coils for a separately-exciting current. This arrangement is, in fact, that of a shunt-dynamo, with an initial magnetic field independent of the strength of the current in the circuit.

FIG. 13.



COMBINATION OF SERIES AND SEPARATE.

FIG. 14.



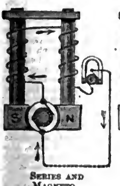
SHUNT AND SEPARATE.

Seeing that the only object in providing the coils for separate excitement is to secure an initial and independent magnetic field, it is clear that other means may be employed to bring about a similar result.

(3.) *Series and Magneto (Constant E.M.F) Perry.*—The initial electromotive force in the circuit, required by Deprez's theory, need not necessarily consist in there being an initial magnetic field of independent origin. It is true that the addition of a permanent magnet, to give an initial partial magnetisation to the pole-pieces of the field-magnets, would meet the case to a certain extent; but Professor Perry has adopted the more general solution of introducing into the circuit of a series-dynamo a separate magneto machine, also driven at a uniform speed, such that it produces in the circuit a constant electromotive force equal to that which it is desired should exist between the leading and return mains (see p. 539, Vol. XXXV).

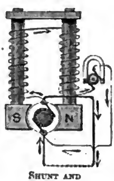
This arrangement, which is depicted in Fig. 15, may be varied by using a shunt-wound dynamo, the magnets being, as before, included in the part of the circuit outside the machines. The combination of a permanent magnet with electro-magnets in one and the same machine, is much older than the suggestions of either Deprez or Perry, having been described by Hjorth in 1854.

FIG. 15



SERIES AND MAGNETO.

FIG. 16.

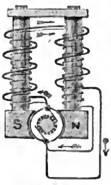


SHUNT AND MAGNETO.

(4). *Shunt and Magneto (Constant Current), Perry.*—Perry's arrangement for constant current is given in diagram in Fig. 16, and consists in combining a shunt dynamo with a magneto machine of independent electromotive force, this magneto machine being inserted either in the armature part or in the magneto-shunt coils of the machine. As before, a certain critical speed must be found from experiment and calculation.

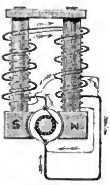
(5). *Series and Shunts.*—A dynamo having its coils wound, as in Fig. 17, so that the field-magnets are excited partly by the main current, partly by a current shunted across the brushes of the machine, is no novelty, having been used in dynamos for some years past. The arrangement is not so perfect as either of the preceding, being more limited in operation. If the shunt coils be comparatively few, and of high resistance, so that their magnetising power is small, the machine will give approximately a uniform electromotive force; whereas, if the shunt be relatively a powerful magnetiser, as compared with the few coils of the main circuit, the machine will be better adapted for giving a constant current; but, as before, each case will correspond to a certain critical speed, depending on the arrangements of the machine.

FIG. 17.



SERIES AND SHUNT.

FIG. 18.



SERIES AND LONG-SHUNT.

(6). *Series and Long Shunt.*—I propose to give this name to a combination closely resembling the preceding, which has not yet, so far as I am aware, been actually tried. If, as in Fig. 18, the magnets are excited partly in series, but also partly by coils of finer wire, connected as a shunt across the whole external circuit, then the combination should be more applicable than the preceding to the case of a constant electromotive force, since any variation in the resistance of the external circuit will produce a greater effect in the "long-shunt" than would be produced if the resistance of the field-magnets were included in the part of the main circuit external to the shunt.

Although the last two combinations are not such perfect solutions of the problem as those which precede, they are more likely, in my opinion, to find an immediate application,* since they can be put into practice upon any ordinary machine, and do not require, as in the first four combinations, the use of separate exciters, or of independent magneto-machines

All these arrangements presuppose a constant velocity of driving; but they are not the only ones consistent with this condition. An ordinary series dynamo may be made to yield a constant current by introducing across the field-magnets a shunt of variable resistance, the resistance of the shunt being adjusted automatically by an electro-magnet, whose coils form part of the circuit. This is actually done in the automatic regulator attached to Brush dynamos, as used in supplying a series of arc lights. A shunt dynamo may similarly be controlled, so as to yield a uniform electromotive force, by introducing a variable resistance into the shunt-magnet circuit, as is done in some of Edison's dynamos. To make the arrangement perfect, this variable resistance should be automatically adjusted by an electro-magnet whose coils are an independent shunt across the mains of the external circuit.

Yet another way of accomplishing the regulation of dynamos is possible in practice, and this without the condition of a constant speed of driving. Let the ordinary centrifugal governor of the steam-engine be abandoned, and let the supply of steam be regulated, not by the condition of the velocity of driving, but by means of an electric governor, such as an electro-magnet working against an opposing spring. If this electro-magnetic governor is to maintain a constant electromotive force, its coils must be a shunt to the mains of the circuit. If it is to maintain a constant current, its coils must be part of the main circuit. Such a governor ought to be more reliable and rapid than any centrifugal governor intended to secure a uniform speed of driving.

Field-Magnets.

In the classification of dynamos, laid down in my first lecture, we found that those of the first class required a single approximately uniform field of force, while those of the second class required a complex field of force differing in intensity and sign at different parts. Accordingly, we find a corresponding general demarcation between the field-magnets in the two classes of machine. In the first, we have usually two pole-pieces on opposite sides of a rotating armature. In the second, a couple of series of poles set alternately round a circumference or crown, the coils which rotate being set upon a frame between two such crowns of poles.

Confining ourselves, at first, to the first-class of machines, we find that in practice, their magnets differ widely in construction and design. In very few of the existing patterns is there much trouble taken to secure steady magnets, by making them long, heavy, and solid, or with very heavy pole-pieces. I have repeatedly, in testing dynamos, had to report that an unnecessary amount of wire had been wound upon the field-magnets; and I find that the usual reply is that with less wire the machine does not work so well. If, however, it is found necessary to wind on so many coils upon the magnets as to bring these practically to saturation long before the machine is doing its maximum work, it is clear that either the iron is insufficient in quantity, or it is deficient in quality. In the Bürgin machines, where cast-iron field-magnets are employed, the smaller magnetic susceptibility of this metal is made up for by employing a great weight of it. In Siemens's smaller dynamos, the amount of iron employed in the field-magnets would be quite insufficient if it were not of high quality. As it is, I am of opinion, the mass of it (especially in the polar parts) might, with advantage, be increased. In some of the early machines of Wilde, and in Edison's well-known dynamos, long field-magnets with heavy pole-pieces are found. Edison's dynamos, indeed, are all remarkable in this feature; the pole-pieces and the yoke connecting the iron cores of the coils are made abnormally heavy. This is not more noticeable in the giant dynamos, than in the smaller machines used in isolated installations for sixty and for fifteen lights.

The principle of shaping the magnets, so that their external form approximates to that of the magnetic curves of the lines of force, is to some extent carried out in such widely differing types of machine as the Gramme with "Jamin" magnet, the Jurgensen dynamo, and Thomson's "mouse-mill" dynamo. The two machines last named exhibit several curious contrasts. In the Jürgensen the field-magnets have heavy pole-pieces; in the Thomson there are none; and in the Thomson machine the iron core is thicker at the middle than at the ends. In both there are auxiliary internal electro-magnets, fixed within the rotating armature, to concentrate and augment the intensity of the field. In the Thompson machine the coils are heaped on more thickly at the middle of the field-magnets; in the Jürgensen, the coils are crowded up around the poles. If we may judge from a report on this machine by Professors Ayrton and Perry, the arrangement is not satisfactory in practice, as there are more coils than suffice to magnetise the magnets. Is it possible that the mistake is not in having too many coils, but in having them in the wrong place?

Another suggestion, which was indicated from theoretical considerations, was that of laminating the pole-pieces, so as to prevent the production in them of wasteful Foucault currents. Here I find that but one machine has been designed in which this precaution is carried into effect. This is the disc-dynamo of Drs. Hopkinson and Muirhead, the field-magnets of which are made up of laminæ of iron, cast into a solid iron backing.

Another matter in which, up to the present time at least, there is nothing but empirical practice to guide us, is the form to be given to pole-pieces, in order to produce the best effect. In fact, we have such singular divergence in practice as to suggest the thought that little importance has been attached to the matter. Yet upon the form and extent given to the pole-pieces depend considerations of no less importance than the reduction of idle wire in the armature, the reduction of sparking at the commutator, and the avoidance of counter-electromotive forces in the armature. If the pole-pieces are badly shaped for their work, or approach one another too far round the armature, they may completely perturb the approximate uniformity of the field, and may cause the central portion of the field to be of much weaker intensity than the two lateral regions between the edges of the pole-pieces. When this is the case, the rotating coils are virtually moving in a double field, and it is even possible that, in consequence, the direction of the currents induced in the individual coils may be reversed four or six times as they make one rotation. In such a case the distribution of potential round the separate bars of the commutator will be abnormal, as we shall see later on.

(*To be continued.*)

THE LARGEST ELECTRO-MAGNET.

THE largest electro-magnet in the world, according to the German *Humboldt*, is that in the physical institute of the Greifswald University.

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* Since the above was written, an account of a similar combination to the 5th mentioned above has appeared under the name of Crompton's Compound Dynamo. Mr. R. M. Bosanquet, of St. John's College, Oxford, has also suggested a similar arrangement for charging accumulators with a constant electromotive force.

It is made of 28 plates of iron, each 7 millimetres (about ¼in.) thick. A massive iron core was not permissible, owing to the cost and other difficulties. These plates were so cut that their width corresponded to the consecutive parallel chords of a circle seven times 28mm. (20in.) in diameter. They were heated in a fire, and bent to a horseshoe form. The sides that were to be opposite each other were varnished or lacquered, to make the action of the extra current as great as possible, and then they were fastened together. The projecting edges were then filed off smooth. In this way a horseshoe magnet was obtained that is 1,270mm. (51in.) high. The diameter of the cylindrical core is about 8in., and its total length 9ft. The distance of the poles from the centre of the cylinder is 24in., and the weight of the core 1,381½lb. The magnetising coil is partially of copper ribbon, and partially of copper wire. The strips of copper are in rings of 15 windings each, separated from each other by strips of guttapercha, and soldered together to form a continuous current. The copper wire is put around it up and down, two and two, with thick paper between the layers. There are five double layers of two wires each, so that with the copper ribbon there are 25 courses, one over the other, the weight of them being 605lb. Total weight of core and coil, 1,986½lb.

For comparison we give the size of other large horseshoe electro-magnets.

	Faraday's.	Pluecker's.	Griefswald.
Length of core....	46½in.	53in.	108in.
Diameter of core..	40in.	40¼in.	80in.
Weight of core....	142½lb.	185lb.	1381lb.
Distance of poles..	6·0in.	11·4in.	24·0in.
Number of layers of wire.........	3	3	25
Total weight......	187lb.	262lb.	1986lb.

The iron core is cemented in a box made of stout oaken plank and resting on wheels. The current is generated by 54 Grove-Poggendorff cells. With this powerful instrument a great variety of experiments can be performed. When a copper cylinder containing 40 grams of Wood's fusible metal (melting at 65° or 70° C.) is rotated between the poles it melts in less than two minutes. A rotating copper disc, 10in. in diameter, which can be rotated rapidly in a vertical plane by means of a weight, is almost stopped on closing the current. The rotation of the plane of polarisation in Faraday's flint glass is seen when the light passes through it only once. By using a sugar solution in a tube 8in. long the plane of polarisation changes from red to light blue on reversing the poles. The magnetic action on liquids, gases, and flames can be made visible to a large audience.

USEFUL AND SCIENTIFIC NOTES.

Poisonous Properties of Edible Fungi.—It is well known that among the higher fungi there are some which, even when cooked, are dangerously poisonous, while other may be eaten without harm. That the latter, however, contain a poisonous principle seems to be proved by experiments recently made by M. Dupetit. He injected under the skin of some animals fresh juice from the edible fungus *Boletus edulis*, in a dose of two cubic centimètres to 100 grammes weight of the animal. This was followed by symptoms of poisoning and by death, the latter in three to six hours in the case of the rabbit, and a longer time in those of the guinea-pig and rat. Similar effects were had from other fungi, supposed non-poisonous, e.g., *Amanita cæsarea*, *Amanita vaginata*, *Amanita rubescens*, and *Agaricus campestris*. The juice of the cultivated agaric seemed less active. It is a curious fact that *Amanita rubescens* alone among the species of fungus experimented with proved poisonous to frogs when the juice was injected. The juices of those fungi may be introduced in large doses and in the fresh state into the alimentary canal of guinea-pigs with impunity. Moreover, *Amanita rubescens*, considered always poisonous in the raw state, produced no apparent injury to dogs which swallowed it raw. The chemical properties of the active principle recall those of soluble ferments, and not those of known alkaloids. Submitted to a temperature of 100° C., the juice always becomes quite innocuous. Thus there is no risk attaching to edible fungi when cooked.

Black Aniline Ink.—For a black aniline ink, the *Journal* of the Society of Chemical Industry gives the following:—Dissolve 5 parts nigrosin in 100 parts water, and if the solution is very blue add a few drops of an aqueous solution of Bismarck brown. With the addition of 5 per cent. of glycerine it becomes a copying ink. For a black lacquer for leather, dissolve best shellac, 40 grammes; sandarac, 10 grammes; mastic, 5 grammes in ½ litre methylated spirit, and add 20 to 30 grammes pure Venetian turpentine. The solution is coloured a deep black by adding nigrosin.

SCIENTIFIC SOCIETIES.

METROPOLITAN SCIENTIFIC ASSOCIATION.

THE fourth meeting of the session was held at 13, Blomfield-street, E.C., on Tuesday, the 9th January; the President, H. T. Vivian, Esq., F.R.A.S., in the chair. An interesting paper, illustrated by sketches and diagrams, was read by Mr. Grenville A. J. Cole, F.G.S., on "Denudation in the Western Highlands," of which the following is an abstract:—

"The Western Highlands and Islands offer abundant examples of the work of denuding agents. The action of the sea in undercutting rocks and producing cliffs is much aided by vertical or overhanging joints. An extreme case is the removal, one by one, of the columns of the Staffa lava-stream, while the slopes of softer secondary strata found under cliffs of jointed basalt illustrate the difference of action upon different rocks. The important work of rain, with its chemical results, produces, by widening vertical joints, the pinnacles of the north of Skye, the inland lava cliffs, and the step-like terraces characteristic of "trap" rocks and distinctly stratified beds. Where the joints overpower the stratification, and the rock has no great coherence, we may have mountains with enormous cliffs carved out of purely horizontal beds. Suilven and the sandstone hills of the north-west are superb examples. The material brought down must be removed, or the work ceases, and rivers serve mainly in this way; but their action in making valleys may be seen in the canon near Loch Broom, and in all the variety of glens. The excavation of the fjords is explained by their being merely submerged valleys. In conclusion, the action of the old glaciers, however we may estimate it, was certainly one of denudation; and a review of the unconformities between the successive formations, many of which, like the Cretaceous, are here reduced to the merest relics, shows how powerful the destructive agents were in all times in this Highland area."

THE METEOROLOGICAL SOCIETY.

THE annual general meeting of this Society was held on Wednesday, the 17th instant, Mr. J. K. Laughton, M.A., F.R.A.S., President, in the chair, who delivered his address. He referred briefly to the great importance of the uniform series of observations now taken under the auspices of the Society, and proceeded to speak, at greater length, of certain other points in which the Society might, by its concerted action, further the interests of meteorological science. The first of these was anemometry, which is at present in a condition far from satisfactory. We know nothing positively either as to the pressure or the velocity of the wind; there is no exact standard instrument; and observations, whatever may be their absolute value, are not comparable one with the other. He thought that the Society might properly interfere, so far as to regulate the wide diversity amongst the instruments now used, in order that when the proper time came, and it was known what anemometer could be trusted, the older observations might be reduced. The movement of air in the upper regions of the atmosphere is not measurable by any existing method; but experiments have been made, at the suggestion of the Meteorological Council, in which the drift of the smoke-cloud of a bursting shell may be observed and measured. The observations of the barometer taken at elevated stations in the United States seem to throw considerable doubt on the received formula for the reduction of barometric readings to sea-level, and for the calculation of heights. When the observations extend over a long period, and are regularly taken under all conditions of weather, then no doubt the height of a mountain can be calculated with a fair approach to accuracy; but isolated observations, subject to the fluctuations of the different readings, are extremely wild in their results. In the same way, the reduction of the barometer to sea-level is complicated by many discrepancies which arise between observations at the upper and lower stations, which have hitherto been ignored. It is impossible to say how far they affect the isobars on which our daily weather charts are based; but it is at least probable that they are at least one additional source of error and of difficulty. It is much to be wished that systematic and continuous observations at high-level stations could be taken, not only on the top of Ben Nevis, but on the top of some others of the highest peaks in different parts of the country. In this way alone can these difficulties of reduction be cleared away.

AMATEUR MECHANICAL SOCIETY.

A FULL meeting of the Council of the Amateur Mechanical Society was held at the Society's Laboratory, No. 5, Robert-street, Adelphi, on the 10th inst, and on examining the balloting-papers, Mr. Perigal and Mr. Capel were unanimously elected members of the council, while Mr. Reginald Masters Smith was elected honorary secretary, in conjunction with Mr. Boord, M.P. An important report was then brought up by Dr. Edmunds upon the subject of screw-threads for the ornamental mandrel-noses, which are still screwed at the obsolete and inconvenient rate of 9·45 threads to the inch, and are so turned out at the base as to endanger their strength. Two cases were reported to the council in which the noses of Holtzapffel lathes thus grooved out at the base had broken off, and the only reason for this shape seemed to be that, like the 9·45 pitch of their thread, the mandrel noses had been so constructed by Mr. Holtzapffel in the early part of the century when the screw-cutting lathe and accurate revolving cutters were not in vogue. After a prolonged discussion, the recommendations of Dr. Edmunds were unanimously adopted, and resolutions were passed recommending:—

1st. That all new mandrel-noses and back poppet cylinders be screwed at the pitch of ten threads to the inch.

2nd. That a cylindrical base larger in diameter than the outside measurement of the screw thread be left at the root of the mandrel-nose, in place of the present circular groove.

3rd. That the thread upon the mandrel-nose and other fine screws for ornamental lathe work be an isosceles triangle of 50°, the tops of the thread to be flattened down or rounded off 7¼ per cent. of the pitch of the thread (more exactly ·0723 of the pitch), thus giving a thread whose altitude and base are equal, while its pitch and depth are also the same.

Dr. Edmunds showed that the elements of this thread would make a most perfect screw in point of strength and durability, and that all calculations as to the strength of the screw-shaft, and the depth of the thread would be vastly simplified, inasmuch as the pitch of this thread at once gave its depth, and double its depth gave the extent to which the cylinder was cut into by its thread. Thus, in a screw of ten threads to the inch, the depth of the groove would be one-tenth of an inch, and double this would give the extent to which the diameter of the shaft would be incised by this screw-thread being cut upon it. Again, a thread of thirty to the inch would cut into the shaft to the extent of one-fifteenth of an inch, and so on for all threads. The thread having its base exactly equal to its altitude, would combine the utmost durability against wear from frequent shifting, as on the mandrel-nose, with the greatest resistance to stripping or deformation under strain. Dr. Edmunds submitted to the council a model mandrel-nose, made by himself, having a clear face for the bearing of wooden and other chucks, extending ·4in. radially from the base of the nose. The base of the nose was a true cylinder, ·15in. long and ·95in. in diameter, and the screwed portion of the nose was ·9in. in diameter outside the thread, and ·75in. in length, making a total length for the nose over all of ·9in. The end of the thread was turned off concentrically to ·7in. in diameter (the diameter of the stem of the nose at bottom of thread) by a tool at 45° to the axis of the mandrel, leaving a circular end of ·7in. in diameter. This was coned out at 15° from the axis of the mandrel to a base of ·5in., and the mandrel drilled throughout with a true axial ·375in. bore, so that a slender rod could be passed through from behind without unshipping anything, while small chucks for delicate purposes could be fitted into the coned and cylindrical bore, and held from behind by a tubular screw-shaft, as in the watch lathe. The groove of the thread was cut with a full end up to the edge of the cylindrical base, but not so as to encroach upon it. In the chuck the thread would commence with a full end, so as to engage fully in the groove of the mandrel nose, and at such a distance from its face as to leave a quarter turn of the groove vacant as a receptacle for casual particles of dirt.

In finishing the end of the mandrel nose, the cylinder base, and the mandril face, Dr. Edmunds thought that, by a skilful use of emery wheels, the surfaces might be left hard without endangering the strength of the mandrel nose itself as by hardening it altogether. Possibly also by truncating the screw thread with an emery wheel the tops might be left so far hard as to give considerable resistance to casual injury.

Dr. Edmunds reported that he had to thank Mr. Evans for a cordial offer of assistance in carrying out the reference of the council, and that, at his suggestion, Mr. Evans had kindly executed for the inspection of the council a beautiful steel mandrel embodying some of the suggestions which he now submitted, and showing a sample of the fine chucks.

A letter from Mr. Evans also was read, asking the council to accept from him, for the use of the members at the laboratory, a complete set of screw-tools, giving such new standards as the council might decide upon. Mr. Evans's offer was accepted, and a cordial vote of thanks was passed for his valuable co-operation.

ON the Marretta and the W.N. Carolina at Red Marble Gap, both railroads will run for a mile on beds of variegated marble of the finest quality.

SCIENTIFIC NEWS.

FROM Dun Echt Circular, No. 68, we learn that Dr. J. Morrison, of the *Nautical Almanac* Office, Washington, has computed the elements of the great comet, 1882, from three observations made at Washington in September, October, and December, and finds a period of 652·506 years. The elliptic elements are—*T* Sept. 16·99876 Washington M.T.; ☊ 346° 0′ 19·2″; π—☊ 69° 39′ 31·4 ; *i* 141° 56′ 56·5″; log. *q* 7·8900692.

Dr. Wentworth Erck, writing from Sherrington, Bray, on the 16th inst., says the comet was again seen this morning, the apparent place at 0h. 50m. G.M.T. being R.A. 6h. 37m., N.P.D. 116° 19′ 30″. The comet was thus about 10° south of Sirius, and passed the meridian three minutes before that star. The moonlight now prevents observations, and when dark nights come again the comet will be too faint to be visible except with the most powerful instruments.

Mr. S. R. Elson writes from Calcutta, sending copies of letters contributed to the Indian press in September, in which he describes the appearance of the comet on Sept. 22-24 as seen from Saugor Roads and the Sandheads. In these he describes the comet as double-tailed, the nucleus nearly as large and bright as Venus and Sirius, Sept. 22. On Sept. 24 he says the two tails have become one broad one, though two are still visible through a telescope.

The observatories of Copenhagen, Greenwich, Kiel, Milan, Paris, Pulkowa, Utrecht, and Vienna have agreed to fix upon Kiel as a centre for the transmission of telegrams. For a sum of five pounds a year each observatory will receive telegraphic information of every astronomical discovery.

Mr. G. H. Darwin, F.R.S., has been appointed Plumian Professor of Astronomy at Cambridge.

Messrs. Mawson and Swan have introduced a small accumulator which is said to be capable of supplying one lamp continuously for two hours. The power of the lamp is not mentioned, but it has been used for taking photographs. The accumulator weighs five pounds. The modified Planté secondary batteries used at the Savoy Theatre weigh less than four pounds.

To give an idea of the price charged for the new accumulators (Faure - Sellon - Volckmar type), we may mention that one consisting of 22 cells, capable of giving one electric horse-power, costs £79 4s. Its maximum charging capacity is 400 ampères. To always maintain the same E.M.F. (which in this case is 45 volts), about 25 per cent. of the electrical energy which the accumulator can receive must be allowed to remain.

The specification of the Elphinstone-Vincent dynamo-machine has been issued. It is No. 2340, 1882, price 10d. The machine is so constructed that the coils pass between the faces of the field-magnets, which are so close together that powerful magnetic fields are formed, while there is no iron core in the armature. As the parts are capable of practically indefinite multiplication, it is claimed that the machines can be made of such a size that one will be sufficient to supply the current necessary for lighting a whole town.

In the American *Naturalist* for January, Prof. E. D. Cope has a note on the "Nevada Biped Tracks," in which, he says, that it is "probable the contemporaneity of man with the horse and other extinct Pliocene mammals in Western North America will soon be satisfactorily demonstrated." It appears that in the argillaceous sandstones of the quarry of the State prison of Nevada, at Carson, the tracks of several species of Pliocene mammalia are accompanied by those of a biped resembling man. In any case, says Prof. Cope, the animal was probably the ancestor of existing man, and was a contemporary of the Elephas primigenius and a species of Equus.

The advantage of planting trees in streets and open spaces in towns has been the subject of correspondence in the local press of Geneva. Dr. Pinchaud concludes that trees in streets do more harm than good, because they impede the circulation of air. Prof. Goret, on the contrary, says that trees temper the heat and serve as a protection from dust, while the evaporation from their leaves helps to keep the air cool and moist. He also contends that by means of their roots they draw up stagnant waters and absorb much of the filth which would otherwise render the subsoil of streets a dangerous nidus for disease.

The Berlin Society for Encouragement of Industry has recently announced the following prizes: (*a*) £100 for a practical method of precipitating zinc, in the compact state, from very dilute sulphate solutions. (In view of the importance of this problem for Government smelting works in the Hartz, the Minister of Public Works was to be asked to add £50.) (*b*) £75 for the best investigation of the raw petroleum found in Germany, both in regard to its chemical and physical nature, and to methods of treatment for the commercial products used in illumination, lubrication, &c. (*c*) £150 for the best critical account of all patented or introduced technical novelties for salt-works since 1860, and suggestions as to how the present mode of work with boiling and drying pans and vaporising apparatus for extraction of ordinary and potash salts, may be improved by use of new technical aids. (*d*) £15 for the best proposals regarding the technical arrangement of public testing institutions, to determine the actual amount of fibre and the tenacity of textile raw materials, spun and woven goods.

In a paper to *La Nature* (13th January), on his system of heating with crystalline acetate of soda, M. Ancelin shows, by curves, the much slower cooling of foot-warmers containing that substance than that of the ordinary ones with water. He states that the French Chemin de Fer de l'Ouest, which last winter heated thus all the trains from Paris to Havre, is this winter applying the system to all the Dieppe trains also. The Chemin de Fer de l'Etat is applying it on the line from Tours to Sables d'Olonne. In England, the London and North-Western Railway, which had last year 3,000 of the warmers in service, will have 6,000 this winter. Other applications have been made in France on the Eastern and the Lyons Railways; in Italy, on the lines of Upper Italy; in Spain, on the line from Madrid to Caurès, and on the Northern Railway of Spain; also on lines in Portugal and in Austria. Among other modes of application of the same principle may be mentioned heaters for beds, dishes, poultices, muffs, feeding-bottles. M. Ancelin mentions that the operation of filling the warmers requires certain precautions to avoid surfusion or supersaturation, which the acetate is liable to in a closed vessel. This phenomenon is apt to occur, especially if there is an excess of water in the acetate (due often to moisture in the air, which the substance absorbs very readily). The precautions consist mainly in elimination or saturation of this excess of water, and also in the employment, in the warmer, of a spherical reservoir of crystals, with thick walls of a material which conducts heat badly. This reservoir also acts in destroying supersaturation by the vibrations it imparts to the liquefied salt during the train's motion.

If chromic acid be poured on sulphuric acid of about 1·5 specific gravity, and the liquid heated to boiling, drops are often (Herr von Jüptner says) thrown up, which, falling back on the surface, do not at once unite with it, but, for 30 or 40 seconds frequently, run about as little balls, diminishing in size, and at length vanishing. This case of Leidenfrost's phenomenon is the more interesting that its cause (gas-development in drop and liquid) is evident.

We observe that in the Paris Academy M. Zenger has been developing his ideas of comets. He furnishes a table of the perihelia of comets observed since 1877, and, dividing the intervals between the perihelia in each case by whole numbers (ranging from 2 to 25), he obtains an average duration of 12·56 days, which corresponds exactly to that of a half-rotation of the sun. He accordingly holds that the origin of comets is intimately connected with the rotation of the sun, for between the epochs of their successive "formations," there must have elapsed an even or odd number of half-rotations of the sun. The formation of comets he accounts for by enormous explosions, driving out the matters of protuberances vast distances. The shock extends to the corona, driving forward its matter also (perhaps meteoric). Suppose some large meteorites moving round the sun near the border of the corona. Their attraction may prevail over that of the sun, by reason of those shocks; thus coronal matter may accumulate round the meteoric nucleus, and the head of the comet be formed; while meteoric dust and small particles form the tail. Further, the periodicity of perihelia shows the general law of motion of planets to apply equally to comets; but the time of revolution must be a multiple of that of a half-rotation of the sun. These views seem to have met with some adverse criticism in the Academy.

An Italian, Signor Carpené, has recently patented an invention for impregnating wine or other liquid with carbonic acid gas, at a temperature of – 6° C., and a pressure of 1 to 1½ atmospheres. The effect is produced in a cylindrical metallic vessel (with axis vertical and an axial stirrer), standing in an ice-holder. The carbonic acid is forced in at the bottom of the cylinder through small holes; and the pipe for drawing off the liquid also comes out from the bottom. The bottle employed has a caoutchouc cap; and a pipe entering it from the upper part of the cylinder makes equilibrium of pressure between the two interiors. Another pipe admits air into the cylinder above. The cold liquid neither foams nor drives the stopper out of the bottle, and at zero temperature only slight corking is necessary. The cork is bound next day.

The following conclusions bearing on the nature of solutions are formulated in a paper by Mr. Goodwin, of Bristol (which was recently read to the Berlin Chemical Society):—1. Solubilities tend to be identical at high temperatures. 2. The solubility for mixed chlorides is usually a mean between those of the separate compounds. 3. The solubility of chlorine in water is increased by the presence of chloride of lithium and chloride of hydrogen. 4. Chlorides influence the solubility of chlorine *chemically* at low temperatures, but *mechanically* at high ones.

An attempt is to be made at Wheeling, West Virginia, to introduce the manufacture of nails made of Bessemer steel instead of wrought iron. Obviously, a steel nail is, weight for weight, stronger and more serviceable than one of iron, but the cost of the plant required for Bessemer steel-making is very great. At Wheeling, however, which is, perhaps, the centre of the American nail manufacture, the subject is thought so important that an association has been formed to raise the necessary capital, and construct works expressly for the production of steel nail-plate, which will be delivered to the nail-manufacturers represented in the association in an agreed proportion. One of the incidental results of this change will be the throwing out of employment of a large number of puddlers.

In summer of this year a General Exhibition of Norwegian Industry and Art will be held at Christiania.

A common way of measuring differences of air or gas pressure is by the difference of level of liquid in a U-tube. For small pressures, however, observations with such an arrangement become difficult. To meet such a case, Drs. Seger and Aron have devised an apparatus consisting of a glass U-tube, which, at the upper ends, widens abruptly into two short vessels of equal size. The piece is fixed to a board, on which is also an adjustable scale. The tube and part of the vessels are filled with two liquids which do not mix, and which are of nearly the same specific gravity, their place of contact being opposite the zero-point of the scale (water and aniline oil may be used, or solar oil and dilute alcohol: one of them is coloured). The stoppers of the vessels are traversed with short bent-glass tubes. The apparatus is hung on the wall near the place of observation. To measure a pressure above or below the atmospheric, one of the short glass tubes is connected with the space considered, the other communicating with the air. The displacement of level is manifested on an enlarged scale by displacement of the play of contact between the two liquids in the tube, this being in the ratio of the cross sections of the vessel and the tube. The apparatus is said to be very sensitive.

The experiments hitherto made to determine the relation between constants of capillarity, and the nature and constitution of liquids, have not led to satisfactory results. According to Herr Schaff, this is because those constants, which are very variable with temperature, have not been determined only at temperatures that are comparable for the various liquids. The boiling point alone fulfils this condition, and Herr Schaff accordingly contrived an arrangement for measuring the capillary ascent of liquids at their boiling point. It is shown, from the results with thirteen aromatic hydrocarbons, that while, at a low temperature, all those substances have exactly the same height of ascent; at the boiling point their constants of capillarity diminish with increasing molecular weight. Herr Schaff recalls the interesting fact recently discovered by Herr Krafft, that the higher hydrocarbons of the fatty series, just above their melting-point, have exactly the same specific gravity. He is continuing his investigation.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE BLACK DROP.

[20978.]—WILL you allow me a word in reply to the letter of your correspondent in your last number on the subject of the "black drop," so called? It is a very simple matter; but it has caused at divers times a good deal of perplexity. The pure "black drop" can only be formed when two *dark bodies* meet together, and are seen *against* a light background. The black drop, as seen in a transit, is not in reality the same phenomenon. It is a compound one. If two *light* bodies meet together, as might two suns, or two candle-flames, then would a *light* drop be seen between them, caused in precisely the same way as the black drop between two dark bodies. In a transit, *both* these are combined, and, strangely enough, are seen together, the black drop, or rather "shading," (in place of a better word) meets the light drop, or light shading, from the sun, and thus meeting together form the *drop*—both caused simply by the size, or linear dimensions, of the eye-pupil. Reduce this to a *point*, and the *drop*, whether light or dark, white or black, disappears totally. I endeavoured, Sir, in the MECHANIC to point this out. This was universally, among astronomers, thought to be a phenomenon of *irradiation*, or *diffraction*, or *inflexion*, or *deflection*, for each of these words was at times employed to define it. I must contend that these four long words are now obsolete, at least in astronomical language. The whole mystery lies in the *make* and *modus operandi* of the eye itself.

Chelsea. **C. B. A.**

ECLIPSES OF SUN BY JUPITER'S SATELLITES.

[20979.]—THERE is an omission of a sentence from the letter (20954): in the last paragraph but one, after "vicinity of satellite or shadow," *and see the satellite shadow overtaking the marking*, or *vice versâ*. As printed it is without meaning.

Also, in the same paragraph, after "4th satellite this month"; *if this apparition* (not "of this apparation"), or perhaps better "if this year's."

S. Broughton.

[20980.]—MR. S. BROUGHTON (let. 20954, p. 452), draws attention to the peculiarities of these phenomena. Is he aware that they were first announced some years since in the ENGLISH MECHANIC? Can he either refer us to a report of Prof. Schuster's lecture, or give fuller details? The theory requires no *verification*, as he suggests. At the same time there are a few recorded observations of the appearances described, and these would always be interesting.

Walthamstow. **T. H. Buffham.**

PARTIALLY GRAPHIC COMPUTATION OF A SOLAR ECLIPSE.

[20981.]—THE facility with which the details of a solar eclipse may be worked out by the partially graphic method discussed in my last communication can hardly be appreciated without a practical example of its application. Let us select, then, the Solar Eclipse of 1880, 31st December, as seen at Greenwich.

The principal uses to be made of the "elements," as given in the *Nautical Almanac*, are four in number. To find:

I. The sun's hour-angle at the instant of central conjunction. This is obtained as follows:—

	h.	m.	s.
G. M. T. of ☌ in R.A., December 31st ..	2	5	41
Equation of time, from Mean Time sub...	0	3	32
Sun's hour angle at ☌	2	2	9

II. The value of $\frac{100\cdot00}{P \cos. l}$: this can be done either with or without logarithms.

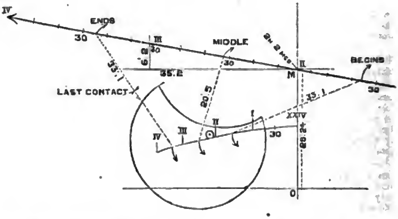
$P = 61\cdot3'$; $\cos l = \cdot6255$: $P \cos. l = 38\cdot34'$.

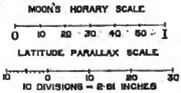
Hence $\frac{100\cdot00}{38\cdot34'} = 2\cdot61$, which is the value of 10 *divisions* of the latitude parallax scale *in inches.*

III. The value of diff., dec. $- P \sin. l \cos. \delta$ .. In this case the elements give diff. dec.	$= 72\cdot17' +$
Also (computed as above) $P \sin. l \cos. \delta$	$= 43\cdot93' +$
Distance of Moon *above* centre of ellipse which forms the projection of parallel of Sun's declination	$= 28\cdot24'$
IV. Moon's (reduced) hourly motion in R.A. ..	$= 35\cdot2'$
Moon's (reduced) Hourly Motion in dec... ..	$= 6\cdot2'$ ascending.

Sum of semidiams $= 33\cdot1'$ Sun's diam. $= 32\cdot6'$.

Hence the resulting diagram will be an enlargement of the accompanying miniature, and must be drawn to scale.





At Greenwich, solar eclipse (adding equation of time)—

			Mean Time.
	h. m. s.	m. s.	h. m. s.
Begins..........	1 36 30	+ 3 32	= 1 39 22
Greatest phase ..	2 32 18	+ 3 33	= 2 35 51
Ends............	3 25 0	+ 3 34	= 3 28 34

$$\text{Magnitude} = \frac{33\cdot07' - 20\cdot55'}{32\cdot6'} = \cdot39.$$

The only limit to the correctness of the result is the accuracy of the above drawing. Where necessary, an allowance may be made for the variation of the Moon's hourly motion in R.A. and Dec. during the time of the eclipse.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage.

SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[20982.]—REPLYING to the letters of Mr. P. Vallance and Mr. T. Westlake in the "E. M." of 19th January, I may put the matter thus: If we introduce a diaphragm or stop between the object-glass and eyepiece of a refractor, we may have the opening in it so small as to allow only the central rays to pass through it; yet we do not thereby affect the size of the focal image; but merely reduce the quantity of light to what would be transmitted by an o.g. of correspondingly reduced size. Similarly, if we use too small a plane, we, in effect, reduce the quantity of light reflected to the eye to the quantity that would be reflected by a smaller mirror; but we do not otherwise alter the focal image.

As to using different flats for different objects, since "the greater includes the less," a flat that suffices for the sun's image would obviously suffice for any other heavenly object. The size of flat would not vary precisely in proportion to the variation in the diameter of mirror, as the size of the image depends on the focal length. If your correspondents will kindly refer to a letter by "F.R.A.S." on page 315 (Dec. 8th), they will find a method of determining the size of the focal image of any object. This method was new to me, but is, doubtless, correct; and I made use of it in determining the dimensions of the flat in the example I gave. If we assume the rays proceeding from the mirror, to form the frustum of a cone whose lower diameter (or base) is the same as that of the mirror, and its upper diameter that of the focal image, as given by "F.R.A.S.'s" rule, and of which frustum the height is equal to the focal length of the mirror, then we can determine (by calculation or diagram), the necessary dimensions of the flat, wherever it may be situated, in such conical frustum. It was on this view that I determined the mirror diameter of the flat which I gave in my former letter.

I do not quite see the meaning of Mr. Vallance's first sentence, because I have certainly not implied that "*more* than the column of rays equalling the size of the mirror are reflected to the flat." I have simply contended that the flat should be large enough to intercept the *whole* cone (or rather, frustum) of rays, and not merely the more or less central portion of them.

I have not made the experiment; but I should imagine, if a card were held at any point in the cone of the reflected rays, the disc of light would be sufficiently defined to show the required size of flat when the sun was being observed, and thus settle the question experimentally. **A. S. L.**

[20983.]—IT is evidently a mistake to think objects are reflected by a mirror to a point, and "A. S. L.," when he says that the focal image of the sun in a mirror of 10ft. focal length is rather less than 1⅛in., is quite right. One star will be reflected as a point, but a double star cannot, or how could an eyepiece show it double? The light from a double star falling on a mirror is reflected in two cones of light, each cone having the mirror as common base, but with their apices diverging; and a star cluster is reflected in as many cones as there are stars in the cluster, whose apices lying in one plane, the focus of the telescope, but not coinciding in one point, form an image of the cluster. Therefore, in estimating the size of flat most convenient, we must consider what sized field of view we wish our telescope to command with the lowest-power eyepiece, and opticians generally proportion their instruments so that the lowest-power eyepiece shall give a field of view of nearly 40', such a field including the sun at one glance. In that case we should find we wanted a flat as nearly as possible the size that Mr. Calver supplied Mr. Westlake with first—viz., 2¼in. with a 12½in. mirror of 9ft. 3in. focal length. **F. M. C.**

NEWTONIAN FLATS—DIVIDING POWER—REFLECTORS v. REFRACTORS.

[20984.]—IF I understand "Faber's" proposal (let. 20956) to remove the flat of a Newtonian from the usual place to the side of the telescope, or even outside it, I fail to see how he can bring the pencil of rays from the large mirror on it without tilting the large mirror so that the axis of the cone of reflected rays is no longer parallel to the incident rays, and this would utterly spoil the definition. After all, the flat obstructs but little light. Remembering that the areas of circles vary as the squares of their radii, it will be seen that a 1½in.

flat only obstructs about $\frac{1}{32}$ of the light from an 8½in. mirror.

Mr. Hanneford (20958) seems to forget that the star discs seen through a telescope are "spurious," and that the larger the aperture the smaller are these discs; hence, if he turned a telescope of 2in. aperture to a double star, separated by half a second, the two spurious discs would overlap and prevent any division being seen; but if he turns the same telescope to Saturn, he may see, under favourable circumstances, "Ball's" division, for the image is no longer spurious; and the reasoning above does not apply.

I have had some experience as an amateur observer of refractors and reflectors, and I am inclined to give the preference to the latter. Small telescopes are very disappointing. I began with a 2in. refractor, then I purchased a 3¼in., but found both very tantalising; so I now have a splendid 8½in. Calver, equatorially mounted; with this I am thoroughly satisfied. The aperture is as large as can be used with advantage on very many nights, and the whole, including an excellent observatory, could be put up for about £100, or even somewhat less. A refractor of equal power would be much more expensive, and require a much larger observatory, and so would be placed beyond the means of most amateurs. I hold no brief for anyone; but if any amateur desires a maximum of efficiency and comfort with a minimum of expense, I should advise him to get as large a reflector of Calver's as he can afford, equatorially mounted, and by no means to dispense with some kind of observatory.

Amateur.

REFLECTOR v. REFRACTOR.

[20985.]—APOLOGIA.—I am sorry that "Prismatique" (20959) has taken my expression "holds brief" differently from what I intended. I meant it simply as a playful allusion, such as one often makes when a person seems to be giving rather an ex-parte statement.

No one could be farther than myself from believing that he or any one else writing in your pages was other than sincere, or that there was no such thing as disinterestedness left. Perhaps I rather held a brief myself, though I think that the supposed difficulties with reflectors are vastly exaggerated; indeed, that they are practically working at all, or at any rate, of no importance, particularly as Mr. Wassell (20936) has shown that now, as made with glass, they are, with care, indestructible. The whole question, when comparing them, seems to be, Which is the most effective? And into this price enters as a most important element.

Fordingbridge. **T. Westlake.**

EQUIVALENT FOCUS OF CASSEGRAIN TELESCOPE.

[20986.]—"A. S. L." says (20685) it has been asked more than once in "our" columns how to find the *equivalent* focus of a "Cassegrain" or "Gregorian"? Here is a rule for the Cassegrain:—Add the focal length of convex (half the radius) to the distance between the mirrors. Subtract the focal length of concave (half the radius) from the product. The "remainder" bears the same proportion to focal length of convex, as the focal length of concave does to the amount required. Example: Concave 5ft. focus, convex 1ft. 4in. focus. The proper distance between mirrors of these foci is 4ft. (that is for the image to be formed at the vortex of large mirror), then 1ft. 4in. + 4ft. − 5ft. = 4in., then, as 4in. is to 1ft. 4in., so is 5ft. to 20ft., therefore the above arrangement is equal to a "Newtonian" or o.g. of 20ft. focus. The rule for finding the distance between the mirrors of any given radii I gave on p. 209, Vol. XXXIII. Construct a right-angle triangle, having the radius of the concave for the base, and twice the radius of the convex for the perpendicular. If the base and perpendicular are equal (which is the case if the convex is half the radius of concave) the hypothenuse divided by 4 will be the required distance.

If the base is longer than the perpendicular, add excess to hypothenuse before dividing by 4; if the perpendicular is longer than the base, subtract the excess before dividing by 4.

"Orderic Vital" very justly remarks that the vortex of large mirror is not generally the position of the image in these instruments; but I think it is a very convenient place to calculate from. Likewise, if we adopt the suggestion of "Hyperion," Vol. XXIV., and use achromatic single lenses for eyepieces, we need not alter it (the position of image) much; the same applies to the Ramsden; but if we use Huyghenian eyepieces, of course the image must be formed further back.

With regard to the "really proper" curve of large mirror of Cassegrain, it seems as far off as ever. Far be it from me to quarrel with the "parabola"; but Mr. Calver's reason for adopting it in the Cassegrain is purely *utilitarian* (I mean the possibility of converting to a Newtonian at any time). This, of course, is a very good reason, and was also suggested by "Hyperion," I think, when he ordered a mirror from the above valued correspondent; but in Vol. XXIV., page 118, Mr. Calver says he prefers an *elliptical curve*, as the small convex is *easier* to figure.

A. N. H.

TELESCOPES

[20987.]—MR. HANNEFORD, letter 20958, is evidently under some misapprehension, as Mr. Wray has certainly not taken any part in the controversy now going on in these columns, and has, to the best of his belief, never had any communication with that gentleman—for whose enlightenment, I may state that Mr. Wray has had in former years a great deal of experience with reflecting telescopes, but has long since given them up on account of their non-permanence, and the difficulty of keeping them in perfect adjustment—to say nothing of the air-currents in the tube, noticed by "Prismatique" in this week's number, whom, by the way, I presume Mr. Hanneford mistakes for Mr. Wray. I do not know who "Prismatique" is, and if I did I should not consider myself at liberty to publish his name without his consent, but can fully endorse his remarks in letter 20959.

If Mr. Hanneford cares to inquire into the matter, he will find that in most cases those who make reflectors do so because they *cannot* make refractors, and that those who use reflectors do so because they are *cheap*. It is a pity that some of these latter gentlemen should try to make a virtue of necessity, and sing the praises of an instrument which will have decayed and become useless when an achromatic made at the same time will be practically as good as new.

There is no reason why an achromatic should not be made of 24in. aperture, or even more, and be as perfect as one of, say, 4in.—providing that discs of that size could be made of uniform density throughout—but this is one of the things yet to be done.

Highgate, Jan. 22. **Henry Wray.**

[20988.]—RE letter 20938 I have an illustration of Herschel's 40ft. reflector, with the timber framework, and in the accompanying description it is stated that "for a detailed account of this magnificent instrument we refer our readers to the Royal Society's *Transactions*, Part II., 1795, where the details are illustrated by 18 engravings." Perhaps "L. L. L." has access to this volume, and the reference may be useful.

"Prismatique's" letters would read all the better if not graced with his usual expressions of depreciation, more especially when it turns out that he is wrong. So far from underrating him, I am greedy to learn from him on optical matters, and I will ask him other questions if you will permit me. I should like to know what he would consider the lowest power on a 6½in. mirror of 54in. focus that would take in the whole of the rays, and not act as a stop? I have not been able to satisfy myself on this point, and I think it would interest others as well as myself.

Will he also give some information as regards a 9in. of 75in. focus? Could he give us the image of a bright star as seen in a large refractor, and say what he regards as the highest power that could be practically used in our climate on a 6in. o.g.? Of course, I know the theoretical limit of everything is perfect, but the useful limit is far lower. What would be the highest on Jupiter and Saturn? May I ask him if he considers the lenses for eyepieces are now made with sufficient care? I have seen one or two so-called "achromatic" which showed a little more colour than the ordinary Huyghenian, and other defects as well. Are they not made in a rather happy-go-lucky style as a rule, without any certainty as to the spherical truth of the curves?

May I ask him if he would expect to be able to use higher powers, as a rule, on a large o.g. in this climate than on a small one? Of course, I know the large one would show more detail; but supposing 150 was the limit on a particular night on a 5in., would it be possible to use a higher power to advantage on a 7in.? **Edwin Holmes.**

SQUARING (?) THE CIRCLE.

[20989.]—"M.I.C.E." (20956) is, of course, well aware that "As horses are not all called mares, so rectangles are not always squares."

The error in his problem is curiously approximate to that in an old problem for finding the side of a square of equal area to a circle; which I take to be what is called "squaring the circle." "M.I.C.E.'s" plus error in area to diameter .1. being ·0003161223, &c., while in the latter case it is ·0003161215, &c., the difference being 7585, &c., preceded by "point nine noughts." This old problem being that in which the diameter is divided into fourteen equal parts, a perpendicular erected at the eleventh division, the line joining the top of this perpendicular with the further end of the diameter being the approximate side of the square. There is yet another problem for the same purpose; for which I may use "M.I.C.E.'s" figure—viz., set off the chord of 60° (= radius) from N. towards W., bisect it, and connect E. with this point, continuing the line to meet the circle; this line is also a near approximation, as the area of the square has a minus error of ·000417, &c.

These three are very pretty problems for a tyro in mathematics to work out—the two first by common arithmetic; but I do not see my way to resolve the last without the use of sines and tangents, except by the clumsy mode of "Trial and Error." Perhaps some kind person may instruct me.

There is an error in the statement of "M.I.C.E.'s" problem at p. 434, but its correction is easily seen.

Robt. J. Lecky.

3, Lorton-terrace, Notting Hill, Jan. 18.

[20990.]—THE value of π, the semicircumference of a circle having radius = 1, can be approximately calculated in several ways. The following method, which I have nowhere met with, may interest, chiefly on account of the simplicity of computation:—

Let θ be the arc whose tangent is $0{\cdot}2 = \frac{1}{5}$; then, since $\tan.^{-1}x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7}$, &c.

$\theta = \frac{1}{5} - \frac{1}{3}(\frac{1}{5})^3 + \frac{1}{5}(\frac{1}{5})^5 - \frac{1}{7}(\frac{1}{5})^7$, &c., a series which converges so rapidly that, taking only four terms, its value to six decimal places is, $\theta = {\cdot}197395$....(1)

$$\text{Since } \tan. 2\theta = \frac{2\tan.\theta}{1-\tan.^2\theta} = \frac{2 \times \frac{1}{5}}{1-\frac{1}{25}} = \frac{10}{24} = \frac{5}{12}$$

$$\tan. 4\theta = \frac{2\tan. 2\theta}{1-\tan.^2 2\theta} = \frac{2 \times \frac{5}{12}}{1-\frac{25}{144}} = \frac{120}{119} \text{ ....(2)}$$

Now, observing that $\frac{120}{119}$ is very little greater than 1, which is the tangent of 45°, or $\frac{\pi}{4}$, we may assume that $4\theta = \frac{\pi}{4} + y$, where y is a very small arc.

$$\text{Now } \tan.\left(\frac{\pi}{4} + y\right) = \frac{\tan.\frac{\pi}{4} + \tan. y}{1 - \tan.\frac{\pi}{4}\tan. y}$$

And as $\tan.\frac{\pi}{4} = 1$, and $\tan y = y$, when y is very small, $\tan. 4\theta = \tan.\left(\frac{\pi}{4} + y\right) = \frac{1+y}{1-y} = \frac{120}{119}$.

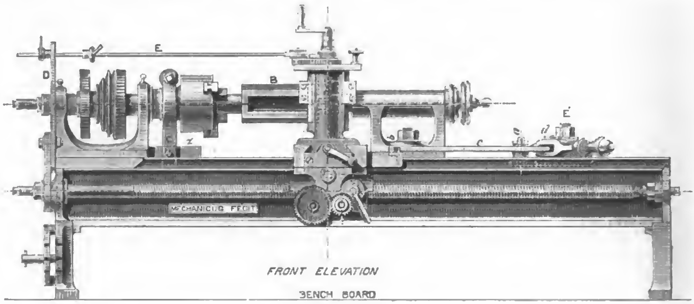
Hence $y = \frac{1}{239} = {\cdot}00418$......................(3)

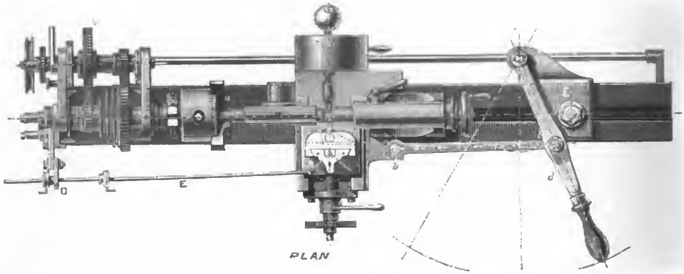
$$\begin{array}{rr}
\text{Since, by (1) ....}\ \theta = & {\cdot}197395 \\
\text{multiplying by} & 4 \\
\hline
4\theta = & {\cdot}78958 \\
\text{subtracting } y = & {\cdot}00418 \\
\hline
\frac{\pi}{4} = 4\theta = y = & {\cdot}7854 \\
\text{and multiplying by} & 4 \\
\hline
\pi = & 3{\cdot}1416
\end{array}$$

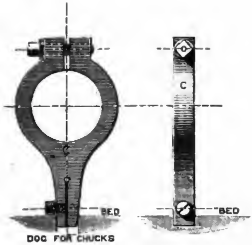
Jan. 17. **John Imray.**

PLANING ON THE LATHE.

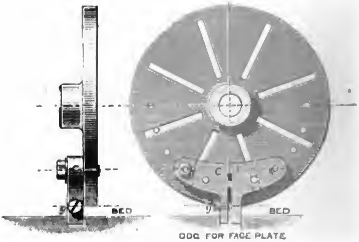
[20991.]—REFERRING again to this oft-mooted subject, I am inclined to think that there is as yet "great cry and little wool." That planing, and especially shaping, can be done on a slide-lathe is patent to any mechanic; but practically it can never be profitably adapted as a planer except for very small surfaces as compared to its own dimensions, such as small slide rests, strips, model-cylinder valve-faces and valve-chests, or articles which can be held between centres or in chucks: this can be easily and cheaply effected by the simple substitution of a vertical slide and swing tool box, in lieu of the ordinary cross slide. The accompanying drawings show my application of this method to a 3½in. centre sliding surfacing and screw-cutting lathe of my own construction. They will, I hope, fully explain the system. I will suppose that I have to get up a new top, tool-holder slide, longer than the one originally made. I make the pattern as usual, but at one end add a round tail-piece about 1½in. long by ¾in. for chucking by. Having trimmed and pickled my casting, I proceed to rough-dress it, so that it bears *tolerably* even on the surface plate, and then scribe my centres, drill them to proper size at once, and turn the tail-piece so that the scroll-chuck may get a good fair bite on it; this is marked B on drawings. I next fix on the neck of chuck the dog or carrier, C, which firmly grips the chuck by means of the top square-headed screw, and is made to jam tight between the ways of the bed by turning the round-headed pushing screw at bottom of C; by this operation the chuck, and consequently, anything gripped in it, are perfectly immovable. I now grip the turned tail-piece, and support the other end by poppet head, giving out as little cylinder as possible; but, previous to this, the saddle has been moved up between the two heads, and space for the necessary travel allowed (I am thus minute in describing the operation, because I conclude that most of your readers are amateurs); I now take out the ordinary surface slide, and substitute the vertical slide A, which is fitted with a nut to fit the traverse screw, and replace the







DOG FOR CHUCKS



DOG FOR FACE PLATE

latter, which serves to set in the cut. The slide A is provided with a table and swing tool-box, actuated by a vertical screw; this, in its turn, is fitted with right-and-left pawl and ratchet action, and a hand-winch. The pawl lever is limited as to travel by shifting stops, sliding in plate below; and motion is given to the lever by means of the jointed-rod and stops working through temporary post fixed on to radial arm. I next fix the shifting-head E carrying the lever fulcrum; ship the lever *d*; pin it; and next, I adjust the connecting-link *c* on to its stud *b* screwed into extension of saddle, and finally drop in the pin *f* to connect link and lever. I now fix a dumpy tool in the tool-box, and proceed to adjust poppet head and fulcrum head, according to travel, as also tapped rod and stops required; screw all up tight; oil the bed; put in a real-cutting tool, and I am ready to plane.

Having got through the scale, or first cut, up or down, on, say, the top face of work, I take out the tool, re-grind it, and proceed with my second cut, after which I take a finishing cut with a nearly flat-faced tool. The top face finished, the vees have to be planed, and to obtain the proper angle for which (previously determined on) I cut an angle-piece or gauge of sheet-zinc, one side to bear on lathe-bed or saddle, the other against top or other face of work at the angle. I now slacken the top or clamping-screw on C, and move chuck and work round till it agrees with zinc gauge; I then reclamp C on chuck, and proceed as before. It follows, from the above-described operation, that, assuming the jaws of the chuck to grip truly central, as the screw holes were drilled, and tail-piece turned from holes as centres, assuming also the poppet-head centre to be also true with axis of mandrel, and both in line with bed, the *whole* of the work *must* be true. When the work is fixed on a face-plate, I use a dog or carrier C', and have a series of tapped holes all round the plate, for shifting work to any angle. When using this, only one bolt is at first tightened up; the bottom pushing-screw is then turned till the piece is immovable, and only then is the other bolt (the hole of which is slotted or drawn) tightened. I would have sent you the working drawing of the vertical slide and tool-box, but that I must have mislaid them. I will, however, do so as soon as found. I must here observe that, although it is perfectly feasible to plane up small simple jobs on a *slide-lathe*, I do not advocate its indiscriminate use. For amateurs, especially for optical instrument makers, or for a small and out of-the-way shop, *it is useful*; but the work performed or planed on a lathe, must of necessity be of very limited size and simple in shape to be held securely; unless, indeed, you choose to incumber the machine with quite a number of special parts. In this case, it becomes safer, more expeditious, and better work is obtained, by using either a real planing machine or a shaper, as the case may require. I know that most amateurs who are fond of mechanical manipulation would feel a just pride in being able to turn out a creditable piece of work on which planing was necessary, and be able to say, "It was all done on my own lathe." Few amateurs have the necessary shop-room for even a small planer or sharper, or if they have the room they may not have the means, and therefore, I say again that for *them* lathe-planers are useful, especially if they can, at little trouble and small cost, fit them up themselves. The entire cost of iron castings for the one I have just described did not exceed 4s. 6d., and the gun-metal under 1s., including the lever of malleable castiron. The labour would cost the more; but, then, for most amateurs, it would be *con amore*.

In conclusion, I may observe that *all* the devices for "lathe planers," hitherto suggested or brought out, are *very limited in scope*—more especially in the stroke; and, again, in the case of the overhanging sewing-machine, like arm and tool-box, the great tendency to spring and, as I saw in one, to dig. For my device, I am not bound to the hand-lever, but, by using the cross arm and traversing rack, can get any length of stroke. I forgot to mention that, in the work above described, I used stops to determine the length of stroke, one marked Z, a piece of ¼in. square brass, abutted against the headstock, while between the saddle and poppet-head was inserted a piece of sole leather. I will shortly send you a drawing and description of "The Lathe as a Shaping Machine, and What can be Done on It." **Mechanicus.**

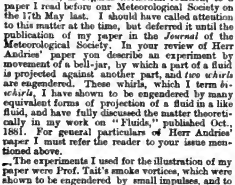
ORIGIN OF CYCLONES.

[20992.]—IN your issue of the 17th Nov. last you gave notice of a paper by Herr Andries to the Austrian Meteorological Society on the above subject. This paper appears to me to bear a certain resemblance, as regards horizontal rotation, to a paper I read before our Meteorological Society on the 17th May last. I should have called attention to this matter at the time, but deferred it until the publication of my paper in the *Journal* of the Meteorological Society. In your review of Herr Andries' paper you describe an experiment by movement of a bell-jar, by which a part of a fluid is projected against another part, and *two whirls* are engendered. These whirls, which I term *bi-whirls*, I have shown to be engendered by many equivalent forms of projection of a fluid in a like fluid, and have fully discussed the matter theoretically in my work on "Fluids," published Oct., 1881. For general particulars of Herr Andries' paper I must refer the reader to your issue mentioned above.

The experiments I used for the illustration of my paper were Prof. Tait's smoke vortices, which were shown to be engendered by small impulses, and to produce an altogether more highly projectile form of motion of air within air than could be obtained by constant pressure, however great. I also pointed out the causes why winds were impulsive (*gusty*) as due to certain effects of the expansion of air by the Sun's heat acting in diurnal periods upon any part of the Earth's surface, together with the sudden condensations of vapours (occupying aerial space) to cloud. The concluding part of my paper is directed to show the cyclonic direction impulsive currents will be induced to take upon the principles discussed as follows:—

Experimental Conditions of Vortex Sections.—An experiment of Professor O. Reynolds* shows that effects equivalent to those produced by Professor Tait's vortex apparatus in air, may be produced in water, the projected water being made visible by colouring matter, as the movement of the air is rendered visible by smoke. This experiment opens out a method of following vortex motions in water; and as these motions in water, although similar, are slower than in air, they are more easily observed. Professor Reynolds projects the vortex or whirl-rings from the end of a deep trough 8ft. long filled with water; the projection is made by pressure upon a piece of thin sheet india-rubber stretched over the mouth of a funnel containing coloured water, the stem of the funnel being inserted in the trough deep in the water, as shown at A, Fig. 4. The author has found that if the water be lowered to the mouth of the funnel*, its surface will cut off part of the whirl-ring, so that the part only which is below the surface will be projected. The motion within the vortex is by this means clearly shown. The sections of this ring at the surface will represent two whirlpools, which constantly diverge and increase in diameter, as represented by sketch at B. The water being coloured, the whirls will be seen to be revolving each towards its centre, in which there is a deep depression. Now, if *pressure were represented by the depths of water in the trough*, it would follow that although the whirl currents were inflowing, the pressure in the centre of the section of the vortex ring would be less than in other parts. It is also evident, from his experiment, that the inflowing currents engendered pressures, not internally, but externally, by the constant deflection of the water by the tangential force of the rotary system. The author's own experiments show that any section of a vortex may be projected by cutting off the other parts by resistance; as, for instance, a thin section of a vortex ring may be projected between two plates.† The above experimental condition shows that in the case of the atmosphere the resistance of the surface of the earth may leave the horizontal elements of a vortex system only active, the vertical element being cut off by the friction of the land or sea. Cyclones may, therefore, represent parts of a vortex system, or there may be a complete vortex system engendered in one plane only. Further, the diminished pressure in the centre of the vortex or cyclone is not necessarily a down-flowing or an up-flowing system, but a result merely of tangential action, where gravitating matter tends to take a position of equilibrium. This may be partially shown by a very simple experiment. If a cup of tea be stirred, so as to put the liquid in rotation, and then milk be poured in near the side of the cup, the milk will at first flow towards the centre in spiral lines without disturbing the general tangential action of the revolving liquid.

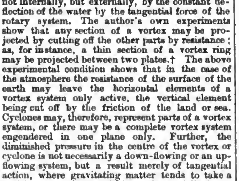
FIG. 4



There is, however, another matter to be considered, which will modify the above conditions—namely, that the relative velocities of the two sides of a bi-whirl or bi-cyclonic projection in a direction from west to east, will be materially affected by the difference of latitudinal arc in which the separated whirls are projected. This may be shown by a diagram (Fig. 5.) Let W E be the axial of projection of a current from west to east. Let the lines $a\,a'$, $b\,b'$ represent parts of parallels of latitude. Then any body resting upon the earth, the air included, at $a\,a'$ will have excess of absolute motion over another body at $b\,b'$, in the ratio of the difference of lengths of latitudinal arcs $a\,a'$ to $b\,b'$. Or any body resting at $c\,c'$ will have like excess over $a\,a'$. Now take a certain latitude of the globe, say 45° N., where the surface of the earth will have an approximate velocity of rotation equal to 500 miles an hour, and suppose a westerly wind to be blowing with a velocity of 21 miles an hour (that is what Sir John Herschel describes as a good sailing breeze), this velocity must be evidently *plus* that of the earth's surface velocity, or 521 miles an hour. And suppose the wind to be deflected in a vortex system north and south, by any resistance, aerial or otherwise, near E., and that the deflections are such as would carry the air 2° to the north and to the south to form a vortex system or pair of cyclones of 240 nautical miles in diameter each. Now suppose the assumed northerly deflection of the wind to remove the air from its position at a to b', it will then clearly be moved to a portion of the earth whose velocity is less, namely, about 479 miles an hour, whereas the wind maintaining its original force will be at 521 miles absolute velocity as before; it will, therefore, have a *plus* velocity over this part of the earth's surface to which it is deflected of 42 miles an hour, assuming it to maintain its force. Therefore, the cyclonic action continues in excess of the initial projection over the velocity of the earth at this position of 47°, and thereby may have power to complete the cyclone. If it be supposed that the southern deflection be removed from a and the wind deflected 2° south to a position c by vortex motion, the wind, assumed as before to be of an absolute velocity of 521 miles an hour, will now be deflected to a position of the earth which possesses the same velocity as itself; therefore the air arriving in this position will have no *plus* velocity, and consequently become calm. From this it follows that westerly vortex currents will be unable to complete cyclones in temperate regions in this hemisphere if projected in a direction from left to right, so that cyclones from right to left only are observed. On a similar hypothesis it might easily be shown that easterly winds would be affected in like manner, but the author assumes that the above demonstration of the principle argued is sufficient.

S. Norwood. **W. F. Stanley.**

FIG. 5



DIRECT-ACTION TRICYCLES.

[20993.]—I WAS glad to see Mr. Pearson's letter, confirming the advantages of the mode of construction adopted by the makers of the Coventry "Royal National." I notice a clerical error in my letter describing the machine. The diameter of the wheels should be 40in., and not 36in., as there stated. Not the least advantage of the "Royal National" is the great command which the rider has over the machine. I have removed the double band-brake fitted to my machine, and find that by back-pedalling, such is the rigidity of the frame-work, and the power conferred by the absence of chains or cogs, that I can pull up within a few yards, although going at full speed. In the same way, the machine can be sent backwards or forwards from rest, almost instantaneously to full speed. This is very useful in avoiding collisions, or getting out of the way of animals, &c.

I also read with interest a letter from "R. P. G.," in which he describes another form of direct-action tricycle—the "Monarch"—in which the makers have lowered the seat, by placing stirrups for the feet, hanging down from the crank-axle. But what would happen to the ankles of the rider, in case of a sudden upset, such as is certain to happen, sooner or later, to every rider of a three-wheeler? Then this make of the machine implies propulsive power gained by a *thrust*, the rider leaning slightly back to push his feet forwards, whereas it is now universally acknowledged that the weight of the rider's body should aid in the work; but to do this the seat must be placed more vertically above the treadles than is possible with the "Monarch." A more serious objection to my mind, however, is the probability of one's feet getting entangled in the stirrups when dismounting. Then I very much doubt if the rider can effectively back pedal. There can be no doubt that in the perfect tricycle *simplicity* is what we must aim at; and it seems to me that this point is more nearly obtained in the "Direct-Action Royal National" than in any other machine.

A Fellow of the Geological Society.

[20994.]—I CAN quite agree with "A Fellow of the Geological Society" and Thos. Pearson, having ridden a "Coventry Royal National" nearly all last season. But I fail to see the advantages of suspended ("Monarch") treadles. Anyone who has, unfortunately, been jerked out, or attempted to jump out, as every tricyclist must sometimes experience, will never fail to remember the "agony" of *the cross-bar against his ankle.*

On horseback, stirrups are bad enough, and a confessed danger; but to put one's feet in stirrups on a tricycle can never be the idea of a *careful man*, to say nothing of the fact that such a form of treadling involves less direct action and loss of power. However, we all have our fancies, although some soon die; but I predict a future for "direct action," as in the "Royal National." I much prefer ball bearings, and the lightest and simplest of everything. **56in.**

LEGAL REPLIES.

[20995.]—LANDLORD AND TENANT—NOTICE TO QUIT (59161).—An agreement to let a tenant stop "as long as he pleases" is void for uncertainty. The tenant should have had a lease for a time certain, and as the tenant has actually stayed 3½ years longer for the increased rent, I do not see what there is to prevent the landlord from now giving him the usual notice to quit as a yearly tenant. In fact, the extra rent was paid because the tenant wanted to stay, and not on a consideration for the landlord leaving him there for an indefinite time.

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* *Proceedings of the Royal Institution*, Vol. VIII., p. 272.

* "Fluids," p. 220.

† "Fluids," p. 221.

Income-Tax—Hedge (49210).—(1.) You ought not to have to pay income-tax upon your cottage; but if you are bound to pay it as property tax, you should get the proper forms from the surveyor of taxes, and ask for its return on the ground that your total income is under £100, and so you are not chargeable. (2.) If this hedge were a boundary hedge, you would have a right to clip it yourself; but if it is not a boundary hedge, and is, in fact, upon someone else's land, which is divided from your garden by a path, I do not see that you have any control over it. Should the path be a highway, the local authorities might interfere and get it cut.

Houses—Overflow of Water (49243).—By allowing the water from his drains to overflow into your house, the landlord commits a trespass for which he can be made liable in damages, unless, of course, a right to allow water to flow over your land has been acquired by him by grant or prescription. The proper remedy is by an action for damages and an injunction, and you had better consult a solicitor.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, London.

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[20996.]—Varicose Veins (49200).—See a former reply.

Drinking-Water (49233).—It is difficult to get any well-defined data as to the effects of various kinds of drinking-water, this influence being so mixed up with other health factors. But waters passing through limestone strata come out saturated with carbonate of lime, and containing also more or less sulphate of lime. The distilled water which, in the form of rain, falls upon the Southdown chalk hills, and makes its way out into the Thames and other rivers, is calculated, I believe, to dissolve off so much chalk as to lower the height of the surface of these hills by about one foot per century. At the Canterbury waterworks this carbonate of lime is thrown out by the addition of caustic lime. Chalk is very insoluble in pure water, but if the water is charged with carbonic acid, then it is soluble to a considerable extent. By the Clark process lime is added to these chalk waters, and this taking the surplus carbonic acid to make chalk, falls down as an insoluble powder, while the chalk previously held in solution by the carbonic acid also falls for want of its solvent. Now, on boiling such water, the carbonic acid is also driven off, and the chalk left insoluble; and this insoluble chalk it is which incrusts the tea-kettle, boiler, hot-water pipes, &c. The remedy is to have another system of hot-water arrangement (that known as Perkins's), which, when properly arranged, answers perfectly, and never becomes obstructed by incrustation. This incrustation not only obstructs the bore of the pipe, but also, as a bad conductor, prevents the fire from heating the water so easily. Gouty persons would certainly do better to drink such water after it has been brought to the boil, but not boiled long—else the water is again hardened, owing to the concentration of such soluble salts as are not precipitated by boiling. If the water also contains sulphate of lime—as will be shown at once by adding to the boiled water solution of chloride of barium—such water is very bad, both for rheumatic and for gouty people. For such people a pure form of distilled water, made for drinking, and sold in bottles under the name of "Salutaris water," should be drunk. And considering that the mode of death in all adults past the meridian of life is rather by gradual choking of the pores, and by earthy deposit in the tissues, I think that this "Salutaris water" should be much more generally used than it is. Of course, people who have been accustomed to drink the sparkling saline water, which is derived from London churchyard wells, in which many generations of the parish have been buried, feel very much like "F.R.C.S." when offered a glass of warm water to drink at dinner instead of his usual absinthe or his sherry. So, again, those who have long drunk chalky water will, at first, think "Salutaris water" flat and insipid, though perfect flatness and insipidity are the true characteristics of pure water. This question of drinking-water is one of vast importance, especially to people who are past the meridian of life, or who have any gouty or rheumatic diathesis. But if "E. C." will get down a few dozen of this water, and drink it at dinner, flavoured with a little fresh lemon-juice, he will very probably not feel his gout any more; if, in other respects, he will live as I have already advised. There is no difficulty in so arranging the kitchen boiler as to make the waste heat provide a constant supply of fresh distilled water.

Cuts, Wounds, and Bruises (49250).—I regret that pressure of other work has prevented me from writing on this and other subjects. I will endeavour to fulfil my promises at an early date.

Lime-Juice (49252).—If taken too largely, or for too long a time, one gets tired of it; or it may even become depressing. Taken from time to time, it is very wholesome; and where vegetables and fresh fruits are not freely accessible, it is a concentrated vegetable essence which is of great value in the diet. If the juice of a fresh lemon be squeezed into a tumbler, and filled up with warm water, or with "Salutaris water," previously warmed by standing the bottle in warm water, that will be found a most wholesome drink; and, for gouty or rheumatic persons, positively antagonistic to their diathesis. But refer also to my former letter on gout.

James Edmunds, M.D., &c.
Grafton-street, Bond-street.

COFFEE AND TEA.

[20997.]—Drs. Edmunds and Allinson seem to be unanimous in condemnation of the above as drinks. I glean three reasons why they are condemned. 1. Because coffee and tea are less good diluents than hot water. 2. Because caffein is a poison. 3. Because the tannic acid contained in either forms an insoluble compound with the gelatine of the meat. I shall treat these three reasons seriatim.

1. It cannot be denied that warm water must be a better diluent; that is, able to dissolve more of a certain matter than when some of its diluent power has been used in dissolving something else. But this is, after all, only a matter of figures. How many grains of caffein, tannic acid, &c., are contained in half a pint of good coffee or tea? So few indeed that a cup of either will dissolve very great quantities of sugar, salts, or any other (in water) soluble matter. And I suppose that there is no difference between the solubility of matter, whether inside or outside the human system.

2. Caffein is a poison. When and where was that proved? If taken in large quantities, perhaps; but then it is not taken in large quantities. Are there not a multitude of substances which can be taken, and are taken, with impunity in small doses, but which would cause serious disturbances if taken in quantities. We do not know what becomes of the caffein when it has entered the system. But anyone familiar with organic chemistry will admit that the relation between caffein and uric acid is an intimate one, so intimate that I do not believe caffein can in any way be counted amongst the accumulative poisons—an assertion, I admit, I have never heard made. What is the difference between caffein and thein?

3. Coffee and tea contain tannic acid, which forms leather-like compounds with the soluble gelatine contained in meat. Quite true. But this is again a matter of figures. If we consume as many ounces of meat as we consume grains of tannic acid at the same meal, I opine there is a nice little margin left for the human system. And that would be pretty nearly reality. And as all this is only a matter of simple calculation, I should like to know how many grains of caffein, tannic acid, essential oil, &c., there is contained respectively in a cup of good coffee or tea. When we get to know that exactly, we may be able to take precautions against the pernicious action of the tannic acid, at least. One nice little thin slice of meat might then be sacrificed on the altar of tannic acid, and becalm the apprehensions of the timorous slop-consumer.

Would it not be better and more scientific if Drs. Edmunds and Allinson gave exact figures? Reasons 1 and 3 are purely chemical, and could be treated scientifically. Now they stand as assertions which are the more objectionable, as they do not tell the whole truth, but only a part that might be used with bias and prejudice.

Anglo-Dane.

WHAT SHALL WE EAT AND DRINK?

[20998.]—Dr. Allinson, writing in your last issue, brings some heavy charges against medical men, to which I have no doubt some of the eminent members of the profession who contribute to your columns will reply.

There is one statement, however, of Dr. Allinson's to which, perhaps, I may be allowed to draw your attention. Dr. Allison says:—"At college, students are taught the supposed beneficial action of drugs and of the knife; but they are not taught the action of food on the system."

Now, of course, I don't know what particular college he had in his mind when he made those remarks; but as a senior student of one of our London hospitals, and as a demonstrator in the Physiological Laboratory of more than 18 months standing, permit me to state that, as far as my experience goes, that assertion of Dr. Allinson's is absolutely incorrect.

For the first two years of their curriculum, medical students are obliged to devote their attention mainly to gaining a knowledge of anatomy and physiology, the text-book of the latter science used in the medical school with which I am connected being the admirable work by Dr. Michael Foster.

No one nowadays can hope to be able to pass any of the London examinations in physiology unless he be well grounded in nutrition. The very question which Dr. Allinson propounds—namely, as to the quantity of food required daily—in order to "stump" his professional brethren, is one that is continually asked at examinations, and one that almost any "first year's man" who had read any physiology at all would be able to answer.

Dr. Allinson certainly shows a remarkable want of knowledge as to the state of teaching in our medical schools, and his ignorance appears the more astounding, occurring, as it does, in one who, according to his own showing, is so far in advance of the rest of his profession as to be able to "teach them the rudiments of knowledge of man," and to dub them "pseudo-doctors." There is, however, one remark in Dr. Allinson's letter that may serve as a key to the remainder of the contents. He says that vegetarians taught him more of the science of life than did all his professors.

This may have been due to the fact that he did not learn as much as his professors could teach him, or else that they did not teach him as much as they should have done. Following Dr. Allinson's own method of drawing conclusions, "first statement is most likely."

Had he followed more carefully the teaching of Foster or Pavy, instead of physiologists of the pamphleteering type, he would have saved himself from making rash assertions, such as saying with confidence he would never be ill, and also from propagating absurd theories about vegetarianism being the only true and physiologically correct diet for man. I inclose my card, and sign myself

A London Medical Student.
January 22nd.

GRAVITY ESCAPEMENT.

[20999.]—Seeing a letter (20946, p. 433) on the rate of a double three-legged Denison gravity escapement, has induced me to give my idea that the double three legs is an unnecessary complication; for, by placing the stops so as to form an angle of 120° at the pallet arbor, and making each leg in its turn strike from stop to stop, all the advantages claimed by Sir E. Beckett can be obtained in a greater degree, with a single three legs.

It would also be an advantage to have separate levers, resting on adjustable studs, for the stops, so that the unlocking could begin at a point before zero, or lowest point of the pendulum's swing, equal to that at which it unlocks after zero; thereby equalising the friction in the descent and ascent, and enabling us to dispense with the fan fly. I may say that I have tried this latter arrangement with a two-legged gravity escapement, where the driving weight varied considerably more than with any turret clock, and with very satisfactory results.

M. S. M.

THE SLIDE-RULE.

[21000.]—Respecting the "cubing rule" referred to in the letters of "Gamma Sigma" (see "E.M.," pages 410, 453, Nos. 928, 930, January 5th and 19th), I shall be obliged if the gentleman carrying above signature will kindly furnish an example showing the application of above instrument, to find the contents of a parallelopipedon, whose end dimensions are, say, 17¾in. by 13in., and length, 3ft. 8½in., so as to leave the whole of the operations and results open for inspection at last.

And so far as concerns the spiral instrument, which to "G. S." appeared very clumsy in working, inasmuch as one arrangement of that kind gives results equivalent to what are obtainable from a 50ft. straight slide-rule, or circular one 8ft. diameter of the ordinary arrangement, while combined with it are a circular instrument 12in. diameter, and a common logarithmic table to four places of decimals, then if the clumsiness which appeared to "G. S." arose from the great size of instrument which was necessarily caused in representing four places of figures, it may be asked, how much larger and clumsier would be that to represent six, which is stated to be what is wanted?

Buttershaw, Jan. 20. **Thomas Dixon.**

THE BRAKE FAILURE AT SPALDING.

[21001.]—On Thursday, the 11th inst., a report was telegraphed to all parts of the country, and, of course published in the newspapers, to the effect that the Westinghouse brake failed at Spalding, in consequence of a pipe bursting, and that a Great Eastern Company's express train had run a quarter of a mile past the station. The following are the facts of the case:—The 9 a.m. train from Liverpool-street to Doncaster, was worked with a Westinghouse brake from London to March, and it was in perfect order. After another engine had been attached the Westinghouse brake was *not in use north of March*, and the train was worked with the usual tender and van hand-brakes. On approaching Spalding, the fireman attempted to put on the tender hand-brake; but this he was unable to do, as a pin which connects the hand gear had fallen out, and was lost. The driver at once reversed his engine, and stopped 150 yards past the station. From these facts it will be seen, that the cause was the failure of the tender hand-brake; that the Westinghouse brake was *not in use, and did not fail*, and that the distance which the train passed the platform was very incorrectly given.

The person who telegraphed the report of this supposed failure of the Westinghouse brake evidently did not understand its construction, or he would not try to account for a failure by stating that "a pipe burst." Doubtless, he thought this would render the brake useless, whereas the fact is it would instantly apply it. The Westinghouse brake being automatic in action, is *applied by a decrease* of air pressure in the brake pipe; therefore, whether by the driver or guard operating his brake valve, the accidental separation of the train, the breaking or bursting of a pipe, or any other means by which the pressure is suddenly reduced, it will be instantly applied and remain "on" until purposely released.

Leicester. **Clement E. Stretton.**

STANDARD WIRE-GAUGE.

[21002.]—IN reference to the letter of your correspondent, "Lestar" (20940), I entirely agree with him as to doing away with the old numbers altogether, and would suggest that whatever system is adopted, the sectional areas of the various sizes should have a geometrical ratio compared with each other; and this, of course, would give the diameters a corresponding relationship. Suppose the ratio to be $\sqrt[3]{2}$, or as 1 : 1·2599, with the centimetre as the unit of area, then—

Size.	Diam.	Area.	Size.	Diam.	Area.
1	1·1284	1·	8	0·502	0·198
2	1·005	0·793	9	0·447	0·157
3	0·895	0·629	10	0·398	0·135
4	0·797	0·5	11	0·355	0·099
5	0·710	0·396	12	0·316	0·078
6	0·633	0·314	13	0·282	0·067
7	0·564	0·25	&c.	&c.	—

The advantage of taking the centimetre is that area × specific gravity equal weight per unit of length—viz., 1 C.M.

Comparing any wire with any other that is either 3, 6, 9, or 12 sizes smaller, their sectional areas will vary ½, ¼, ⅛, and $\frac{1}{16}$ respectively; and conversely, by comparing with sizes that are larger, in the same order, they will be 2, 4, 8, and 16 times greater, their weight per equal lengths bearing the same proportion. The electrical resistance will vary inversely to the weight. By comparing the diameter of any wire with 6, 12, or 18 sizes smaller, or larger, they will vary ½, ¼, ⅛, and 2, 4, 8 times, respectively. I think the adoption of a ratio which is a root of 2 will considerably facilitate calculations, and effect a great saving of time.

James B. Spurge.

The Avenue, Erith, Kent, Jan. 16.

CUTTING STEEL WITH A WET IRON DISC.

[21003.]—THE operation described by the correspondent of the *American Machinist*—viz., that of cutting steel bars by means of a soft iron disc—is, to my knowledge, at least 40 years old, and I daresay many of your readers of my age (63) will remember seeing it in operation from 1836-1844 at the Royal Adelaide Gallery, where it was exhibited cutting an 18in. coach-smiths' "rubber"—not smaller—through in about 45 seconds *dry*. The disc spindle ran inside the projecting rim of two anti-friction wheels, and revolved at about 3,000 rev. per min. It was driven by a small engine by the elder Perkins, the founder of the present firm of boiler engineers. The cylinder of this engine was only 2½in. diam. by 12in. stroke and ran at 40 to 50 rev. per min. The steam was supplied by one of Perkins's coil generators, and was, generally, while running the engine alone, worked up to 500lb. At this pressure the little engine developed 6 h.p., but of this the disc absorbed quite half. The same boiler was used for working the steam-gun (Perkins's) where the steam-pressure was raised to 1,000lb. per sq. in., and sometimes higher. As I was at that time acquainted with Professor Faraday, who was scientific lecturer at the Adelaide, and often accompanied him there, I had the above data *from him*. It was with this boiler or generator I first experienced the *cold blast* induced by steam at such a tremendous pressure issuing from the safety-valve. No steam proper was visible, but for about 3in. all round the valve appeared a beautiful ultramarine halo; beyond this the issuing vapour blew as perceptibly cold to the hand, in fact, it was like holding one's hand against a tuyere in full blast. At that time the properties of the disc had only been applied to show the abrading effects of soft metal at high velocities. The American application of it to useful purposes is the first I have heard of.

Mechanicus.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48559.]—**Dynamo (U.Q.)**—The querist will do well to read the Cantor lectures on "Dynamos," which are being published in "ours," and in the *Journal* of the Society of Arts. The reason of machine heating is an electrical, not a mechanical, defect—resistance of armature too high, or of external circuit too low. Oil being an insulator is hardly a good thing to put on the commutator. The position for the brushes is at the extremities of the diameter of commutation, as is very fully explained in the lectures above referred to.—KAPPA.

[48582.]—**Granule Cells (U.Q.)**—Mr. Dale informs me that his cells have a constant E.M.F. of 1·72 volt. I should imagine that their low internal resistance would render them quite as suitable as Bunsen for electric light, not to mention the advantage of having no fumes.—KAPPA.

[48752.]—**Adulteration of Tea.**—I would supplement the remarks on this subject by stating that I believe there are such things made as tea-mills. Who are they used by, and for what purpose if not for adulteration? Leaves of the hawthorn, the common sloe, and bass, such as used in the manufacture of brooms, have been suggested as playing important parts in "a cup of tea."—A. FRANCOIS.

[48774.]—**Watch Repairing (U.Q.)**—Querist can learn what he requires by perusing the last Vol. of this paper, and Britten's "Handbook," advertised in "E.M." but lately, price 5s.—C. M. R.

[48790.]—**Watchwork (U.Q.)**—"Dial" seems to me to answer the first part of his query himself, if I understand it aright. Remedy: either new pivots or new holes. If you want to fit cylinder-pivots, it requires special tools; but much can be learnt by perusing back numbers, especially the last Vol.—C. M. R.

[48814.]—**Grinding Glasses.**—For glazing spectacles any moderately fine-grained stone will do. Bilston grits are rather scarce. If your stone is too coarse, it will fleck the edges. For polishing the edges you require a very fine stone, pronounced "Crag Lee," for use after the ordinary grindstone, and which will leave your glass perfectly smooth, but dull. A polishing bulb of withy, upon which you may use either finely-powdered pumice or rottenstone is all that is required. It is well to have a vessel containing water handy, into which you may dip the glass and your fingers, so that any particle of dirt or pumice-stone adhering thereunto may be removed, or you will find the surface of the glass scratched when polished. You will not be able to purchase pumice-stone in powder fine enough, and in the absence of a mill can crush it upon an iron plate with an ordinary flat iron.—A. FRANCOIS.

[48817.]—**Restoring Silk and Woollen Goods.**—It is rather strange that simple pressure should bleach a black colour. If a logwood black, perhaps sponging with very weak ammonia water will restore shade.—ASSAYER, Trinidad, Colo.

[48829.]—**Lathe-Bed.**—I saw the remarks of "W. J., Patternmaker," but thinking it only a matter of opinion, I did not think it necessary to write. But in answer to W. H. Scriven (48689), I may say that he interprets my description correctly as regards part B, Fig. 1, page 365. E shows the bed of sand; A, represents the top box; after removing which the sand in the middle is removed in the usual manner—viz., by having a slip of wood (iron plate if the casting is large or many castings wanted) the length of the bed, placed under the sand to be lifted; two or more hand or lifting-irons screw into this slip. While the inside of the pattern is being rammed these irons are left in and come level with the top parting. When the operation is done they are unscrewed; a piece of paper placed over the holes to keep the sand out, and then the top box rammed.—E. P., Liverpool.

[48835.]—**Fusible Plugs.**—I hope my remarks will lead to "serious consequences," as your correspondent says, provided those consequences are nothing more serious than a careful inquiry into the real merits of fusible plugs as made and applied. Possibly it is because I have "penetrated the subject" that I spoke of them as a "delusion and a snare," and I fail to see that "B. W." has done anything to remove that impression: on the contrary, he supports it. I cannot agree with him, however, that a water "entirely unfit for boiler purposes," can be rendered so by the use of any fusible plug yet invented. I need not occupy space, though, for in the adjoining column on p. 457, "Boswell" puts the matter on a proper footing. "B. W.," however, says that large openings are necessary, so that the incrustation offers no impediment to the steam. I, on the contrary, would say that the plug should be placed in such a position that it could not be covered with scale. Boilers that are properly looked after and fitted with low water safety-valves do not require fusible plugs, but in locomotives, where they are really useful, it is the practice to change them about every month—a little fact which says a good deal. Probably the alloys undergo some change through the prolonged heat, for, as is well known, alloys melt at temperatures below the mean of the melting-points of their components—why has never been satisfactorily explained.—T. P.

[48906.]—**Horsehair Pillows.**—Cannot be done; horsehair is sure to go lumpy unless well shook up, especially if it has room to move about. Horsehair cushions are always stuffed tight for that reason.—R. J. M.

[48911.]—**Self-Registering Thermometer.**—I have made the liquor in my self-registering thermometer join again by alternate heating and cooling before a fire; but cold, such as we sometimes get here (Colorado), parts it again. The instrument has recorded all right for three years, but spoilt this winter. I fancy the liquor (spirit?) is yellower in colour than it used to be.—ASSAYER, Trinidad, Colo.

[48914.]—**Tea and Coffee after Meals.**—The reply on p. 458 looks very absurd after Dr. Edmunds has given a definite answer to the question; but it shows how ready some people are to scatter "information" broadcast without taking the trouble to learn if it is correct. Theine and caffeine do not contain tannin, and the latter is used to convert hides into leather, not to harden leather. Dr. Allinson was more cautious in his first letter (p. 385) than on p. 455. Then he wrote, "The tannin of the tea is said to form leather with the gelatin of the meat"; now he speaks much too positively, and offers not a particle of proof for the statement that, "In fact, meat is changed into leather." Perhaps Mr. Allen can tell us whether any experiments have been made on this point, for I submit that decoction of oak-bark with skins is not quite analogous to a nice juicy steak and a cup of tea. Will Dr. Allinson try the experiment, or preferably, Mr. Allen, of endeavouring to convert a piece of hide into leather with oak-bark, accompanied by gastric juice and the other accompaniments or equivalents of the cup of tea and the meat; or, reversing the process, will one of these gentlemen try how far steak digests in an artificial gastric juice, plus a cup of tea? The results would be science, and would be more convincing than mere sweeping assertions.—NUX. DOB.

[48915.]—**Jack-in-the-Box Gearing.**—Will querist say where he saw the term? There is, or was, the jack-frame, or jack-in-the-box, used in the cotton manufacture for giving a twist to the drawn sliver, winding on a bobbin as it was received in the roving can. Has that anything to do with it?—T. P.

[48935.]—**Fan for Smith's Hearth.**—This query is a bit of a puzzle; but if it is meant that the blades of the fan are only 6in. square and move in a chamber 9in. wide and 22in. in diameter, the remedy is obvious; put longer and wider blades, so that they nearly fill the space they have to move in.—S. M.

[48968.]—**Ordnance Survey.**—If "F. C. T." wants to join the civil division, he would only require a recommendation from his last employer, and make application to Captain Morgan, Ordnance Survey Office, Hereford, as that is the division office for Warwickshire, &c. If the R.E.'s, he would require to be some tradesman. The opportunities and promotion is sure, if steady, and attentive to duties.—KNOWNOTHING, Birm.

[48993.]—**Yellow and Red Timber.**—"W. J." at page 458, thinks I am wrong in saying that Dantsic or Memel fir is often spoken of as red pine, such is my experience when questioning workmen, but that they are not the same wood, I believe I made clear in answering the query on page 413, "W. J." will find, however, that the opinion is very common, and is expressed by good authorities, (e.g.) Rankine in his "Civil Engineering" says, "Pine timber of the best sort is the produce of the red pine or Scottish fir (Pinus sylvestris) grown in Normandy, Sweden, Russia, and Poland; the best is exported from Riga, the next from Memel, and Dantsic." In "Chambers' Ency.," art. "Pine," he will also find the same wood spoken of as red deal or red pine; and R. Murray, C.E., expresses similar views in "Shipbuilding, and Steam-ships," page 150-51. Hurst, in his "Architectural Handbook," also mentions the inconvenience arising from this practice. From the above it would seem as if there was some doubt about the matter, and for myself I always decide by finding whether the wood in question is imported from America or Europe: if the former, it is pine, and in the latter case fir. Will "W. J." kindly explain the difference between red pine timber and red pine deal, which he mentions at the end of his answer? And if any of your readers can explain how this confusion has got about, many, no doubt besides myself would feel obliged.—Shipwright.

[49024.]—**Stains or Dyes for Wood.**—If "Dandie Dinmont" would apply to his deal an aqueous decoction of gum catechu; afterwards, when dry, give it a coat of bichromate of potash dissolved in water, which will give a colour from the lightest brown to nearly black, according to the strength of the solutions, which will take a good deal of scrubbing (as he calls it) to erase, I am sure "D. D." will be satisfied as regards cost.—Aberdeenshire.

[49026.]—**Geological Query.**—The hypothesis referred to by "H. T. W." has now been before geologists for some time. Mr. Lancaster, judging from his reply to query, has not seen an account of it. The position maintained by its author has not yet been seriously criticised, our knowledge of terrestrial movements being still very limited. Experience will show whether the hypothesis is tenable or not. Meanwhile, I believe geologists will be inclined to regard it as a very valuable contribution to the most obscure department of geological research. Taken in conjunction with the causes previously recognised, it helps us to understand how it is that some of our British lake and estuarine deposits, notably the Old Red Sandstone and Wealden series, accumulated to such an immense thickness within comparatively limited areas.—I. E. George, Liverpool.

[49044.]—**Extracting Paraffin-Oil from Floor.**—Yes. A strong hot solution of oxalic acid applied, and by the after-use of the scrubbing-brush, you will remove all stain from your boards.—A. E. B. Smith.

[49050.]—**Pumps.**—To "Engineman," p. 459. We have a 7in. pump, 6in. pipe, length of suction about 50 yards, total dip about 7ft.; this pump is worked with the hauling ropes, which run the waggons and pump at the same time; length of delivery pipes 800 yards, with total rise of 100ft., revolutions about 40 per minute. We have an 8in. pump running with endless rope, about same speed; length of suction about 40 yards, dip about 10ft., length of delivery 400 yards, rise about 84ft. It is advisable to have a clack-valve as near the end of suction as possible.—Brakesman.

[49060.]—**Vice for Bench.**—Will R. T. Lewis inform me where the vices may be seen in London, the prices, and weights of 3in., 3½in., and 4in. jaws? Are they fitted with "solid boxes"—*i.e.*, the thread turned out of the solid, and not formed by brazing in a strip?—Mechanic.

[49070.]—**Brush-Dynamo.**—Use No. 18 on armature, No. 10 or 12 on F.M. Get *pure* copper wire, cotton-covered. Well insulate wire on armature with silk-ribbon. Cotton or paper will do for F.M. If the cores of field-magnets are large, use the No. 10. Quantity a matter of experiment.—A. J. Ss.

[49072.]—**Use of Marine Glue.**—In using marine glue, Miss Richards should have the surfaces of the articles she wishes to unite perfectly clean, dry, and warmed; then, and not till then, may she apply just sufficient hot glue on one surface only to form a thin layer. The best tool for the purpose is a narrow spatula. This done, press the articles together, and continue the pressure till firmly united.—A. E. B. Smith.

[49077.]—**Pyrometers.**—It will be a difficult thing to make a pyrometer to work through 1,000°, as you seem to wish to do. I can give you instructions how to make a good one, to work from 400° to 1,000° F. If this will answer your purpose, let me know in another query, and I will help you.—W. J. Lancaster.

[49078.]—**Spontaneous Combustion of Oils.**—It is a difficult thing to answer this question, but we might place in the order of their spontaneity—1st, light mineral oils (the benzol and the benzine series); 2nd, essential oils (including the turpentine series); 3rd, heavy mineral oils; 4th, fish oils; 5th, fixed (as a rule) seed oils. I think "J. F. S." will find that the spontaneity of the different oils of each class varies in ratio to their specific gravities.—A. E. B. Smith.

[49086.]—**Collimators.**—A long collimator is better than a short one, where space is not much object. The longer the collimator, the better can you adjust the slit for fine lines. A short collimator must have the edges of the slit as nearly perfection as possible, and they must be able to approach each other with an accuracy not at all necessary in a long collimator. For star spectroscopy, though, the longer the slit is away from focus of o.g. the less light does it receive, so that a long collimator would not be so good as a moderately short one for a star spectroscope.—W. J. Lancaster.

[49089.]—**Pronunciation of Hebrew.**—The Eton Hebrew grammar gives the sound as *a*; Wolf's grammar as *aw* in *call*. Parkhurst and others omit the points, and give Aleph as in *call*, *war*. The true pronunciation of Hebrew is supposed to be lost—like the other ancient languages—and the points are a recent invention.—Sob.

[49089.]—**Pronunciation of Hebrew.**—There is no "standard" pronunciation of Hebrew; scarcely any two books agree. Some Hebraists recommend the language being learnt "without the points," a short *a* or *e* being added between the consonants. This, of course, affects the pronunciation. Bleek (introduction to Old Testament) says the Synagogue rolls are still written without points.—Gimel.

[49092.]—**Constant Battery.**—Will "Sigma" accept my thanks for his reply to my query, and allow me to trespass once more upon his good-nature with a revised question? I want a continuous current through a closed circuit offering a resistance of from four to five ohms. The E.M.F. of the Daniell cell would be ample for my purpose, and what I want to know is for how many days, weeks, or months would such a cell give out a current practically unvarying, and after what period of time would the current fall to, say, one-third of its original amount? If these data are still insufficient, will "Sigma" kindly state how long will a Daniell—or, if "Sigma" considers it superior, any other form of cell—supply a continuous current if the poles be connected by a short thick conductor, the external resistance being practically nil? I know that I could solve the question by experiment, but thinking that his experience in electrical matters would enable "Sigma" to answer the question offhand, I addressed it to him.—Ligurian.

[49094.]—**Bell Telephones.**—I should say, Certainly not. Why don't you write to the present company, and ask them the question as to exchange? and then you would have the only answer you can get. You cannot alter them and number them yourself. The company alone will number their productions.—W. J. Lancaster.

[49100.]—**Varicocele.**—Having been radically cured by undergoing three different kinds of operations, allow me to say some are very simple, others very heroic. The suffering can be mitigated by wearing a suspender, resting in the horizontal position, and avoiding much standing, which is worse than moving about. A bidet is valuable for cold local bathing. A radical cure cannot be effected without obliterating the veins—mine were, on both sides. Vide Coulson on "Varicocele."—C. T. R.

[49105.]—**Artificial Foot.**—In reply to "Timber Toes," a friend had his foot amputated at the ankle, and was told by a dealer in artificial limbs it was taken off at the wrong place, and could not be fitted. I made him one which he has worn for ten years. I mistake—he has had two in that time; he walks well without stick, and I have seen him lift heavy weights into railway-waggons. He takes part of the bearing on end of stump, leg, and under the knee a leather socket fits the leg, and laces up behind, and buckles round below the knee-joint, and pushes this into another leather socket with steel strips up each side, riveted on, with a joint at the ankle, and another at the root of the toes. The foot is made of willow, same as cricket bats, exactly the same size as the other. He can buy shoes at any shop, and walk off. Last year I made him a tricycle; he went on a tour for five days, riding every day, and can mount hills that many bicyclists would not attempt. If Editor will find space, I will give more particulars and help the querist to make his own, which he can do if a mechanic.—Ex.

[49108.]—**The Vose Induction Machine.**—The hole in your stationary-plate can be best cut in the following way:—Have a small disc of wood (ordinary picture-backing will do well), and with it, of course made to size, cut with the diamond a circle. Tap it carefully all round till the cut has gone through. Put a pointed tool (say a graver) point upwards, in the vice. Hold your plate so that the middle of the disc of glass you wish to remove rests on the point. With a small hammer (I use a watchmaker's hammer) hit gently just above the point. You will make a hole, and by moving the glass and by careful manipulation, you can easily remove the part wanted. Some experience is necessary, but the actual work can be easily accomplished in ten minutes. The Leyden jars may be of any size you like: with large ones you will have more dense but fewer discharges than with small ones; 4 or 5in. of tinfoil for each surface is sufficient. The great point is long insulation, and for this purpose long jars coated only up a small way from the bottom are best. The holders for the brushes that feed the armatures may be fastened on the stationary plate any convenient way—the only points are that when they touch the buttons there must be electric connection throughout; else the machine will not be self-starting. I have bored holes in some plates and secured the small wire arm with small wooden or vulcanite nuts, and I have also secured them by a clipping arrangement, made of wire, to fasten on the edge of the plate. To the other parts of the query, "Not material" is sufficient answer.—A. R. Molison.

[49115.]—**Gasometers.**—Galvanised iron will make excellent gasometers, and will last a lifetime. If you make the inner one 2ft. square, and to lift 2ft. out of the outer one, it will hold 6ft. of gas; have side strips and pulleys with counterpoises. Gasometers may be either makeshifts, or may, with the same trouble, be made to do their work well.—W. J. Lancaster.

[49117.]—**Thermometer.**—You do not say whether the liquid is mercury or spirit; if mercury, then by shaking the thermometer, bulb side down, the mercury will join; but take care to keep index well up the tube. If spirits, a similar shaking will rejoin the broken column, and when putting out the thermometer, let the top of thermometer be lifted some 1½in. to 2in. above bulb; the column will never break then.—W. J. Lancaster.

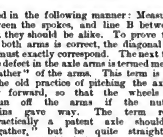
[49118.]—**Brick Bridges for Boiler.**—The best proportion for these is that obtained by direct experiment. If there is no iron bridge-plate, and the back fire-bars rest on a cross bearer-bar, you should have a wall 14in. through, but with an iron bridge-plate 9in. is sufficient. But the distance from top of bridge wall to crown of furnace depends somewhat on the draught, and also on one or two other considerations; but for a beginning, allow 10in. between crown of furnace to top of bridge. You can easily find for yourself the best proportion afterwards.—Labor Omnia Vincit.

[49120.]—**Violin Bow.**—Can, I believe, be cleaned by rubbing with a cinder from the fire (cold of course). A better way is to pass it up and down between the fingers, using grease to remove the rosin. Afterwards use soap and water in the same manner and allow to dry. Use a little care.—A. Francois.

[49120.]—**To Clean Violin Bows.**—Take a small piece of flannel, wet it (cold process), well rub it with best yellow soap, double it, holding the hair gently between the finger and thumb, rub gently till clean, using plenty of soap; rinse flannel, wipe off, then wipe dry with a piece of calico or linen; in an hour afterwards it will be ready for the rosin. I formerly used a solution of borax-and-water, but prefer the soap process.—Meliora.

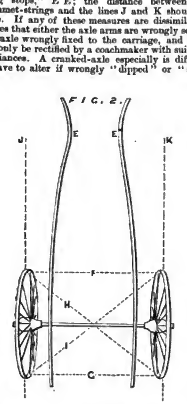
[49122.]—**Dog-cart Axle.**—"No Name" can test the truth of his dog-cart axle for the "dip" of the arms, thus: Have your dog-cart on a level floor, with the shafts as high as the horse carries them, spin both wheels to find if truly "boxed-on." Stand the wheels so that an under spoke of each shall be upright from the floor. These spokes must be what are termed "front-set" spokes, that is they are framed into the nave ½in. forward of the next spoke, which is termed a "back-set" spoke. If the "dip" of the arms be correct, these spokes will be vertical, viewed from the back or front edge of the wheel, as shown by diagram, Fig. 1. This is proved in the following manner: Measure line A between the spokes, and line B between the spokes: they should be alike. To prove that the dip of both arms is correct, the diagonal lines C and D must exactly correspond. The next test of a possible defect in the axle arms is termed measuring the "gather" of the arms. This term is derived from the old practice of pitching the axle-arms slightly forward, so that the wheels should not run off the arms if the nuts and linch-pins gave way. The term remains, but practically a patent axle should have no "gather," but be quite straight. The only way to test this is by a coachmaker's tool called an "axle-gauge"; to use this, axle and wheels are mostly removed from the carriage. Fig. 2 shows axle with wheels fixed truly: the lines F and G, measured between the wheels at the height of the axle, should be alike; the diagonal lines, H and I, measured at the same places, should also be alike. The foregoing measures may prove the wheels to be truly boxed on to the arms of the axle, and the arms in a straight line, and with the proper "dip." Another point to consider is whether the axle is fixed truly in the carriage; this is easily proved by holding a line against the face

FIG. 1.



of the wheel at the height of the axles, parallel with the floor, reaching to the length of the shafts at the "tug stops," as shown by the lines J and K. Two plummet-strings have to be dropped from the "tug stops," E E; the distance between the plummet-strings and the lines J and K should be alike. If any of these measures are dissimilar, it proves that either the axle arms are wrongly set, or the axle wrongly fixed to the carriage, and they can only be rectified by a coachmaker with suitable appliances. A cranked-axle especially is difficult to have to alter if wrongly "dipped" or "set."

FIG. 2.

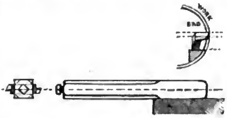


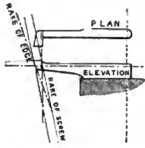
Why have such an axle? I use a dog-cart, with a straight axle, 4ft. 8in. high wheels, and yet have a doorway behind for entrance to two cross seats for hind-seat riders; the bottom of this part of the dog-cart body is only 20in. from the ground; the axle is in front of this part of the "well" of the body. I alter the balance of the body for the hills 6in., by a hand lever, and for two or more riders 13in., by sliding front seat backwards or forwards; both back and front seats have hoods on steel frames, which fold up under the front cross-seat out of sight. I am 20 miles west of London, and shall be pleased to show it to anyone interested in dog-carts and their improvements.—J. C. KING.

[49123.]—**Electricity in Horse-Training.**—The easiest method of finding the effect of a shock from an induction coil to a horse is to try it in your own mouth. Hold one of the handles coupled to a coil in your mouth, the other in your hand, and get some one to turn on the coil. The method for horses originated by M. Defoy, and was used, I believe, in a number of cases by the Paris General Omnibus Company, and also has been used to quiet restive horses when being shod; but I hope it will never become at all a common practice. Try kindness first.—W. J. LANCASTER.

[49126.]—**Huyghenian Eyepieces.**—I am glad you have said that you sent to a London *dealer*. I should have been sorry if you had been treated so badly by any optician. You can, with the lenses you have, make up a Ramsden eyepiece; or you can buy two other lenses, ⅝in. and 3in. focus, and make up two Huyghenian eyepieces. To obtain the power you require, though, you must get two new lenses, ¼in. and ⅜in. planos, and mount these, flat surfaces next to eye-hole, barely ⅛in. apart. You should, of course, use your best efforts to mount them true; the ¼in. lens will be the most difficult for you to mount, and in mounting it let the plane surface rest against a flat bearing, having the hole in to look through. You will mount true in this way; but if you attempt to mount it round side down, you will be sure to fail in getting it true. Put a diaphragm in the focus of eye-lens, and same diameter as eye-lens.—W. J. LANCASTER.

[49127.]—**Twist Drills.**—The proper shape for an inside single screw tool is as per sketch. In use, keep the cutting-edge just a little above the axial line of work; if set lower than this line, the tool is apt to dig, and, consequently, to damage its sharp cutting-edge. Also bear in mind that you must give to the front or end cutting-edge a little more rake than what is due to the pitch of screw, and this varies with the diameter, else the tool will either not-cut, or it will bind. An excellent form for internal screw-cutting, I make as follows: (see sketch, Figs. 4 and 5). A piece of square steel, from ⅜in. for a 3in. lathe, to ⅝in. for a 5in. or 6in., of suitable length, is drilled up at one end with from ⅜in. to $\frac{5}{16}$in. hole, according to size of steel, and at from ¼in. to ⅜in. from same end. Two same-sized holes are drilled right through centre of bar, and at right-angles to each other. The end hole is tapped to receive a short square-headed binding-screw, pushing against a very short piece of brass wire forced into the hole. The other holes are then tapped with a very fine and shallow thread. The cutting-tool is made round steel rod, and is also screwed to fit holes easy. A separate shape may be filed on each end of cutter, and when fitted to shape, the top or table of tool is formed by filing down to centre of rod; it is then hardened and tempered throughout, and as very little of the steel need project beyond the tool-holder, there is little fear of the cutter breaking. This form admits of canting the tool when cutting quick pitches. I have used this pattern tool for the last 30 years, and find them do their work well. The square bar may be octagonal for about two-thirds its length; this allows the cutter to be set in still closer. I also use the threaded cutters and holders for front and side slide-rest tools.—MECHANICUS.





[49130.]—**To "F. W." or "Alfojoe."**—Possibly "Scotus" may find that the follower which contains hole for escape wheel pivot has been forced partly or wholly out of what is called the counter-potance, which he will find just above the contrate-wheel if he holds watchdial downwards; if it is not out, by pushing it in until escape-wheel has very little undershake, he may find the watch go again. Probably, however, he will find that the escape-wheel teeth are injured; to correct this, the watch must be taken to pieces, the escape-wheel placed in turns, and whilst revolving with bow, just touch tips of teeth until he has touched all, with a piece of bluestone; just touch every tooth, but no more. Next, with a suitable file, cut away superfluous metal from back of teeth; but be careful not to touch the tips. Now put verge and escape-wheel in place, when he will probably find that escape-wheel wants to be closer to verge. To do this, remove wheel and potance, and file away face of dovetail (in which escape-wheel pivot works) a little at a time, carefully testing each time until the drop is right. This requires plenty of practice to do well, and he will find much to help him in Vol. XXXV. of this paper. To prevent a similar disaster in future, never remove or unscrew the verge-cock with the watch wound, unless you first insert a bristle or something similar, to prevent it running down.—C. M. R.

[49132.]—**Silver.**—Owing either to a *lapsus calami*, or else a printer's error, in my answer to query 49132, the third word in the third line was rendered "that," and should have been printed "heat"; thus altering the character of the answer.—E. G. T., Plymouth.

[49134.]—**Northcott's Irregular Turning.**—Will Harry Grosvenor give the offered description of his arrangement of Northcott's irregular turning? as no doubt it will be interesting to many readers of "ours," as well as yours truly—PHOTO.

[49139.]—**Glazed Tiles.**—Cut the glazed face with a diamond, the rough back with a file, and lightly tap along the furrow with a cold chisel. For fixing them where they have to stand heat, use Keen's cement.—HAMMER.

[49146.]—**Lime-Light Apparatus.**—Presuming that the apparatus alluded to by "Lantern" is Chadwick's "oxygen generator," I may tell him that it is most convenient and perfectly safe. It consists of a small retort, heated by a Bunsen burner or spirit-lamp, from which, when in use, an indiarubber tube leads down to a small gasholder, capable of holding about two cubic feet. The gas is made, as required during an exhibition, from cakes of chlorate of potash and manganese, which can either be made or purchased. These cakes are most convenient to handle, perfectly hard, and cleanly, and when used are lifted from the retort whole, being merely somewhat distended. Each cake gives about one and a half or two cubic feet of gas. The whole apparatus packs up in a small compass, and the displacement chamber of the gasholder forms a very convenient packing-case for a lantern or slides. I have used the apparatus with both "mixed-gas" and "blow-through" jets with perfect safety.—W. A. BEZANT.

[49149.]—**L. B. and S. C. Engines**—137 Dijon, 125 Navarre, 506 Rouen, 140 Toulouse, 142 Toulon, 39 Denmark, 56 Shoreditch, 162 Penge, 94 and 158 no names.—DUBLIN.

[49157.]—**Roller Skates.**—Roller skating is not now so popular as it once was, and it is probable that second-hand Plimpton skates might be purchased for little money. These skates are, undoubtedly, the best, and are really the only ones which have been received by the public with approval. The reason is made clear by the following extract from the "Patent Specification," No, 2190, 25th August, 1865. "This invention relates to an improvement in attaching the rollers or runners to the stock or foot-stand of the skate, whereby the rollers or runners are made to turn or cant by the rocking of the stock or foot-stand, so as to assume radii of a circle, and facilitate the turning of the skate on the ice or floor, and admit of the skaters performing with ease gyrations or revolutions, without taxing unduly the muscles of the foot or ankles." The patentee has been most successful in maintaining his claim to patent right against many infringements, and the invention has yielded him a large sum of money.—R. B. HANSELL.

[49162.]—**Horehound Beer.**—The reason "J. S.'s" horehound beer turns sour is on account of the yeast not being properly worked out before bottling. Horehound beer can be made with or without yeast, and can be made to keep for 12 months or more. "J. S." cannot use malt in his horehound beer without paying a license. By using malt, he would have, instead of a non-intoxicating beverage, neither more or less than what is usually termed ale. I may just mention, for "J. S.'s" guidance, that he is not allowed by law to have more than 3 per cent. of proof spirit in his Horehound beer; and if he uses too much sugar when it undergoes the process of fermentation, it will produce too much spirit (1lb. sugar to the gallon produces about 11 per cent.), and he will consequently be liable to pay a license and duty same as brewers. In the past the law has been a dead letter as regards what are usually termed non-intoxicating beverages; but the Inland Revenue officers are now turning their attention to the subject—I presume to raise revenue on account of the falling off in the receipts from the liquor traffic. If "J. S." requires any further information, if he will advertise his address, I will communicate with him on the subject.—MANUFACTURER.

[49163.]—**Transmission of Power of Electricity.**—Two dynamos about £100 each; a 10 h.p. steam-engine and boiler, say £100.—A. J. Sa.

[49163.]—**Transmission of Power of Electricity.**—You can obtain an estimate from any of the companies who supply dynamos. The first cost for 6-horse on the field at 600 yards away from driving dynamo would be about £350, including cable. The cost of working will be but little more than the cost of a 10 to 12 engine to drive dynamo—that is, if reasonable care be taken of dynamo and motor.—W. J. LANCASTER.

[49169.]—**Niello Work.**—The finest examples of this charming art hail from Russia. The French have produced very creditable specimens. Little of it is attempted in England. It is somewhat similar to enamel work, but is applied solely to articles of silver. The design required is drawn upon the article, and the ground is cut away moderately deep by an engraver. The hollows are then filled up with niel, the preparation of which I cull from "Spon's Workshop Receipts." "Heat a certain proportion of sulphur in a deep crucible; heat a certain quantity of silver, copper, and lead in another crucible, and when melted pour into the fused sulphur, which transforms these metals into sulphides; then add a little sal-ammoniac. Remove from the crucible and pulverise for use. First crucible, flowers of sulphur, 27oz.; sal-ammoniac, 2¾oz. Second crucible, which after fusion is poured into the first, silver, ¾oz.; copper, 1¼oz.; lead, 2¼oz. After reducing the niel to a powder, mix with a small portion of a solution of sal-ammoniac. Having filled up the groundwork of the design the article has to be heated in a muffle until the composition solders to the metal; uncover the pattern by a level polish, when the silver will appear as on a black ground." I do not say that this would come out well in practice, but it gives an idea of the process. —A. Francois.

[49174.]—**Sluggish Liver.**—"1883" well describes the misery of this affliction. For the first thirty to forty years of life I suffered as he has done, with occasional congestion attacks and dreadful spasms—the latter probably occasioned by the passage of gall-stones. A physician advised me to take a large wineglassful of "Pullna water," tempered by a little warm water, each morning on rising. This had a most beneficial effect, but was rather reducing after two or three months' use; but I believe it saved my life. Abstain from butter and pastry in every form; perhaps also from eggs and cheese. The only fatty matter which appears to agree with a sluggish liver is bacon, judging from my own experience.—Hammer.

[49175.]—**Typhoid Fever.**—Typhoid fever has for its great pathological injury, ulceration of certain glandular portions of the inner wall of the intestine. These ulcers heal on recovery, but leave more or less irritability of the mucous membrane, often persisting through life; therefore the patient is more liable to diarrhœa, dysentery, and other results of a sensitive intestine—not necessarily to another attack of typhoid. The diet should be attended to for a year or more after recovery. Highly-spiced, strongly-salted, or flavoured articles should be avoided; alcohol, if required, taken in a dilute form; chalybeates useful so long as constipation is avoided, and the iron is diluted. Fever impoverishes the hæmoglobin of the blood, which iron restores.—Gerard.

[49176.]—**Dynamo-Machine.**—I am afraid you have the wire on field magnets wound wrong. Of course, you know that both of the upper ends of field magnets should be of one polarity, and both of the bottom ends the opposite. I fancy you have the wire so wound as to give opposite polarity to the two upper ends, and vice-versâ. You certainly have something fatally wrong, and this is the only place I can attach any doubt to.—W. J. Lancaster.

[49176.]—**Dynamo Machine.**—I am now working on a machine of my own design, but previously was thinking about making one after the style of Bürgin's. The armature should have been longer (twice the diameter) 6½in. The fault is in the F.M. having fine wire—so having a high resistance. Use No. 10, 11, or 12 (see answer 49070). Have the cores of F.M. large, as the action is steadier. The brushes must be arranged so as to cut out the coils on the neutral line. Be sure and have the brushes wide, and a good *bearing on commutator strips*.—A. J. Ss.

[49178.]—**Velocity of Electricity.**—Electricity has all sorts of velocities. Wheatstone, in 1834, made experiments from which he obtained 288,000 miles per second, as its velocity in copper wire between the inner and outer coatings of a Leyden jar. Gonella and Fizeau found a velocity of 111,834 miles in copper wire, and 62,130 in iron, while other observers have noted a lot of differing velocities. It is, of course, impossible to measure the velocity of electricity in an ordinary atmosphere or even in a vacuum. The duration of a spark has been measured, and may be anything between one twenty-four thousandth of a second and one fifty millionth of a second. By-and-by we shall know more about electricity than we do now. At present, conclusions are made too rashly, only to be altered again just as quickly. It will only be after long patient investigation that we shall be able to know what now we don't know.—W. J. Lancaster.

[49179.]—**Glass Sweating During Frost.**—I read a reply to a similar query in "ours" some time ago, and the correspondent—our friend, "J. J. A.," I think—said that the only way to effectually prevent "sweating" was to reduce the temperature inside the shop to nearly that of the atmosphere outside; but of course no one but a candidate for Colney Hatch would try that in a frost such as we had about Dec. 10th; so I am afraid querist must take "Hobson's choice," and let his windows sweat at their own sweet will. I take it for granted that the windows are not inclosed, for of course an air-tight inclosure would at once obviate the difficulty.—E. G. T.

[49179.]—**Glass Sweating During Frost.**—This "sweating," I have noticed, does not occur during the day, only when the gas is lighted, consequently, it is caused by the formation of water, or dew, by the hydrogen in the gas, and the oxygen of the air, deposited upon the cold glass in condensed form as "sweat." Not very much can be done to prevent it, except by the admission of outside air, and the passage out of the hot vapour-laden air. An acquaintance of mine prevented it, to some extent, by putting on two doors on his shop, outside one always open, inner, "spring" to close automatically—fanlight over inner door, pivoted in the middle of edge, to swing open at top and bottom; "spring" also, with a cord attached, passing over small pulley to inner side of counter, and attached to a sort of scale, by which the opening of fanlight can be graduated, more or less, according to temperature of outside air; and last, and not the least important, a communication through holes in wainscot of window and upper lining of walls, with the aforesaid swinging fanlight (which is closed in from shop), which creates a draught, and does a good deal to prevent the objectionable "sweat." But it is not perfect, as I observe he keeps a long cane, with a "mop" on end, which is used to "swab" the window occasionally.—Scotus.

[49186.]—**Goods Lost at Sea.**—These are almost always insured, therefore the loss falls upon the underwriters. Whether the shipper or the consignee insures them depends upon circumstances. As a general custom the shipper draws a bill upon the consignee for the cost of the goods, and as the consignee accepts this bill, he will, of course, have to pay it at maturity, whether the goods come to hand or not; therefore it is his duty to insure for his own protection. If he is expecting goods which may or may not come forward, as in case of an order sent for produce, which, perhaps, cannot be executed at his limit of price, he effects what is called an "open policy," which will cover the goods if they are shipped, or be cancelled if they are not shipped. It is a common custom now, however, for the shipper to insure and charge the premium in the cost. In such cases the foreign underwriters have an agent in the consignee's port to pay the loss, to enable the consignee to meet the bill he has accepted. Therefore, if "T. J. P." orders goods from America, he will state whether the price is to be simply "f. o. b."—that is, "free on board"—in which case he will pay the freight, and also the insurance effected by himself here; or "c. & f."—that is, "cost and freight"—in which case he will pay only the insurance; or "c. i. & f." —that is, "cost, insurance, and freight"—in which he pays only the bill drawn upon him, which he will have to do in all cases.—Hammer.

[49188.]—**To "F. W.," or "Alfojoe."**—Respecting the adjusting-rod, an explanation of its use was given very recently; so it is needless to rewrite it here. If you cannot find the letter containing a description of its use, I will look it up for you. If the hairspring is not very badly twisted or bent, it may be set right by a careful and judicious use of the tweezers. As it is bent down towards the plate, it requires to be slightly pinched up exactly opposite to the part touching. This will cause the spring to rise more or less. If it has been made uneven in the coils, you will have more difficulty in getting it right, and much care will have to be exercised to prevent the spring from being broken during the operation of resetting and flattening. To do this, you will have to remove it, together with the collet, from the staff, and work it up little by little, upon a smooth and flat surface. I shall go into this subject more fully shortly.—Alfojoe.

[49189.]—**Electro-Motor.**—Use flat pieces of iron to screw to pole-pieces to have wire wound on. Let the iron be 3in. wide—that is, same as the length of armature, and if the iron is ½in. to 1in. thick, you ought to obtain a good power. When motor is finished anneal the iron; get it really as soft as you can. Put into the fire at night and leave it in all night: it will be all right in the morning.—W. J. Lancaster.

[49191.]—**Flute for Small Hands.**—The Siccama flute is the only one which retains precisely the same fingering, reaching each third hole by an open-standing key. It is not much made now, others being considered superior in executive power; but it may suit "Flautist," and can sometimes be bought second-hand at a moderate price. Extra keys are to give more facility in certain modulations.—L. Wright.

[49191.]—**To Flautists.**—Your correspondent cannot have a concert flute with the ordinary fingering, in which the holes are closer than in the usual model, for the simple reason that the notes are made by the length of the column of air, and the holes must therefore be at the regulation distance apart. He can, however, have a flute made in which the holes are closed or opened by keys, the ends of which may be brought within the reach of his fingers, however small they may be. To answer his last question, it would be necessary to know what flute he means—there are some which have an extra key and extra length to reach B, but they are very rare, so that the four extra keys he speaks of would probably be to facilitate fingering or shakes, or to get notes which cannot easily be obtained on the ordinary eight-keyed instrument. He should endeavour to see a Boehm flute and a Siccama, and compare the two. The latter has keys for closing holes, and the former is really an ingenious method of aiding the executant by mechanical means. But a concert flute must be of a certain length, and the holes must be so far apart or the notes will not be true.—Nun. Dor.

[49203.]—**Gas and Paraffin.**—"G. B. A." will find mineral oil a cheaper illuminant than gas. Supposing he wishes to light a room, say 12ft. square, he will require to burn about 6ft. of gas per hour. Allowing 5 hours per night winter months, at ordinary prices charged in country towns, 4s. 6d. per 1,000, nearly 1s. per week. The same amount of light could be obtained from paraffin (at 1s. per gallon) with a 1in. flat-wick burner for 8d. per week; or if with the new round-wick Berlin or Silber's burners, at about 25 per cent. less than that.—Dustpan.

[49203.]—**Gas and Paraffin.**—Paraffin odourless is such a rarity, otherwise paraffin-lamps would be far preferable to gas in one's home. As it is, gas is used in many places where a paraffin-lamp would answer every purpose, and not deposit one-half the soot that gas does. As to cost, I don't think there is much difference. If paraffin-lamps could be kept perfectly clean, so that full value could be got out of the oil, I have no doubt the paraffin would be the cheaper of the two, and the more healthy.—W. J. Lancaster.

[49203.]—**Gas and Paraffin.**—The actual cost of these, light for light, is, on an average, about the same; but it is usual to be content with a much smaller light from paraffin. In rooms which would be usually lighted with one paraffin lamp of, say, 20 to 25 candle-power, it is quite common to use two or three gas-burners, each of 15 to 20 candle-power. The difference is at once appreciated by the fact that it is quite easy to see to read at the far corners of a room lighted by gas, in positions where, in a room lighted by petroleum lamps, it would be impossible to read ordinary print. The practical conclusion is that, with petroleum, much less cost is incurred, and less fuel is burnt to vitiate the air than with gas. Petroleum has also the advantage of being free from sulphur; but on the other hand there are the trouble, mess, and risk of accidents to which petroleum lamps are liable. There is also the fact that petroleum is useful for lighting only, whereas gas is most valuable for heating and cooking purposes. As an approximate rule for comparative cost, petroleum at 9d. per gallon is about equal to 18-candle gas at 3s. per 1,000 cubic feet, provided both are burnt under the best conditions; but it is easy to alter the comparative cost by the use of faulty gas-burners on the one hand, and badly-trimmed wicks or inferior lamps on the other hand. Taking all these things into consideration, there can be no question that gas is the most useful servant, and is to be preferred where it can be obtained, as a matter of convenience and economy. For the same light there is no great difference either way as regards vitiating the air, provided users of gas would be content with the same light as from a lamp, which is certainly not the case.—Thos. Fletcher, Museum-street, Warrington.

[49204.]—**G.W.R. Engines.**—The engines running the 6.10 p.m. Penzance express are Nos. 2042 and 2043. They were formerly Bristol and Exeter Railway engines. The cylinders are 17in. by 24in., coupled wheels, 5ft. 6in., and bogie 3ft. 6in. Further particulars, with sketch of these engines, appeared in No. 888, Vol. XXXV.—Clyde.

[49205.]—**L. and S.W.R. Engines.**—The engines working these trains are the new 10-wheel tanks and the Sharp Stewart bogies. The former have outside cylinders, 17½in. by 24in., and coupled wheels 5ft. 7in. in diameter; the bogie and trailing-wheels are 3ft. in diameter. The latter class have cylinders 17½in. by 26in. and 18½in. by 26in., and 6ft. 6in. coupled drivers; the bogie-wheels are 3ft. 3in. in diameter. This class is provided with a 6-wheel tender. Both these class engines are fitted with the Gresham automatic vacuum brake.—Clyde.

[49212.]—**Expansion of Steam.**—You do not give sufficient data to have your question answered fully. To find the amount of advantage of using steam expansively, the rule is: "Divide the length of stroke by the distance the piston has moved before steam is cut off, find the hyperbolic log. of the quotient, plus 1, and the sum is the ratio of the gain." Take, for example, an engine with 6ft. stroke of piston, with steam cut off at one-third stroke; that is, when the piston has moved 2ft. Then $6 \div 2 = 3$; hyp. log. of $3 = 1{\cdot}0986 + 1 = 2{\cdot}0986$ ratio of gain, or very nearly 70 per cent. of steam saved when cut-off at one-third, over no expansion at all. But to get the same amount of power, you must either increase the steam pressure or cylinder capacity in proportion; that is, if the engine is already working up to full power, with full boiler-pressure in the cylinder at commencement of stroke. Without further knowledge of the engine and boiler, I would rather not say positively what fuel you would save by having three expansions in the cylinder. You might get the same power with ten tons of coal, or you might require more than that; it is impossible to say with certainty without knowing more about the case.—Labor Omnia Vincit.

[49213.]—**Ice.**—Both are right; ice is formed at the bottom and only at the top. This is a paradox, one would say; but ice is formed at the bottom *only* of shallow streams or near the edge of a lake. The earth radiates heat much faster than water does, consequently the layer of water immediately in contact with the soil freezes, and when a sufficient quantity has frozen to make it, pebbles as well, lighter than the water, the whole of it will rise to the surface, the pebbles, &c., being firmly frozen to the under surface of the layer. Sea-ice is only surface-ice, and is only formed on the top of the water. Of course, after the first layer is formed, then successive layers are frozen below the surface.—W. J. LANCASTER.

[49214.]—**Water Analysis.**—I think, if the querist applies to Mr. Fletcher, of Warrington, he will find an arrangement for using paraffin oil so as to get a smokeless flame. Lime should be weighed as carbonate, certainly not as caustic lime, because this would rapidly absorb both water and carbonic acid. The precipitate after ignition should be moistened with carbonate of ammonia, dried, and again slightly ignited to convert any reduced oxide to the carbonate.—SIGMA.

[49216.]—**Renovating Papier Mache Goods.**—Half-pint linseed oil, ½ pint of old ale, the white of an egg, 1oz. spirits of wine, 1oz. spirits of salts; well shake before using. A little to be applied to the face of soft linen pad, and lightly rubbed for a minute or two over the article to be restored, which must afterwards be polished off with old silk handkerchief. This will keep any length of time, if well corked. Invaluable for delicate cabinet-work.—DUSTPAN.

[49218.]—**Plain Malt Spirit.**—A spirit made from a non-flavoured malt. Flavour is imparted to the malt when in the drying-kiln, the finished spirit having the same flavour. The process of manufacture, after the malt is taken from the kiln, is the same for all kinds of malt spirit.—REBA.

[49218.]—**Plain Malt Spirit.**—Plain malt spirit is sufficiently described by its name. It is the alcoholic liquid obtained by distilling a mash of malt. In practice, a large quantity of crushed unmalted grain is used with a proportion of malt, and it is made into a mash and fermented with yeast, until it ceases to attenuate. The "wash," as it is then called, is put into the still and heat applied. The liquor that comes over is usually received in separate vessels, because it is of different strength, but all has to be rectified, that is re-distilled. In trade, "plain malt spirit" should mean alcohol obtained from malt alone, without any flavouring. That is used for the production of British spirits of the best quality; but as alcohol can be made from anything that can be converted into sugar, distillation and rectification are often two distinct trades—that is a distiller is a man who manufactures crude spirit, and the rectifier is the man who produces therefrom the potable spirituous liquors of commerce.—NUN. DOR.

[49220.] — **Mechanics.** — Multiply length of short arm of lever by weight attached, and divide by the long arm of lever, which will give you the required power.—MIDLAND LOCO.

[49220.]—**Mechanics.**—Units of weight multiplied by units of length of short arm, must equal units of power multiplied by units of length of long arm.—J. A. B.

[49222.]—**Dyeing Woollen Coats Dark Blue.**—"M. P." Certainly has very little knowledge of woollen manufacturing. I know some woollen factories where the hint he asks would be worth from £500 to £2,000 a year. If "M. P." sends the coats to a woollen dyer and gets them dyed an Indigo blue at a fair price, he will be well pleased.—BLUE HAND.

[49223.] — **Ventilation.** — The "ventilating-brick near ceiling to outside," which you say "admits a little cold air," should really be an outlet for the impure air, and, judging from your query, your room, when door and windows are shut, must have no other inlet or outlet. I would suggest an inlet from the outside, at the opposite end and side of the room, and near the floor, the air to be conducted by means of a tube inside the room, to the height of from 2ft. to 3ft. above the fire-grate level; the latter precaution to prevent the air from the inlet at once escaping up the chimney. Of course it is very important that the outlet should be large enough to allow the impure air to escape as soon as generated, and the inlet should be large enough to force its action a little.—REBA.

[49223.]—**Ventilation.**—The hot air which ascends to the top of the room (it being lighter than the cool) is as a usual rule impure, and has to be got rid of, and the fresh air, which is the cold external air, has to be admitted without creating such a draught as may be either unpleasant or injurious. The above conclusion is that the hot-air must be allowed to escape at the top of the room, and the fresh admitted at the bottom—the intermediate action of the fire being taken into account. As a general rule, a down-draught from a ventilator in the upper part of a room is a mistake, and likely to be mischievous. An air-brick introduced in the wall between floor and ceiling, and small holes dispersed at intervals along the side of the room, will assist in providing fresh air without a draught. The escape of vitiated air can be accomplished by having small openings in the cornice, and in the centre piece which also allows the hot air from the gas to escape. Another good plan is to have the bottom rail of the ordinary window-sash made of double thickness or depth, the other proportions remaining the same, the effect being that the sash can be lifted from 1in. to 2in. without admitting air at the level of the sill. This affords a means of ingress for cold air, or egress for hot, according to circumstances, there being no direct draught.—NOMEN.

[49223.]—**Ventilation.**—The simplest plan is one I have long used in every room of my houses, and have several times described in these pages. Take out a couple of bricks in the wall between room and passage; over the door is a good position, but anywhere about 2ft. below the ceiling. Bevel the wall above the opening made. On each side of the opening fix a piece of wood, 3in. wide, at the top, and tapering to nothing out or on below the opening. On these nail either wood or strong canvas, and paper it over, leaving the top open. The air enters, and is driven up to the ceiling, spreads out in a sheet, and descends into the room. A picture can be hung over the sloping face, and another outside, to hide the opening. At first, I used to take an inch or two off the top of the door itself, and fix a piece of metal inside to deflect the air upwards; but the openings in the wall are very much better. The improvement in the rooms is wonderful, and it puts an end to all draughts, and generally cures smoky chimneys if, as is frequently the case, these are due to deficient air supply.—SIGMA.

[49223.]—**Ventilating Small Room.**—A room which has a chimney cannot be satisfactorily ventilated by any opening in the upper part of the walls. The "pull" of the chimney is sufficient to cause a strong inward draught which blows down on the head, causing influenza, and forcing down the vitiated hot air from the top of the room. The proper way is to make an opening as low as possible, near or in the skirting, and cover this with a casing open at the top, so as to turn the inward current up, and prevent it blowing on the feet. The cold air rises up the wall, and gradually distributes itself, without causing a draught, and the chimney or the opening at the top of the wall will then cause an exchange of air in the room, sufficient to keep it fresh. There will be no trouble with ventilation provided the cold-air inlets are placed sufficiently low in a room, and they are boxed in in such a manner as to distribute the air without causing a draught.—THOS. FLETCHER, Museum-street, Warrington.

[49226.]—**Linoleum.**—This can be kept perfectly fresh and bright if, after washing, it is rubbed over with new milk which has been thoroughly skimmed, so as to remove all traces of cream. If any cream is left in the milk the surface remains sticky, and rapidly becomes soiled. The skim-milk forms, when dry, a smooth elastic varnish, which permanently protects the linoleum, and assists it in resisting wear.—THOS. FLETCHER, Museum-street, Warrington.

[49227.]—**Induction Coil.**—To MR. LANCASTER.—This question is not an easy one to answer. For instance, I could say both "No" and "Yes," and both would be right; thus, if the current from the cells is capable of driving a motor of given size, then the secondary current will not drive the same motor; so that here we have loss of work. On the other hand, the spark from the cells would not drive a hole through a thick card; that from secondary would make a hole. Let me know exactly what kind of work you mean, and I will tell you what you wish to know.—W. J. LANCASTER.

[49228.]—**Bookbinding.**—Nothing but practice will enable you to succeed in rounding the backs of books properly. If the glue on the backs has been allowed to get dry and hard, you should slightly damp them, which will enable you to round them more easily. Some books are much more easy to round than others. A great deal depends on the manner in which the books are sewn. If they have much swell in the backs, the process of rounding will not present much difficulty. The rounding is best done after the books have been glued up and allowed to set. If the glue is allowed to get too dry and hard, it makes the rounding of the backs more difficult.—G. FRYER.

[49230.]—**Softening Steel.**—Place the steel in a close box with iron turnings, filings, lime, or other matters, which will eliminate the carbon from the steel, and reduce it to the condition of pure soft iron.—NOMEN.

[49230.]—**Softening Steel.**—Get a sheet-iron box, the same size as the steel requiring softening, only about 3in. deep; put a layer of sawdust, 1½ thick, make your steel red-hot; put it on the sawdust, and fill up your box with more sawdust, pressing it well down. Let it remain until the lot is cold, and I think you will find your steel soft enough.—FITTER.

[49232.]—**Eyes Glowing in the Dark.**—The glowing in question is simply the reflection of a light. If, on a dark night, you cast the projected light of a bull's-eye lantern on a dog fifty yards away, you will see his eyes like diamonds. The dog looks back at the lantern, and images of the light are focussed on his retinæ, and the lenses of his eyes act just like the lens of your bull's-eye lantern in projecting these images back to you. A companion standing at ten yards distance, at right-angles to the line from you to the dog, will not see the dog's eyes glow, without the dog looks at a point midway between your companion and yourself, according to the laws of reflection.—HAMMER.

[49236.]—**Screw Propulsion.**—In answer to "R. A. S.'s" query: (1) As 36 cubic feet of fresh water equal 1 ton, his canoe will displace 36 ÷ (20 / 2) = 3·6 cubic feet, and query (2) can hardly be answered without the draught of water, length, &c., of the canoe are given. One screw would do as well as two if he has sufficient draught. If he will give more particulars I will try to help him.—SHIPWRIGHT.

[49237.]—**Cleaning Parchment.**—I recently managed to clean this by immersing the parchment in a solution of acetic acid, and gently rubbing the stained parts while wet on a flat board with pumice stone. I then bleached it with chloride of lime. This process was recommended in a back number of this paper. It was not very successful, but it served my purpose, making it white enough for bookbinding. It had, however, the objectionable qualities of not making the parchment flexible, and when dried it was as hard as a board, and it had no gloss like the virgin parchment. The parchment I cleaned was orginally a bundle of old law documents in a very dirty condition. On no account must the parchment be washed in very hot water or held before a fire, as it will shrivel up in a most provoking manner. I think that "H. C. B." would make much better work if he simply erased the blot carefully with a sharp eraser so as not to fray the surface, and then simply burnish. I have written on many sheets of parchment, and when an accident happened, I simply did so. The ink on a parchment erasure does not blur so much as it does on paper.—ELEPH.

[49239.]—**Incandescent Lamps.**—To MR. W. J. LANCASTER.—To light the six lamps, each containing about 1½in. of platinum of the gauge you mention, you will require five quart Bunsens connected in series. Of course, the platinums are inclosed in exhausted globes; if not, it will take more cells.—W. J. LANCASTER.

[49245.]—**Packing Pumps.**—You should use plaited hemp gasket, a little thicker than is really required for the stuffing-box, so that it can be driven down well. There is no necessity to use tallow, as the grease in the sewage gives sufficient lubrication.—LABOR OMNIA VINCIT.

[49246.]—**Steam-Cock.**—If very bad, I use ground glass and finish with bath-brick. The plug should be turned completely round. It is much better and quicker if you can fix the cock in a lathe and grind the plug in whilst the shell revolves.—LABOR OMNIA VINCIT.

[49246.]—**Steam-Cock.**—"J. C." will find Calais sand and oil an excellent substitute for the Bath-brick and oil which he has been using, for grinding in his blow-off and steam-cocks. After trying this, he will not, I think, return to Bath-brick and oil.—MIDLAND LOCO.

[49246.]—**Steam-Cock.**—If you get a brace (joiner's), and get a bit to fit, the end shaped like a chisel; if not a nick in your valve, make one; place the chisel end of your bit in the nick, and keep turning it round, using oil and flour of emery until it is properly faced all round, and finish off with brickdust and water, and you will succeed.—FITTER.

[49247.]—**Wire Resistance.**—What are 20, 22, and 18 gauge wires? I give the figures, as in my "Electricity," for bare wire. The querist must ascertain the deduction for the covering, which is very variable, and greater for small than large wires.

18 diam. in., ·050; ohms in lb., 0·547.
20 „ ·040; „ 1·335.
22 „ ·032; „ 3·259.

This is for pure copper, and must be increased inversely as conductivity, and lowered by the proportionate weight of covering to copper as found in a piece weighed. I am recalculating an extensive table on this subject, and will, by-and-by, insert it for the benefit of "our" readers.—SIGMA.

[49248 and 49260.]—**Wimshurst's Influence Machine.**—It is essential that both the brushes to the one disc should be in metallic contact, and also that they should touch the opposite (diameter) sectors at the same moment; the second disc, which revolves in the opposite direction, is fitted in all respects the same as the front one; but whether the brushes of the front disc are, or are not, metallically connected to those of the second or back disc, makes no difference. The discs should be varnished before the sectors are fixed on—giant cement answers very well. Shellac dissolved in methylated spirit makes a good varnish for the glasses; it also does for the frame; it should be used quickly, and the glasses should be dried by heat. It is handy to mix the varnish in a large-mouthed bottle, and to fix the handle of the brush in the cork; it is then always ready for use. Paraffin paper will not do for condensers.—M.Ph.S.

[49249.]—**Magneto-Electric Machine.**—The direction of the winding is of no great consequence so long as, in finally connecting up, the ends are arranged to give the current in the proper direction; but for symmetry, the coils should be wound alike. The effect will be that as they face each other they will be different on the machine. As, however, the polar faces are opposed, the wires will then hold similar relations to the lines of force, and also it will be known that the inner ends will correspond to each other, all becoming + or - in the same position as regards the field magnets. But the safe plan is to test each coil in position, by seeing the current it gives as it crosses a field pole.—Sigma.

[49254.]—**L. and S.W.R. Engines.**—The following are goods engines:—8, Vesta; 12, Jupiter; 50, Buffalo; 60, Sappho; 104, Tigress; 105, Leopard; 109, Rocklin; 112, Trent. The following are passenger engines:—14, Mercury; 56, Mentor; 107, Gem. I am unable to give No. 161.—Clyde.

[49256.]—**Handiness of Steamers at High Speeds.**—Possibly the steamer was brought slowly up to the bend, then the helm put hard over, and the engines worked full-speed ahead, when the rush of water sent astern hy the screw before the inertia of the ship had been overcome, would act powerfully on the rudder, and cause her to turn quickly. The subsequent increase in the ship's speed would be a secondary result. There may, however, have been reasons for running the ship at full speed from the first—*e.g.*, to limit as much as possible her exposure to the action of the tide or wind. The ebb runs very swiftly down the Channel abreast of Queenstown.—J. Brown, Belfast.

[49256.]—**Handiness of Steamers at High Speeds.**—Has not Prof. Osborne Reynolds demonstrated, hy his experiments on the Clyde, that the long steamers are handled with more certainty when at speed than when slowed down? Possibly, the captain of the White Star liner knew where he was going, and knew that his vessel would answer her helm better when at high speed. Prof. Reynolds has shown good reason for believing that the *Grösser Kurfurst* would not have been sunk if the following vessel had been turned on one side by the rudder instead of having had her engines stopped, and thus lost steerage-way. I am much interested in this question, and shall be glad to read the opinions of any sailors on the point.—Nun. Dor.

[49256.]—**Handiness of Steamers at High Speeds.**—As a matter of fact a vessel is no handier at a low than she is at a high speed, as will be seen from the following table:—

Steamer.	Diam. of circle at 12 knots.	Diam. of circle at 5 knots.
A	618 yds.	616 yds.
B	760 ,,	609 ,,
C	401 ,,	345 ,,
D	378 ,,	390 ,,

What differences there are can be accounted for hy the greater difficulty of putting the rudder over at a high speed; but if a vessel has little headway, and the rudder is put over to turn her, it has little effect, because the force of the water impinging upon it is small; but if a stream of water be driven against it hy causing the screw to revolve rapidly, the great increase of the force of the impinging water will give considerable steering-power. This, increasing much faster than the vessel, gains headway, consequently she can be put round a sharper curve by this means than she could either at a moderate or high speed; hut of course such manœuvring requires considerable experience of the capabilities of the ship and engines, as well as sound judgment on the part of the captain.—Shipwright.

[49258.]—**Electrolysis.**—Of course, when salt is electrolysed with a copper anode, the chlorine unites with the copper, which passes into solution.—Sigma.

[49258.]—**Electrolysis.**—I should imagine that the chlorine of the chloride of sodium liberated at the anode combined with the copper electrode, forming chloride of copper, which has about the colour "Thorough" mentions.—Kappa.

[49264.]—**Magnetic Effect.**—The approach of the keeper alters the work doing, and the resistance; therefore, the current also. A shunt circuit thus affected would partially affect the main circuit hy modifying the shunt ratios.—Sigma.

[49265.]—**Cement.**—A solution of casein in a concentrated aqueous solution of borax, made with cold water, makes a very tenacious cement.—W. Henley Richmond.

[49265.]—**Cement for Cloth.**—I give a recipe for cementing either cloth or leather:—Gutta-percha, 16; caoutchouc, 4; pitch, 2; shellac, 1; linseed-oil, 2.—Nomen.

[49265.]—**Cement for Fastening Cloth on Iron Rolls.**—I believe there is nothing better for this purpose than good glue, to which has been added tannin until the glue becomes ropy.—Nun. Dor.

[49265.]—**Cement for Fastening Cloth on Iron Rolls.**—What is this mangle for, and are the rolls to be heated when working, or used cold? Have you tried the endless woollen jackets for covering rolls, which are shrunk on? For some purposes, these are excellent things, and if properly put on, do not slip. There is also a roller supplied now, made of "compressed cloth," and used in calendar mangles. These I have seen working for years, with very little sign of wear; and are far superior and cheaper than any strapping or cementing. If above are anything in "Ironfounder's" line, and he will advertise address, I can send him maker's name.—Mangle.

[49268.]—**Engine Query.**—If "Bend Orr" has access to the 31st Volume, No. 787, for April 23rd, 1880, p. 160, he will find therein an article on steam pipes, long, short, and middling. If he cannot obtain it, I could send him the part containing the article, if he would return it to me, and will advertise his address in the Sale Column. There was an error or omission in the original, which I have corrected.—G.B.

[49268.]—**Engine Query.**—You will get better results with a 2½in. piping from your boiler; a common tap will do to stop and start your engine with; and I should advise you to have a drain-cock on your steam piping that will let out the condensed water at pleasure; and put a covering of felt, or some composition, which will save you a deal of steam, as well as stopping a deal of condensing.—Fitter.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

* Since our last "Kappa" has replied to 48550, 48582; "C. M. R." 48774, 48790.

48597. Boot Heel, p. 259.
48606. Pressure on Pedals in Bicycle and Tricycle, 260.
48609. Electro-Plating, 260.
48610. Watchwork, 260.
48611. Organic Analysis Table, 260.
48615. Electrical, 260.
48616. Steel Castings, 260.
48625. Fingering, 260.
48635. Concrete, 260.
48637. Insurance Companies, 260.
48638. Gauge-glasses, 260.

48892. Observing Seat and Lamp, p. 346.
48893. Mangle Rollers, 346.
48894. Jigger Saw, 346.
48902. North London Engines, 346.
48916. Buttons, 347.
48932. Renewing Lathe Collar, 347.
48938. Harmonic Analysis, 347.
48939. Stewarton Beehive, 347.

QUERIES.

[49271.]—**Speaking Tubes.**—What is the longest distance that conversation can be satisfactorily carried on by means of a speaking tube? and would a compo. pipe 1in. internal diameter give satisfactorily results for 160 yards with several turns?—Speaking Tube.

[49272.]—**Wire Coils.**—Will some one please describe how I can coil by steam-lathe a continuous close coil of, say, with No. 18 iron wire, ¼ hole? Also a flat steel wire about 10 and 16 with 3-16 hole?—J. S.

[49273.]—**Legal.**—I want to know whether I can be legally compelled to pay towards the support of my wife's father, or whether she can be summoned and made to do so? She has no money, or means of her own, and never had any.—A. X.

[49274.]—**Legal.**—A. belongs to a friendly society, and has been laid up for some time, but cannot get any of the sick pay due to him. What would be the best plan to recover same, through the county-court or by an order to wind up the society. Probable cost of the latter?—Justice.

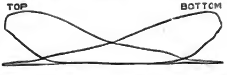
[49275.]—**To Dr. Edmunds.**—I am a great sufferer from coldness in left foot, summer and winter alike; I have various veins in that leg. I soon get tired of standing any time, but am a splendid walker. My employment is sedentary, and I am constantly warming the affected foot by the fire. Can you relieve me? I am 38 years of age?—A. Giles.

[49276.]—**Threatened Rupture.**—Being unfortunate enough to have a tendency to rupture, particularly on the left side, I should be thankful if any medical reader could tell me of any course of treatment or means by which the part might be strengthened? I am told that it is not bad enough at present to necessitate my wearing a truss.—Bell-Ringer.

[49277.]—**Watch.**—Will any of ours inform me how I can tell a three-quarter plate watch, and why are they called so? Also is naming in the dial considered better than on the plates or main spring cover? Will those named on dial last well, or is it likely to come off by opening watch in ordinary use?—Young Watchmaker.

[49278.]—**Blowing Forge.**—Will any of ours suggest a better plan and less room to blow fire than old fiddle-pattern bellows? They take so much room, and they get to let air out. Could I manage with small fan? I have gas-engine I could drive same by. Could I have two pipes to stop draught to fire, or would fast and loose pulley be best?—size of fan best to use?—is hand power sufficient?—do not want to use more than two hours a day.—Young Butler.

[49279.]—**Indicator Diagram.**—Please give opinion of inclosed diagram? Revolutions 100; boiler-press. 55lb.; stroke 2ft.; diameter 16in. I think it indicates pinching in steam-ways, the steam-ports, I fancy; because it seems to me the steam does not get into or out of the cylinder quickly enough. I may add my knowledge of indicators is only theoretical, none practically.—B. N.



[49280.]—**Wheel-Cutting Engine.**—Would some correspondent kindly show me through the columns of ours how to set out a cog wheel 6in. in diameter 120 teeth, to gear into a lantern pinion of 12 teeth? Also could he send me a sketch of a simple-made wheel-cutting engine, and could he recommend me to a cheap work on wheel cutting? Any information would greatly oblige—Novice.

[49281.]—**Plaster Busts.**—I have attempted to paint some plaster busts; but the paint will not dry, the casts being, as I am told, coated with wax, to make the plaster surface smooth and free from small holes, which would otherwise appear. How can I remove the moist paint and the waxen surface under it without damaging the casts, and how make them receive colour? A preliminary coating of size had no effect, nor a subsequent coat of varnish, as size, paint, and varnish all peeled off together.—G.N.R.

[49282.]—**Laxey Wheel, Isle of Man.**—Could you, Mr. Editor, or any kind reader of the "E. M." furnish me with all the particulars of the Laxey wheel? I want to know where the water comes from that drives it. Everyone that I have asked about it, tells me that it pumps its own water, and I can't see that?—John Downie.

[49283.]—**Walking-Sticks.**—I have a piece of English vine which I want to convert into a walking-stick. Will any of your readers kindly tell me whether there is any means of straightening it, and how to trim the knot and polish it?—H. S.

[49284.]—**Lime Bricks.**—Will any kind reader inform me how this brick or clay is manufactured for the Thomas-Gilchrist process? Is it used as it is found, or is it put through some refining process? If it is, what is it?—A Reader.

[49285.]—**Springs.**—I want to make a quantity of springs, similar to pianoforte hopper springs, but of very stout piano steel wire (Smith's No. 25). Will some one kindly describe the plate they should be made on, or give a sketch of same, showing what I believe are called "setts" for giving springs the required shape? I may say the springs I wish to make would have five coils: the tail to be 1¼in. long, the other end 2in. long.—Springer.

[49286.]—**Lubricating Oils.**—On p. 428 it states that "fine mineral oils stand first on the list of those which adhere well to metal surfaces." An engine-driver of large experience tells me he has used all kinds of oils, and says that mineral oils do not adhere well; that when used, machinery requires oiling oftener to prevent the bearing heating, and consequently more oil is used; but that lard oil or melted tallow stands first, adheres the best, and is really the most economical to use. What is Mr. Allen's opinion on the above statements, and will Mr. Allen kindly state what oil, or mixture of oils, is the best for lubricating agricultural machinery.—Jimbo.

[49287.]—**Model Boiler.**—Will any kind reader assist me with the following? I want to make a boiler for a model beam-engine 12in. diam. with fire in centre (not a tubular one). I should like it to have a good draught, so that it would burn charcoal well. Any assistance will be thankfully received by—Milo.

[49288.]—**Copper-Plating Pewter.**—Will "Ox." tell me how to make a solution for coppering pewter? I have tried many, but cannot manage it.—An Amateur.

[49289.]—**Speculum.**—Some time ago an old friend of mine gave me a 3½in. speculum, 18in. focus, which had accidentally come into his possession, and which I have reason to think is a good one, and so determined to fit it up as a Gregorian telescope. I have followed the instructions given in Brewster's "Optics" as near as I could, and find now, when all is completed, that although I can see the image of any object on the small mirror, which, by the way, is 3in. focus, and is adjusted by the usual screw arrangement at side of tube, I cannot see anything of it when the eyepiece (Huyghenian of low power) is put in its place. I am at a loss to account for this, and shall feel obliged if any correspondent will help me in this matter.—Puzzled.

[49290.]—**Obesity.**—In a case when there is a tendency to a development of this disease, could a medical correspondent mention any means by which it may be prevented or at least kept in check? Is the use of the extract of sea wrack, *Fucus vesiculosus*, which is sold under the name, I believe, of "Anti-Fat," dangerous and worthless, or harmless and effective? As this is a matter interesting to a great many people, any practical discussion of it would be esteemed.—Subscriber.

[49291.]—**Asbestos and Plumbago.**—I should esteem it a favour if any one of your numerous readers would kindly inform me what the value is in England or elsewhere per ton of crude or unprepared asbestos in lengths of 3, 4, 6 and 8in., and of short do.? Also of fair quality plumbago, and where a market would be found for these minerals?—MINNA.

[49292.]—**Injector.**—Having the last 14 vols. of the "E. M.," in which there are several small injectors described, I should like to know from some reader who has made one: the size of the steam cone and water do. suitable for supplying a boiler 6ft. long, 18in. diam., to work at pressures between 50lb. and 100lb. per sq. in.?—INJECTOR.

[49293.]—**Fulham's Process for Ornamenting in Gold.**—Would some one kindly give details of Fulham's process for ornamenting muslin and silk with flowers and sprigs of gold?—CHROMIO.

[49294.]—**Low-Pressure Air Reservoir.**—From an air reservoir, the pressure in which varies from 40 to 90lb. per sq. in., I wish to keep charged a smaller reservoir at a much lower but constant pressure, say 7lb. to the sq. in., so arranged that any reduction of this pressure by abstracting air will be at once made up again automatically. Any suggestions to this end from fellow-readers who are always so ready to assist one in a fix will be thankfully received.—A. C. H.

[49295.]—**Cement.**—I want a cement that will adhere firmly to metal and to cloth, and that can be spread with a brush, after the manner of glue. Can any one assist me?—A ROLLER COVERER.

[49296.]—**Legal.**—Would Mr. Wetherfield give his opinion in the following case?—A person is engaged as manager of a business. He is paid at the rate of so much per annum: but the amount is paid weekly, at the employer's wish, thinking it will be most convenient to the manager, who also has the house for his residence—open shop attached. Employer dies, leaving the business to a son, who wishing to sell it, wants to turn out the manager at a week's notice. He is advised that by the custom of the trade (which is well-known to the manager) he is entitled to at least a month's notice; but also from the fact that he has the house in lieu of a larger salary—he is entitled to three months' notice to quit the premises. If ordered to quit, could he sue the executors, the son not being one?—DILEMMA.

[49297.]—**Science Exams.**—Can any of "ours" recommend any really good books to study for the Science and Art Department Examinations in the following subjects—viz.: arts of construction, surveying, electricity, and geology? and oblige—WAITING.

[49298.]—**To Mr. Lancaster.**—Many thanks. I shall be glad of a description of your camera for lunar photograph. I have only a common telescope with night eyepiece and common camera, and would like to know how to use them.—AN AMATEUR.

[49299.]—**Clarifying Extracts.**—Occasionally I make extracts for medicinal purposes, but sometimes they turn out turbid without any apparent cause, and which no amount of filtering will clarify. Just now I have made some tincture of coffee with unroasted Mocha and proof spirit, which is not clear. Can any one say how it can be clarified without interfering with its medical properties? I find this very useful in some cases of diarrhœa.—GIBAL.

[49300.]—**Wimshurst's Machine.**—(1) Would this machine be at all dangerous if tampered with by children or ignorant persons? (2) Can one or more of such machines be used for a small electric light, or for storing electricity for this or any other purpose?—GIBAL.

[49301.]—**Organ Stops.**—Will "Uranium," who wrote on the subject some vols. back, kindly give us the benefit of his further experience with "gamba" stops? Apparently, the slotted kind are displacing the "conical-with-bell," and the salicional adopted instead of keraulophon. Is there good reason for this? Your obliging correspondent's opinion on the clarionet-flute and traverse flute would also be valuable.—C. H. D.

[49302.]—**Gas-Engines.**—Will any kind reader having experience in above say if this engine has been successfully used in a boat, and if so, what nominal h.p. would be required to drive a light 20ft. boat? Also if reversing gear has been fixed for such? and much oblige—SLIGO.

[49303.]—**Pump.**—Will Mr. P. J. Davies, or some other correspondent, kindly advise me? I have to get water (for household purpose) from a stream about 170 yards (for nearly the whole of which distance there is a gradual, but slight, rise) to my house. As I cannot arrange to get a fall, I must use a pump, which, of course, must be fixed at my end. I am laying down 1in. galvanised iron pipe, 12in. under the surface, taking care that all joints are properly made. I shall be glad to know what size and description of pump to use? Also approximate cost of same? Will an ordinary lift-pump answer my purpose? What precautions shall I take against frost?—NORTH WALES.

[49304.]—**Restoring Vulcanite.**—Having a vulcanite locket which was accidentally dropped into some hot tea, it has turned green outside, the inside is as black as ever. Can any of ours inform me how to restore same, and oblige—C. M. R.

[49305.]—**Classification of Sugars by the Polariscope.**—I should feel glad if some practical one of "ours" would give me a lesson on the grading of sugars by means of the polariscope, as the instrument is likely to be put into the hands of the C.S. of Canada, of which I am one. A lesson through the pages of the "E. M." would prove a boon to the service as well as to myself. May I ask for references to works specially bearing on the subject? Where is our old friend, "Titler Green," now?—OLD SOD.

[49306.]—**Spectrum Analysis.**—I have tried to get the absorption spectrum of sodium with the oxy-hydrogen light, but have failed. Can anyone give me any advice on the subject? I have followed the instructions in Lewis Wright's book on "Light."—J. E. B.

[49307.]—**Enlargements.**—How can I enlarge a photo. negative quarter-plate size to life size? Is this done, or has a negative to be taken especially for enlarging? The reason I ask the above is, that I was informed that it can be done upon sensitised paper by development. If it can be done so, I would feel obliged to any photo. friend who would be kind enough to give me some instructions on the above.—R. J.

[49308.]—**Siphon.**—What is the greatest height from level of water to bend over which water can be raised or passed by means of a siphon—supposing siphon to be full of water at starting?—D. T.

[49309.]—**Playing-Marbles.**—Will any one kindly give sketch, and describe revolving cylinders for rounding marbles?—SAXONY.

[49310.] — **To "Fellow - Workman" or "Alfojoe."**—Will you tell me the best way to let down French clock for cleaning when it is wound full up—one with visible escapement?—ONA LEO.

[49311.]—**Ebonising.**—Can any reader of the "E. M." suggest a simple way of ebonising woods, such as teak, mahogany, &c., for telephones, &c.? As also the best manner of polishing after the ebonising? and oblige—ATELIER.

[49312.]—**Velociman.**—As the velociman is made to order only, I should be thankful for some advice. Probably the inventor, Rev. R. H. Charsley, will kindly give it? What height wheels would be best for a hilly country, short, but moderately stiff ones? Weight of rider about 11st.; strong, and full use of arms; none, or at least, very little, use of legs;—or plain bearings, if kept clean, as well as ball-bearings?—HOPEFUL.

[49313.]—**Legal.**—Under a recent Act of Parliament what is the expense of enfranchising a copyhold estate value £150. Is it about 20 per cent. on the value? Is there a maximum per-centage, which no lawyer dare exceed?—T. B. M.

[49314.]—**Legal — Widow and Daughter.**—Daughter has an illegitimate child. Is the widow liable for the maintenance of the child to the parish, other sources having failed?—INQUIRER.

[49315.]—**Legal — Declaration of Trust.**—For real or personal property, which is the most proper form, by endorsement of deeds, or on separate document? Does it require stamp, witness, or registry? Is it liable to succession or other duties, and may it be made conditionally as well as absolutely? Can shares, bonds, &c., be given in this form? Can husband or wife make such to each other?—HUSBAND.

[49316.]—**Water-Motor.**—Will some one tell me how to make an oscillating water-motor, and how the ports are made to work a capstan—one on Sir W. Armstrong's principle, of Newcastle-upon-Tyne?—J. CANE.

[49317.]—**Ingot Joints.**—I have to make ingot joints in telegraph wire by casting an ingot of zinc over the twisted ends of the wire. I always find great difficulty in casting these ingots, owing to air becoming confined in the mould used, and causing large holes to remain inside the zinc. No amount of ventilation of the mould is any use. Could anyone tell me how to avoid these air bubbles?—A. J.

[49318.]—**Induction Coil.**—To. MR. LANCASTER.—I propose making a coil from the following:—Reel, 8in. long by 1in. internal diam., wound with two layers of No. 16 for primary, and 1½lb. of No. 36 for secondary—both silk-covered. Condenser to be composed of sixty sheets of tin-foil 6in. by 5in. Will you kindly say if these details are correct, and what length of spark I should expect, supposing the insulation were perfect, and I had sufficient battery power? Would you also say what would be the proper battery power? Grove cells are generally used, but they are so expensive that I propose using Leclanchés, as the latter are very constant, and might be used for bells, &c.—W. F. JAMES.

[49319.]—**Astronomical.**—Is γ (gamma) Leonis a good test for a 2in., as I can just divide it with high powers? If not, can anyone give me a few test doubles? I have never seen the *comites* to Vega, Rigel, or Polaris; although I (and others) can see Cassini's division in Saturn's Ring, with 2in. o.g.—J. R., Ventnor.

[49320.]—**Prime Cost.**—I am a young engineer's clerk desirous of improving my position, and should be glad if any fellow-reader could inform me if there is any book published upon the above subject, or give me a few hints as to best method of keeping cost accounts? Also what books are most suitable for a beginner to study upon getting out quantities and calculating strains?—POOR QUILL DRIVER.

[49321.] — **Depraved Appetite.** — Would Dr. Edmunds or some other medical reader say what is the cause and remedy for an unnatural craving for food after a full meal has been taken?—NOXER.

[49322.]—**Induction Coil.**—I am desirous of making a coil to give a good 2in. spark, but have failed to find the information in back numbers. I wish to have four powers, and am in doubt as to the exact quantity and gauges of wire required, and also as to the method of making the connections under the base board—that is, as to leads of the different wires? An answer to this would doubtless be useful to others besides—M. E. R.

[49323.]—**Dyeing Rabbit-Skins.**—I have some wild rabbit-skins nicely cured. I want to know if there is any method to dye the same a rich brown colour, without spoiling the skin by boiling? I shall feel obliged to anyone inclined to help me.—R. Rs. D.

[49324.]—**Joshua and the Sun and Moon.**—If there are amongst your readers any Jews possessed of the requisite knowledge, I should be obliged if they would kindly inform me what interpretation is put upon the 12, 13, and 14th verses of the tenth chapter of Joshua? The 14th verse has the appearance of being an interpolation, and the 12th and 13th are apparently a quotation from the book of Jasher. Years ago I read an explanation which pointed out that the princes of Israel having concluded a league with the Gibeonites, a "wily" people, felt bound to leave their temples of the sun at Gibeon, and of the moon at Ajalon unharmed—that is, their priests as well as the buildings—and that Joshua really commanded the priests to be silent for evermore on that eventful day—not the earth to cease from rotating for a space of 24 hours. It seems strange that so little was said of what must have been a most remarkable event, and the writer of the 14th verse was certainly justified in saying that there was no day like that before or after it. I should be pleased if some member of the Jewish community would inform me how the passage is regarded by their scholars. It will be seen that if verses 12—14 are omitted, the narrative is better connected than as now printed in our authorised version.—NUN DOR.

[49325.]—**Nettle-Rash.**—My wife and myself and two of our neighbours in different directions were a few days ago all at one time seized with nettle-rash. There is nothing in common between our neighbours and ourselves to account for the simultaneous attack beyond breathing the same air and drinking the same tap-water. Is nettle-rash ever epidemic? If so, what is the cause, and how may it be avoided? My wife is subject to it after eating fish, but this is my own and my neighbours' first attack. We had eaten fish two days before; our neighbours had not for some weeks.—H. GOBNALL.

[Was it nettle-rash? Was the fish partaken of smoked or dried? We knew a case not long since of a similar eruption breaking out on all the members of a family after breakfasting on "smoked" mackerel, which there was good reason to believe had been "smoked" by a much shorter, but very pernicious, process. The medical man who attended the family was of the same opinion.—ED.]

[49326.]—**Air Current.**—I have an apparatus in which I use a vertical tapered pipe 4½in. long by ¾ and 1in. diameter at ends, the small end uppermost, which heated gas ascends at a high speed; the said tube is exposed to a horizontal variable current of cold air also travelling at a high speed, which obstructs the heated gas in ascending. Could some kind friend inform me if the top of the tube can in any way be constructed so as not to be affected by the horizontal current? I have had it incased inside another larger tube, but still the obstruction occurs.—AIR CURRENT.

[49327.]—**Convulsions in Cats.**—We have a kitten 14 weeks old, and for six weeks past it has been subject to convulsions several times during the week. At first it seemed to weaken it, and affect one hind-leg only, but now, it quite prostrates it, and affects all four legs and the back. We have given it castor-oil, and likewise syrup of buckthorn, but with no good effect. Don't see any worms. Will some kind friends let us know how to cure it, and oblige?—G. B.

[49328.]—**Blowpipe Apparatus.**—Can anyone inform me how to make for a small blowpipe, an attachment or reservoir, which could be filled with air, by any means, so that a constant and uniform current could be kept up, thus doing away with the direct mouth blowing now necessary? I find that I cannot maintain a continuous blowing from the mouth without physical injury. I know of Cohen's blowpipe, but it does not suit my purposes.—FIDELIS.

[49329.] — **Heating Drying-Room by Hot Water.**—Can any reader state whether it if possible to heat a drying-room or stove, say 60ft. by 30ft. by 12ft. high, to 250° or 300° Fahr., by means of hot-water pipes, and if so, to maintain it under any conditions? What pressure per inch in lbs. would the pipes be subject to? Would they be liable to burst? Any other information would be gladly received by—AN OLD READER OF THE ENGLISH MECHANIC.

[49330.]—**Radical Cure for Hernia.**—For 18 years I have had a small hernia in left side, femoral; always worn a truss, the hernia when truss has been off, has never projected more than about the size of half a walnut and I have never suffered any pain through it. I am thin, 40 years of age. Is the operation for radical cure a severe one? Twelve years ago, a doctor promised to perform it, but illness prevented him. I understand it is simpler and oftener done now than then. You may ask why trouble about a cure now? The answer is very simple. Being afflicted with hernia prevents me from getting appointment that I could otherwise obtain.—AN ENGINEER.

[49331.]—**Reflector.**—Wishing to fit up Huyghenian eyepiece for a reflector 7ft. focal length, and encouraged by "Aldebaran's" answer, 49126, page 460, I would wish to ask him to give me the focal length of field and eye lens for the following powers, 60, 150, 200, 350, 500, and one, a Ramsden eyepiece with power of 30, and say the size of the eye-hole for the lowest power, and also for the highest?—TELESCOPIC.

[49332.]—**Colouring Steel without Heat.**—"Essar" gives a receipt in "E. M." Oct. 27th, 1882, reply 47387. I have tried and cannot get it to answer, and I would feel obliged if he would tell me how he put the Prussian blue into the liquid—whether he puts the powder blue into the liquid and lets it stand until it dissolves, or whether he mixes it in first?—LINCOLN.

[49333.]—**Flat-Fish.**—What are habits of the pleuronectidæ? When and where do they spawn? Quantities are caught about the coast in August and September, but in winter they appear to leave the shallow water. Where do they go?—J. BROWN.

[49334.]—**Eel-Fishery.**—What kind of traps or nets are used for eels, and how are they managed in a river where large quantities of dead leaves, weeds, &c., come down at the time the eels are running, and would choke up nets, &c.—J. BROWN.

[49335.]—**Bi-oxide of Barium.**—What is it, and how is it made? Can it be produced by an amateur?—S.

[49336.]—**Bichromate Battery.**—What are those purplish crystals that form at bottom of the jars in which the solution for the above battery has been standing some time?—S.

[49337.]—**Electrical.**—What would be the result if zinc and silver plates (as used in Smee's battery) were used with the same solution as employed in a bichromate battery, also vice versâ (using carbon and zinc in the ordinary "Smee's" solution)?—S.

[49338.]—**To Mr. Lancaster.**—I am about to take a number of photos of mechanical drawings, and intend to use quarter-plate. Could the photos. be magnified so that the figures might be read? Would it be any advantage to use half-plate size? Is there any process of copying the drawing direct without a tracing?—CE. ME.

[49339.]—**Dogs.**—Has any rational explanation been given—(1) of the dislike dogs often show to music; (2) of the futile scraping action they perform after dropping fæces? With regard to the former I would remark that both the scent and the hearing of dogs seem to be more acute than ours; in the case of hearing, a dog in the house will hear a footstep outside sooner than any person in the house, and will also distinguish whether the footstep is that of a friend or a foe (or person to be barked at). As to music, it is curious to see a dog, which might easily escape from the source of discomfort, helplessly sit down, and lift up his voice in a prolonged howl of misery and amazement at this thusness. Are we to suppose that what seems to us pleasant harmony is to the finer sense of a dog nothing but jarring discord? What does the anatomy of a dog's inner ear reveal? In what ways does the dog's ear differ from ours, and do the facts afford any light on the matter referred to? I may mention the case of a dog belonging to a friend, which howled only at a particular tune; whenever this was brought into any piece, the howl infallibly began.—Mac.

[49340.]—**Jupiter.**—Observing the planet on January 15th about 10 p.m., I saw what seemed to be the great red spot in transit. If this really was the spot, it appeared but the ghost of its former self. With 3½ "Wray" and power 120, it was just discernible, and presented a very great contrast to its appearance during 1880. I would like to know from some one who saw the planet with a larger aperture on that night, if this was certainly the red spot?—F. T.

[49341.]—**Legal.**—I am a widower with one son and three daughters. I have a piece of copyhold land. I made it over to my married daughter, who has children, who have since died. If my will is not altered, who will take the property at my death?—M. W. R.

[49342.]—**Waterhouse Diaphragm.**—I am fitting above to a quarter-plate portrait lens. Will Mr W. J. Lancaster kindly inform me if the exact centre between the backs of the lenses is the correct place to cut the tube?—Photo.

[49343.]—**Crystoleum Pictures.**—Can some of your correspondents inform best way to make crystoleum pictures? What kind of varnishes and adhesives are used?—Photo.

[49344.]—**Violin Queries.**—(1) It is said that stringed instruments are always tuned in perfect fifths. If so, how do they manage to play in tune with the other instruments of the orchestra and with the pianoforte, all of which have the tempered scale? (2) Middle C (C on the first line above the bass stave) is in the highest part of male voices; but the same note played by the violin and other instruments is an octave lower. If this view is correct, how is it that no mention is ever made of it?—Voltameter.

[49345.]—**Hoist.**—Would any of our readers be good enough to give a diagram of a hoist-rope or chain capable of lifting about 5cwt.? I have a sketch of a hoist in Vol. XXXII. of the "E. M."; but it is not plain enough to work from. Please to give dimensions and probable cost of such hoist, and oblige—Ego Alpha.

[49346.]—**Legal—Promissory Note.**—To Mr. Wetherfield.—Noticing your reply to Promissory Note and the Statute of Limitation, may I ask if I can legally claim 6 per cent. which the borrower on promissory note agreed to pay? Also, though for eight years he has not paid interest on the amount, but being an insurance agent he has annually paid my life-policy premium in his company, in which I am insured; but the amount does not equal the interest. Is not this a recognition of the debt?—Beta.

[49347.]—**G.W. Engines.**—Can any reader give size of cylinders of the following classes?—455, 613, 850, 1216, 1501 and 1801.—C. H.

[49348.] — **G.E. Engines.** — Wanted principal dimensions of—56, 72, 189, 229, 234, 400 and 406.—C. H.

[49349.]—**Clock.**—I wish to fit a new pair of pallets to a 30-hour American clock, and not having the old ones for a guide, I want some help. I purchased a new pair, and I can't get them right. How many teeth should there be between pallet, and how am I to correct the "drop"?—Country.

[49350.]—**Toy Gas-Engines.**—Can any one inform me whether these have yet been made? If not, would not a model one be practicable to be driven from ordinary gas-burner?—Dustpan.

[49351.]—**Corrugated Tile Roof.**—I have a large room roofed with best corrugated tiles, and pointed inside and out, but yet the rain finds its way in. Would it do any good to give it a coat of tar on the outside, or is there any other remedy?—One Wanting to Know.

[49352.]—**To Mr. Lancaster.**—Many thanks for reply. In another answer last week you state that there are incandescent electric lamps which require less battery power than Swan's. Would you be kind enough to tell me the name of a cheap one, as I want to light up to five-candle power with as few cells as possible?—One Wanting to Know.

[49353.]—**Astronomical.**—I would wish to know what branches of pure and applied mathematics it would be necessary to learn in order to be able to calculate the exact times of the occultation of stars by the moon and such other occurrences as we see registered in the *Nautical Almanac*. Also if such calculations are very long and tedious operations?—Archimedes.

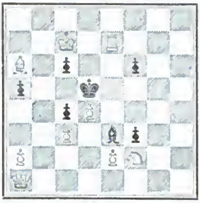
Catalogue of Tools.—From Rd. Melhuish and Sons, of Fetter-lane, E.C., we have a catalogue of tools which would have surprised the mechanics of fifty years ago—so many useful novelties having been introduced that, for any peculiar piece of work there is now a special tool. The demand for tools has increased the supply, and consequently prices are much lower than they were. Our amateur friends might look through this catalogue with advantage. It will be surprising if they do not find something that is just what they want.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCCXIX.—By Sergt. Major Mc Arthur.

Black.

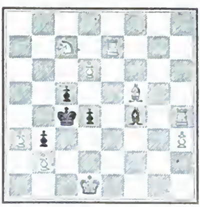


White. [9+7

White to play and mate in two moves.

PROBLEM DCCCXX.—By J. P. Taylor.

Black.



White. [9+5

White to play and mate in two moves.

Solution to 815.

White.	*Black.*
1. B-K 8	1. Anything
2. Mates	

Solution to 816.

White.	*Black.*
1. Q-K B 5	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 813, 814, 815, 816 by Dicky Sam; to 817, 818 by D. Mackay; to 815 by A. T. Scott (in 816, Black King escapes at Q Kt 6 on second move); to 809, 810 by J. Roe; to 815, 816 by S. Follwell, J. B., of Boxford, and W. T. Bayne; to 814, 816 by A. Briggs; to 815 by T. Gaskell; to 814, 815, 816 by Schmucke; to 818 by J. B., of Boxford.

D. Mackay.—Thanks for problem.

J. B., of Boxford.—The fact of no solution appearing to your four-mover proves its difficulty.

Steam Jackets and Economy.—At a recent trial of an engine made in Belgium on the Corliss system, the following details are given concerning the efficiency of the steam jacket:—Working under average conditions, without the jacket, the engine developed 127·6 horse-power, with a consumption of 2·47 pounds of steam per indicated horse-power per hour. With precisely the same opening of the valves, and under otherwise exactly similar conditions, except that steam was admitted to the jacket, the work rose to 157·13 horse-power, and the consumption of steam fell to 19·85lb. per indicated horse-power per hour, making in this way a gain of 19·6 per cent. A somewhat defective action of the steam traps existed the day on which these results were recorded. This trial was repeated the following day, and the consumption of steam fell to 18·96lb. per indicated horse-power per hour, making a gain of 23½ per cent., the amount of power being sensibly the same. Comparing the mean of these two days' work, the same engine did 23·7 per cent. more work with the jackets than without, while the saving of steam per indicated horse-power per hour was 2·16 per cent. by the use of the jacket.—*Engineer and Iron Trades Advertiser.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 24, and unacknowledged elsewhere:—

Salio, Sonnenthal, and Co.—T. James.—E. B. Fenessy.—T. and Co.—C. F. Bally.—T. R. Willis.—J. Dewey and Co.—Dr. Wentworth Erck.—G. Pearson.—Capt. Watkin.—Engineman.—A Novice.—H. T. W.—Tube.—F. J. P.—Student.—W. R.—E. H. H.—Amateur Watchmaker.—T. Clarke.—Non Valeo.—F. A. Muhlenbeck.—E. E. Barry.—J. T. Rochard.—W. R.—W. Dearden.—Turbine.—J. A. G.—H. Kent.—J. Morrell.—Ironmonger.—Amateur Electrician.—Xylo.—T. W.—Summit of England.—T. B. C.—J. S. B. Bell.—A Fellow of the Royal Astronomical Society.

Robert Roberts. (We fear we cannot just yet spare more space for the subject.)—Enquirer. (If Y. ever turns up alive, Z. will be liable to prosecution for bigamy.)—Mechanic. (We do not think the marriage could be set aside on the grounds named.)—H. F. Gitts. (Lockwood and Co. publish a useful little manual. The best and fullest treatise is, however, Mr. Warman's, lately partially completed in these pages, and which, we hope, will be published separately one of these days.)—J. L. Tar. (There is no such examination if you mean "Assoc. I.C.E." or "Memb. I.C.E." You had better write the Secretary of the Institution of Civil Engineers for fuller particulars.)—Scissors. (A sailing vessel, certainly, if time is no object. Sydney, Melbourne, or Brisbane.)—Question. (We cannot offer any suggestion, nor do we see very well how we can append a sample of the sand to each copy of the "E. M." so as to solicit our readers' opinions. You had better try the "Address column," and send samples direct.)—C. T. Ball. (The Ethoxo-limelight was fully described in No. 882, p. 609. See also some remarks on it in Vol. XXXV., pp. 59, 107, 177.)—Magica Laterna. (If you mean painting, see p. 553, No. 908, and the indices of back volumes. In Vol. XII., we had a series of articles giving instructions in painting dissolving-view slides, which were afterwards revised by the author and published by Mr. Hughes, of Hoxton-street, N.)—Elfer. (Recipes for violin stains and varnish on p. 538, No. 776. Picture varnish is exactly what is recommended. Amber varnish is about the most difficult of all for an amateur to make, and we do not know how it is to be made without heat. It is always cheaper to buy varnishes than to make on the small scale.)—J. B. (The number for Jan. 1, 1875, contains a variety of directions for making camera obscura. It can be had for five halfpenny stamps.)—C. F. Firth. (The numbers containing Bellows Camera are entered in the list of Back Numbers, appearing in this column the first week in every month. For Instantaneous Shutter, see p. 382, No. 901, and p. 36, No. 912.)—Ontario. (The sheet zinc would be probably quite as good as the block. Gas carbon is the scurf from the retorts at the gasworks. It is sawn into plates and slabs. The carbon used for the arc lights is the same generally, crushed and moulded under pressure, and then recarbonised in a furnace. 2. As to the telephone, are not the directions on p. 233 sufficient? Leclanché or Fuller battery.)—Tua Futura. (If you will kindly refer to the past and look in the indices of recent volumes, you will find many references to accumulators or secondary batteries. We should not be surprised if there were something about them in this number.)—W. W. Balaam. (There is a little book on "Organ Voicing and Tuning," published by C. W. Brabner, 150, Kingsland-road; but if you look in Vol. X. you will find full directions for voicing and wood and metal pipe-making. See pp. 375, 698, Vol. XXII.; and p. 153, Vol. XXIII.)—R. S. B. (A bar of wrought iron expands about one ten-thousandth of its length for an increase of temperature of 16° Fahr. Thus, a bar would need to be about 70ft. long to expand one-twelfth of an inch.)—W. M. (Such work is too delicate for an amateur to attempt. We do not know where agate centres can be had, but possibly some of our advertisers can supply them.)—P. K. M. (You want an electro-motor of some kind. There are several in recent volumes. Perhaps that on p. 16, Vol. XXXIV., will suit, or same volume, p. 477. If not, look at p. 39, last volume, or p. 95 of the present volume. 2. It is the pith of the elder. 3. It is a couple of light skiffs united together and fitted with paddle wheels. The address is—Searle and Son, Stangate, Lambeth. 4. Illustrations of methods of making moving models of vessels and sea on p. 458, No. 861.)—A Moulder. (We do not know of such a book. There is the "Metallurgy of Iron," by Bauerman, which may help. It is published by Lockwood and Co., Stationers' Hall-court. You may also find some useful books in the catalogue issued by Mr. Calvert, Great Jackson-street, Manchester.)—

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 2, 1883.

THE STANLEY SHOW.

THE sixth annual exhibition of bicycles, tricycles, &c., held under the auspices of the Stanley Bicycle Club, was opened at the Albert Hall last Monday; but although the regulations distinctly state that "exhibits must be in position on January 27," many of the exhibitors were not in apple-pie order by midday on Monday. The cause is readily found. The goods could not be received before the morning of Saturday last, and the Albert Hall, whatever it may be intended for, being scarcely a suitable place for an exhibition of velocipedes, some of the exhibitors could not find their allotted spaces, and when they found them, refused to accept them. The natural consequence was that the catalogue—not remarkable for its descriptive contents—scarcely tallied with the numbers on the stands. We have no doubt it was made all right as soon as possible; but if the announcement of the opening of an exhibition is published, and the public are invited to attend, some effort should be made to insure a little more order than prevailed at the Albert Hall on the opening day. This year there is a rival exhibition at the Agricultural Hall, and if we may judge from the complaints of the exhibitors, the Stanley Club must make better arrangements in future, if it wishes to still command the suffrages of the makers of velocipedes. The exhibits are scattered over the area (or arena) of the hall, in the orchestra, the balcony-floor, and in the gallery. The latter is by far the best place; and there we found the exhibits of the larger firms, with a few exceptions; but the balcony-floor is something like a maze, and it will be little wonder if many visitors, anxious to see all, depart without inspecting some of the more interesting exhibits. In the gallery, then, the Surrey Machinists Company show samples of their roadsters, and racers of their well-known patterns, which have deservedly won high favour, and close by, the Britannia Company, of Colchester, appear with decided novelties for an exhibition of the kind, in the shape of samples of their lathes. They show, amongst other lathes, their "No. 13 screw-cutting," which is rigged up with the slide-rest, and is a very taking tool for amateurs: it appears so small and compact, though capable of doing a great deal of work. Singer and Co. have an extensive exhibit of bicycles and tricycles, and, like others, they show their machines on both sides of the gangway—a desirable arrangement. Sociables form an important feature; but perhaps the exhibit which attracts most attention is Mr. Charsley's velociman, which is shown in its original form, and also with double drivers. The tandem sociable comes next, as it is convertible into a tricycle for one, and thus serves a double purpose—a feature which has been studied by other exhibitors. Rucker and Co. show a selection of their makes, and the same remark applies to other exhibitors, for the firms with established reputations have not produced many novelties or improvements. From a purely trade point of view, there is no reason why a bicycle made for Blank Blank, Esq., of So-and-so B. C., should not be exhibited; but, except as a specimen of the work turned out by the firm exhibiting it, there is also no reason why it should be at the Albert Hall. That fact will explain our reason for passing over some of the exhibits, though, if we have unwittingly omitted to notice any novelty or improvement, we shall be glad to hear direct from the exhibitor. One feature of the exhibition, it may be as well to mention at once, is the appearance of several racing tricycles, or three-wheelers, in which the object has been to reduce weight as much as possible; but, as the regulations prohibit the statement of weight, unless that has been verified by the Stanley Club, we have only the assertions of the attendants of the stands as a guide. Whether it is wise to make such a regulation, and not insist on weighing every machine claiming to be exceptionally light, is a matter for the Stanley Club to settle; for, as things are, those interested simply ask the question and get an answer which may or may not be true. By-and-by, the principal makers—discovering how little the Stanley Club does for them—will take the matter into their own hands, and have an exhibition on their own account. Hydes and Wigfull show some thoroughly good machines of well-known patterns, and Ellis and Co. are to the fore with their Faciles, not forgetting the identical machine on which W. Snook made the memorable ride of 214½ miles in 24 hours in September last. We noticed the Facile some time ago (p. 370, Vol. XXXI.), and as an easy-going safe roadster it commends itself to all riders of the so-called "timid" (we should say prudent) school; for as Mr. Snook has shown, it is capable of doing quick work, and is practically as safe as any bicycle can possibly be. For the benefit of those who do not know it, we may say that the cranks are worked by levers pivoted to extensions of the fork, and that while the action is simply up and down, the feet are within reach of the ground, so that there is little fear of a tumble. Mr. Andrews is to the fore with some excellent specimens of his machines, notable for their remarkable lightness, while his improvements are found in not a few of the other exhibits. Hillman, Herbert, and Cooper have a splendid show of machines of their make, including some youths' and children's bicycles; while the Coventry Machinists' Company follow suit with their well-known machines; but also exhibit some novelties in the shape of a racing tricycle, 46in., weighing 46lb., and a couple of "Coolie" tricycles, as they are called, in which the passenger sits in the front, and is propelled by a native "athlete." One of these is for the King of Siam, and has accommodation for two passengers, with one coolie to drive—the action being placed behind. These machines are suited for work in India and tropical countries where labour is cheap, and exercise of the tricycling kind not altogether advisable for Europeans. Bayliss, Thomas, and Co. have a representative collection of their well-known machines, and a decided novelty in the shape of a lady's tricycle, in which the dress is entirely covered by a light case (called the Beatrice Shield), the doors of which open out in front like those of a Hansom cab. They also show a hand-lever Excelsior, for use by persons who are weak or deformed in the legs. The Bicycle and Tricycle Supply Association show the "Matchless" bicycle, in which vibration is reduced to a minimum by the use of india-rubber—the handles, fork, bearings, and all parts capable of conveying a shake to the rider being clothed with rubber. Contrary to expectation, it is found that the rubber where it is subjected to friction is not worn so much as would be expected, and as oil is carefully excluded, this machine is highly appreciated by many riders, as the vibration, if not entirely absorbed by the rubber, is materially lessened. This association also exhibit specimens of the omnicycle, a machine which dispenses with a crank by using a set of combination levers, and which, it is said, can be propelled up the steepest hill with comparative ease. Starley Bros. have a good show of their machines, and a full size model of the balance gear or differential gear, or whatever it may be called, which other makers have utilised or copied, in their endeavours to obtain double-driving for tricycles without the defects of the double gear, pure and simple. The Royal Machine Manufacturing Company show a modification of this plan, in which the pinion and gear wheels are placed in a box, and a shaft at the back connects the two drivers by means of mortise wheels; the St. George's Foundry Company show the same principle, carried out in a different manner by means of a ball chain. All these devices are ingenious, but it may be doubted whether the game is worth the candle. Double-driving is no doubt an advantage, but as it can only be attained by a complication of parts, there is always the additional friction and the extra wear and tear. The last-named Company also show improved forms of the Rapid tricycle, in which the gearing is altered by a simple movement of a lever; but effective as these are, they add to the weight of the machine, and as dust can easily reach the gearing, there must be scrupulous cleaning, or rapid wear will result. Amongst the "sociable" class there is a tendency to adopt the tandem style; but without the balanced gear these machines are rather risky. Some are arranged for each rider to drive a separate wheel; then, as the power applied is almost sure to be different, there is a tendency in the machine to swerve to one side; and if the arrangements are such that both drive one axle, it is obvious that the weakest rider does little to propel the machine—hence the balance gear is coming into favour for sociables. Some exhibitors, too, show tricycles running on two tracks, the steering-wheel being in line with one of the drivers, and they claim that there is free exit from the machine in the event of a "spill"; but, unfortunately, the placing of the steering-wheel to one side is likely to cause a spill, which might be avoided with an ordinary front or rear steerer. Rudge and Co. show specimens of their standard machines, with a novelty in the shape of the tangent-wheel racer, made for F. Moore, the "amateur champion." In this machine the spokes are taken through the hub and bent back to the rim, where they are secured—a revival, we think, of an old idea. This machine (a 55in.) is said to weigh 24lb. The same firm show specimens of the Coventry Rotary, which, one of the earliest, still holds its place, and is not unlikely to obtain premier position, now that the gear has been placed in the centre of the machine, and it lends itself so readily to the formation of a "convertible." In the tricycle form this machine leaves little to be desired, for the big wheel acts as a powerful driver, and the two small wheels being connected together, with the weight fairly distributed, afford ample means of steering, while one can easily get off in the event of danger ahead. As regards the matter of rapid exit, Mr. Moore shows a novelty in the shape of a front-steered tricycle, called the "Orbicycle," because the driving and balance gear is concealed within an orb in the centre of the axle-tube. This "orb" is connected by a tube to the front wheel, near which is another orb containing the driving-gear on the pedal-shaft. There is nothing in front of the rider but the wheel and the cranks, the frame being simply a T, with the vertical limb inclined. The gear being completely inclosed, is protected from dust, and also from contact with the dress. By reversing the seat-rod (of the now common ┐-type) the machine can be converted into a rear-steerer of the Humber pattern. The "Ideal" cycle, which we illustrated on p. 454, is shown in two machines, both of which give evidence of having done much work; and in the same room or department of the "maze" the National Bicycle Co. show, amongst other exhibits, a "Hansom Sociable Tricycle," so named, apparently, because the front seat (for the lady) is protected by a sort of canopy. It is on the tandem plan, each rider driving one wheel. W. Keen and Co. show machines fitted with Kinnaird's patent lever action, the advantage of which it is difficult to discover. In the Facile and the 'Xtraordinary there is an object in connecting the pedals to the crank by a link, but the Kinnaird simply introduces another link without any corresponding advantage. Another novelty of doubtful advantage is the Patent Crypto-dynamic two-speed gearing of Messrs. Shaw and Sydenham, which is a method of adapting what is commonly known as power-gearing to a bicycle. The additional weight is about 10lb., and with that, and the disadvantage inherent to all gearing, the bicyclist will be able to speed a 52in. wheel, say, down to 31in., as the patent gearing gives power of 1·66. The change is effected instantaneously, so that a bicyclist, on approaching a hill, can put the gear into action, and exert a little extra pressure to compensate for the friction. In the centre of the area Goy has an exhibit of machines and all the accessories of a cycling outfit, with a Swiss châlet having measured doors to test the ability of the tricycles to pass within given dimensions. The "home-trainers" will attract some attention, now that it is known they are patronised by Dr. Richardson. They consist of a strong heavy pedestal, carrying a saddle, and having a disc driven by pedals, the tension of which can be regulated by a strap to imitate the resistance of the road to the cycle. A counter and a bell show and indicate the "distance" traversed. Maynard, Harris, and Co. exhibit specimens of the Devon Tricycle, and J. Devey and Co. have a good selection of machines notable for their low price. A comparison of prices does not come within our province, but we may be allowed to suggest that some machines are very dear. The South London Machinists' Co., besides their well-known machines, show a front-steered double-driving tricycle, with balanced gear, a feature which many makers are adopting because the box containing the gear offers facilities for the application of a band brake. We must not omit to mention that Mr. Bown, as usual, has a fine show of ball bearings and fittings generally, which will attract the attention of amateur mechanics who make their own machines. The show contains more than 600 machines, and the preponderance of tricycles indicates that makers are endeavouring to supply a demand which is steadily growing, for there can be little doubt that before long the number of tricycles and sociables in use will exceed that of two-wheelers.

THE ELECTRIC LIGHT IN A FRENCH WORKSHOP.

THE electric installation at the railway works of Saint Denis is pronounced by *La Nature* one of the best examples that could be cited of the great variety of applications of which electricity is susceptible, and the numerous services it may render when judiciously employed.

The workshop and sheds of Saint Denis are exclusively—at least in the part lit electrically—devoted to the construction of railway carriages. The numerous machine tools used in this manufacture are driven by a steam-engine of 60-horse power, of which there is always, at least, 10 available (otherwise) during the whole time of work, but the nature of the work does not allow of taking more than 10 in a permanent way at any moment; and yet this available force would be insufficient for lighting the workshops, which is effected with 10 arc-lamps of the Weston system, and 24 Maxim incandescent lamps; representing, when the whole is in operation, a work of 15 to 16 horse-power. This difficulty has been got over by the use of accumulators in the following way:—The dynamo electric machine which, in the evening, feeds the Weston lamps, serves by day to charge the accumulators, which, in the evening are discharged through the incandescent lamps. Thus, the available work of the engine is utilised throughout the day, and a single dynamo-machine suffices to insure the total lighting service, which is thus established under the best economical conditions.

The machine employed in this installation is a continuous-current dynamo of the Weston system, with inductors in circuit. It furnishes, with a velocity of 900 revolutions, an electro-motive force of about 250 volts, and a current of 20 ampères, capable of supplying 10 Weston lamps in current. These lamps, similar in principle to those of the Brush system, are characterised by the feature, prominently brought out by the recent Electric Exhibition Committee, that they act with a very small arc, a small electro-motive force, and a comparatively intense current; since 250 volts in the machine is sufficient to feed 10 lamps in circuit, which is less than 25 effective volts per lamp.

By day, the machine-current is sent into 80 accumulators with goffered plates of the Kabath system, arranged in two series of 40 elements each. A two-direction commutator allows of changing the course of the current at will, to the Weston lamps, or to the accumulators. The arrangement of the machine requires, in this latter case, some special precautions. It has been stated that the inductors of the machine were placed in the same circuit. It results from this that if the machine were directly shunted to the accumulators, at the moment of charging, the current of these accumulators would reverse the excitation, and, consequently, the current produced by the machine, and the effect of this would be to quickly empty the accumulators, instead of filling them, and perhaps they would be damaged. The following method to obviate this is adopted:—The circuit of the machine is first closed through a resistance of suitable length for a few minutes, and the machine is then gradually excited to its normal power, the polarity corresponding to the remanent magnetism of the inductors being preserved. When this resistance is suppressed, the current sent into the accumulators is produced in the direction which suits their charge. If, from any cause, the slowing of the machine, *e.g.*, the electromotive force of the machine tended to become inferior to the inverse electromotive force of the accumulators, an automatic break in the circuit would cut the communication between the accumulators and the machine before the direction of the current was reversed; and any accident would thus be avoided.

The machine having an electromotive force too great to charge the accumulators, it has been necessary to introduce a certain resistance into the circuit of charge, so as not to fatigue and heat it (this is a waste of force, *La Nature* remarks, which might be avoided by variation of the number and grouping of the accumulators).

At present the charging of the accumulators takes only four hours a day, and is produced by a current of 20 to 22 ampéres, or 10 to 11 ampéres per series.

The discharge is effected through 24 Maxim incandescent lamps mounted in derivation with the two series of accumulators. The current furnished is, on an average, about 40 ampères; that is to say, about double the current of charge; but the duration of action does not exceed an hour and a quarter to an hour and a half.

As the discharge of the accumulators is not constant, and the flow gradually weakens, this flow is regulated by hand, by introducing into the discharge circuit gradually decreasing resistances, which admit of keeping the lamps in their normal state during the whole hour of lighting. These resistances consist of bare iron wire, wound in the form of spiral springs, and connected with the successive keys of a round commutator, with 14 directions, worked with a handle. "The employment of these resistances, again, is not very economical, and it would be possible to obviate this fresh waste by using a larger number of accumulators grouped in a different manner; but it must not be left out of sight, that in the case under consideration the economy of force is only a secondary consideration, since this available force of the machine is of very small cost comparatively.. It would be easy to obtain a better utilisation by increasing the number of lamps and accumulators. In this particular case, Mr. Charles Farquhar, the engineer of M. de Kabath, who has directed the installation, has sought simplicity above all, and, we must say, he has fully succeeded."

It remains to speak of the ingenious arrangement devised by Mr. Farquhar, to meet the special exigencies of illumination of the large workshop in which the incandescent lamps are placed. This place is devoted exclusively to drying and painting of the carriages, which are placed on the rails in parallel lines. The points where the light is necessary vary continually with the degree of advancement of each carriage, and the nature of the work to be done. Thus there was need of *movable*, though suspended, lamps, without a quantity of hanging wires, which would have been a hindrance and trouble, and would have got into confusion through the carelessness of workmen. The difficulty has been surmounted thus: Between each range of carriages are stretched (parallel with each other and the rails), about 16ft. above the ground, two bare copper wires connected with the two poles of the accumulators. The wire are about a foot apart. The incandescent lamps are each fixed to the end of a hollow rigid rod about 10ft. long; within this rod are two insulated wires, which communicate with the binding screws of the lamp, and with two horizontal arms at the top, the whole presenting the aspect of a long T. These two horizontal arms rest on the two stretched copper wires, and bring the current to the lamp-wires. By this arrangement, which is likely to be often imitated, the lamps can be easily shifted in position by pushing with a rod, making the top of the T-piece slide along on the stretched wires. To insure good contact, it is sufficient to rub the conducting wires once a month with a piece of emery-paper fixed on the end of a rod.

In this way the light can be brought to the points where it is specially required, other points being left in comparative darkness.

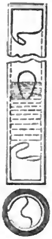
AYRTON AND PERRY'S ELECTRIC METER.

UNDER the rather long title of "Contrivances for Registering the Amount of Work given Electrically to any part of an Electric Circuit in a given time," Profs. Ayrton and Perry have obtained letters patent for the invention of an instrument which shows by pointers on dials the total amount of energy which has passed electrically into a circuit. It consists of a small machine shaped like a dynamo, the movable field-magnet of which is wound with moderately thick wire. The fixed armatures are wound with a wire whose resistance may be more than two hundred ohms; or, again, the moving part may have a considerable resistance, and the fixed may have the smaller resistance. The cores in both cases may be of very soft iron, or other magnetic matter, or they may be of non-magnetic matter, so that they cannot become permanently magnetic or of electrically non-conducting matter. The ends of the bobbin of high resistance are connected with the extremities of the portion of an electric circuit whose supply of energy it is desired to measure; the main current, or any fractional portion of the main current, being allowed to pass through the coils of smaller resistance. It is well known that the average force acting between the movable and fixed parts is proportional to the product of the currents flowing in them, and this is evidently proportional to the horse-power which is being expended in the main circuit: hence the horse-power so expended, multiplied by the velocity with which the movable part is made to rotate, is proportional to the mechanical power given out by the motor. If now the only work done by the motor is done in overcoming fluid friction, or in causing magnets to revolve in front of metallic plates, such as copper, or, as in Arago's disc experiments, in all these cases the forces resisting motion are proportional to the velocity, and it is obvious that the number of revolutions made by the motor in any time is proportional to the electrical energy given to the circuit in that time. The only work therefore done by the motor is the moving of vanes in the liquid, or in the relative motion of magnets and conductors, with the exception of the small amount of work necessarily done in overcoming the friction at the bearings of the machine, and in moving the recording apparatus. The number of revolutions made by the motor in any time is determined in much the same way as that employed in gas or water meters, and the electric energy given to a house or machine, or a lamp, during any period of time, is represented by the difference of the readings of the instrument at the beginning and end of the time in question, just as in a gas or water-meter, the quantity of gas or the quantity of water is measured. Steel or cast iron must not be used either in the armature or fixed parts of the machine, and, indeed, it is probably preferable not to use in the moving part any metallic core, as the induction currents give rise to prejudicial resistance. In some of the instruments the armature coils have non-conducting cores. The distinguishing characteristic of the machine is that when it moves under the action of electricity, the average forces causing motion are proportional to the product of the currents flowing in the fixed and movable parts, one of these currents being proportional to the whole or a fractional part of the electromotive force in the main circuit, and the other being the whole or a fractional part of the main current. The arrangement made for resisting motion may be any one in which the resistance is proportional to the speed, so that the mechanical power wasted is proportional to the square of the speed. Some constant frictional resistance will necessarily be present, but it is reduced as much as possible, and the correction for it is made by adding to the reading a certain number multiplied by the time which has elapsed.

Another method employed to register the energy given electrically to any circuit is of the nature of an addition to a pendulum or balance, or other regulator of a clock or watch. On such vibrating regulator Profs. Ayrton and Perry place a coil of wire, and in the neighbourhood, perfectly fixed in position, is another coil of wire. One of these coils has great resistance, and connects the two extremities of the part of the circuit about which it is wished to have a record, so that the current flowing in it is proportional to the difference of potential. Through the other coil passes the whole or any fractional part of the main current. These coils are so placed that the attractions or repululsions between would, in the absence of gravity or of the forces of springs, cause a very slow vibration of the regulator if displaced from the mean position. The effect of their being added to the ordinary forces is to slightly quicken or shorten the time of vibration of the regulator. If this shortening or quickening is a small fraction of the whole time of vibration, they have proved that the loss or gain of the time-keeper from what the recorded time would be, if there were no electric currents, is proportional to the total energy given to the circuit in any time. If, however, the shortening or quickening of time of vibration is large compared with the whole time of vibration the loss or gain of the time-keeper is no longer proportional to the total energy. Profs. Ayrton and Perry are aware that electromotors, as well as clocks, have been employed to measure the quantity of electricity that has passed in a circuit, but a knowledge of the quantity of electricity that has passed gives no indication of the work the electricity has done; their instruments are not designed to record the quantity of electricity that has passed, but instead, the electric energy previously given to a circuit—that is, they record the time-integral of current into electromotive force.

IMPROVED WATER-GAUGE.

AN improved water-gauge, for use on boilers and other vessels, has been recently patented in this country on behalf of Mr. L. M. Fleet, of Boston, Mass. The object of the invention is to render the height of the water apparent at a glance. The construction will be readily understood from the annexed engraving. The tube is of glass of any suitable dimensions. One half of the exterior surface being ground to form a background for enabling the column of water in the gauge to be seen to better advantage, or more distinctly, than with the ordinary tubes. The tube is provided with a hollow ball or float, preferably composed of coloured glass, and pear-shaped: the float may, however, if preferred, be round, or may be composed of other material than glass, and have two bulbs, the object of the float being to enable the height of the water in the tube to be instantly ascertained, even at a considerable distance from the gauge.



The guards at the ends of the tubes are composed of thin sheet-metal, and provided with inwardly projecting flanges or fingers, for preventing the float from passing out of the tube into the fittings of the gauge when the water is very high or very low. The body of the guard is bent to such a curve laterally, that when it is inserted in the tube it will be sustained in position by the "spring" or expansive action against the inner surface of the tube, the projecting flange or finger striking the float and preventing it from passing through the guard. When a double float is used it should be so constructed and weighted as to bring the water line to the neck or narrow part of the float, the upper bulb being entirely out of the water, thus effectually serving the purposes of a signal. It will be obvious that the tube, having one half of its surface ground longitudinally, may be used without the float or guards if desired.

PRACTICAL NOTES ON PLUMBING.—LIX.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 446.)

NOW should you have to uncover the well, do not rush headlong into your grave by descending into a space filled with carbonic acid, a gas which cannot support life, nor can it be seen, but it will smother the strongest animal in the world. Always lower a lighted candle before you descend into any well; if the candle will burn, you are safe; *if not, do not, upon any consideration*, venture down until this deadly and treacherous enemy is driven out or cleared away, which is done as follows, namely:—by lowering anything to cause heat, so as to rarefy the air, or by blowing air from a foul-air blowing-machine, as shown at Fig. 301, or by the use of a gas and hot water, or blacksmith's portable forge, or to blow down a lot of iron, india-rubber, or other pipes, and which must reach down to the water, or nearly. Sometimes the rising mains (not having tail or chamber-valves) are made use of for this pumping down fresh air. This is done by fixing a ball stop-cock upon the main pipe near the barrel, with a pipe leading to the surface of the water in the well. Such ball-cocks are best worked with rods reaching from top to bottom. Of course, by attaching a rubber hose on the outlet of the main, and by pumping air down the main in large quantities, the foul air will soon mingle with the fresh air and rise to the surface, when the candle will burn. It may be asked, How am I to get down a well? You should be let down by the aid of a windlass, and wound up upon a rope such as shown at ROPE Fig. 302.

FIG. 301.

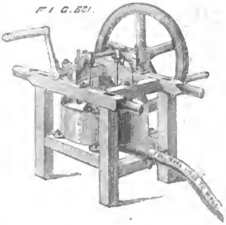
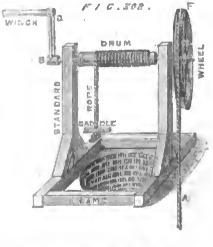


FIG. 302.



Two men take the windlass, one on each side. The other handle is not shown on the wheel, but that does not signify. Sit across the SADDLE with the rope between your legs, and at first, until you are used to the work, with a piece of sash cord over the right shoulder round the rope and under the left armpit, and away you go grandly to the bottom stage. If you have never been let down before, you will have some very peculiar feelings as you descend, and will be full of wonderment as to whether the brickwork is safe, are the stages safe? and will anything fall? It is a way down! Suppose that the rope should break, or those on the top should accidentally let go the winches! Then you wonder if there is any foul air in the well. All this is running through your mind as you first go down. Shall I fall off? Then, if a very deep well, you may see that the brickwork is winding, and the chances are, that you will say to yourself, "This is not a safe well." Perhaps there are a few bricks out in places, or that you may be in a dangerous well; then you will, from the first moment of your descent, wish yourself on top again. All this will pass through your mind, and this is the very thing, if you are in safe and trusty men's hands, that you must forget, for it only makes you more nervous, and under the influence of such wretched feelings, men have been known to faint and fall off, as though foul air was in the well. A plumber has no right to enter a well if he has an idea that he cannot stand the first horrors of well-work, more especially if it be a dangerous well. For example, sometimes you will have to descend 50ft. or 100ft., and then walk along a heading perhaps 60ft. or 100ft., then go down another well, which is another 50ft or 100ft. deep. These are the wells wherein the danger lies, and yet, after a little while, you become thoroughly at home in such wells. It requires confidence and great skill in making proper examination and preparations every time you enter a well.

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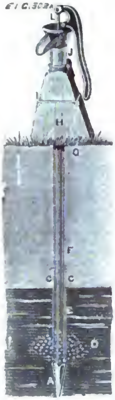


FIG. 302A

Sometimes it happens that you work off ladders from stage to stage, &c. When such is the case, take care that you fix the ladder safely, and that the *stages are sound*, for it is not at all an uncommon occurrence to find the stages of old wells give way under one's feet, to the horror and dismay of the person descending. My advice is, never to descend into a well from stage to stage on ladders, unless you are quite certain that the stages are safe. I also contend that all stages should be of iron, granite, or gun-metal. Such stages will be illustrated as we proceed with our deep well pumps; but before entering upon this it will be best to explain the simpler kinds to fix.

Tube Well and Pump.

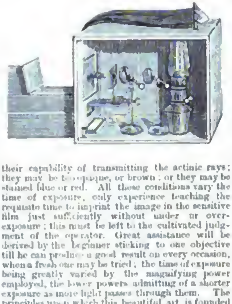
This kind of pump was much used by the English soldiers during the Abyssinian war. Fig. 302, A, is an illustration of this pump, showing the suction A, E, F, driven into a water-bearing strata at A, D, E; it will be plain that if you drive the tube G, F, E, A, through the soil, &c., as explained in the geological woodcut, Fig. 270 or 271, or into a water-bearing stratum, as shown, you can pump up the water in due proportion to the moisture of the said strata at the blast-holes, and that by continual pumping the vacuum produced by the suction will cause the water to flow towards the blast-holes. Such is the construction of the tube-wells which we have heard so much about these last few years. I may add that, however useful these wells may have been found in times of war, &c., you must not at all times expect such wells to yield that plentiful supply which can be obtained from the digging of a properly-constructed well, nor can you expect these kinds of pumps will work with the same ease that the ordinary jack pump does when fixed in an ordinary well, and why? Simply because in the tube-pump you are depending upon the interrupted pressure of the atmosphere for assistance, and which is hindered by its passing through the different strata of the earth before it can get to the water near the blast-holes, and to which to a great extent the tube well owes its source of supply.

(*To be continued.*)

PHOTO-MICROGRAPHY.

By T. C. White, M.R.C.S.*

I AM glad to see by the photographic journals that many in the provinces and abroad are awakening to the interest attached to this process, and much good will result. I must, however, proceed to the subject of this evening's demonstration. The method most generally practised and recommended is that the microscope being placed in a horizontal position, its tube should be attached by a blackened tube or a cone to the front of a photographic camera, the lens of which has been removed. Now, I find these difficulties arise. It is not everyone who has got a camera, and they may not feel disposed to go to the expense of procuring one, while all the members of this Club possess microscopical objectives; but, further, if they have a camera, it is not an easy matter to see the fine details of a subject through the ordinary ground focussing glass. Again, unless the camera and microscope are securely fastened down to a base-board, there is a tendency to unsteadiness which is irritating in the extreme; and futhermore, this usual plan does not offer any advantages over that I wish to introduce to your notice this evening. In the apparatus before you, and which I have found so convenient, it is not necessary to have either a camera or a microscope, and is so simple that it can be adopted by the youngest member of the Club; but even with this, difficulties will arise which are altogether apart from the apparatus, for instance, objects differ in their capability of transmitting the actinic rays; they may be too opaque, or brown; or they may be stained blue or red. All these conditions vary the time of exposure, only experience teaching the requisite time to imprint the image in the sensitive film just sufficiently without under or over-exposure; this must be left to the cultivated judgment of the operator. Great assistance will be derived by the beginner sticking to one objective till he can produce a good result on every occasion, when a fresh one may be tried; the time of exposure being greatly varied by the magnifying power employed, the lower powers admitting of a shorter exposure as more light passes through them. The principles upon which this beautiful art is founded may be read in any of the many manuals on photography, and which are published at a cheap rate; therefore, leaving these, I will pass on to the practice. If anyone needs to learn about the various apparatus employed for photo-micrography, full particulars will be found in Beale's "How to Work with the Microscope," and in Cutter's "Microscopical Technology," both of which works are in our library.



In the first place, I claim for my plan, its great simplicity, being, as you see, nothing more than a lidless box placed on its side; at the left end it has a square hole, but any aperture will do; a brass plate having an adaptor in it, slides in or out on runners for more easily changing the powers when it is desired to do so. Another long aperature is made at the top side, covered by a blackened chimney to carry off the heat from the duplex paraffin lamp inside; another aperture at the bottom of the right side serves to admit the air to the lamp when the front of the box is covered up by the black focussing cloth; within the box, and attached to the left side, is a carrier working on a long and fine screw, which serves to adjust the object to the correct focus. Two condensing lenses, one to render the rays of the lamp parallel, and the other to condense them on the object, complete the arrangement as far as the box is concerned. The light passing from these through the objective emerges as a cone, and on the principle of a magic lantern projects the image on a screen to the left of the operator.

The screen consists of a heavy piece of wood having a groove formed in it, and carrying another block upon which the screen is held. The screen which receives the image may be made of an oblong piece of glass either 4¼in. by 3¼in., called by photographers a quarter-plate, or by a plate 5 by 4, according to the amplification you intend to employ or the nature of the object may indicate, or, if lantern slides are desired, on a square 3¼in.; these ought to have a piece of smooth writing-paper gummed on that surface presented to the image. The image is then thrown on to one of these, and, the hand placed under the focussing-cloth, the carrier is to be moved by means of the screw adjustment till the image of the object is sharply defined on the screen.

In many writings on this subject it is stated that the actinic and visual foci of microscopical objectives are not coincident. All I can say is, that with a ¼ of an inch, which I shall employ this evening, and with Zeiss's D, no alteration is needed from the visual focus. The screen may now be removed, and its place occupied by a dry gelatine plate, and the exposure accurately timed according to the nature of the object; but only experiments can determine this. Care must be taken before making the exposure that the light through the objective be cut off till the plate is in position, when it may be allowed to fall on the plate for the requisite time, and then cut off again before removing the plate to the developing dish; this is done, as must be evident to you all, to avoid blurring the image. I need not say that the only outside light must be a non-actinic red light, and no ray of white light must be allowed to reach the plate, or it will be "fogged"; that is, when it is developed, it will be veiled by a misty deposit in the film; therefore no actinic light is admissable till the plate is fixed.

The developer I use is the ferrous oxalate made by a saturated solution of protosulphate of iron being added to a saturated solution of neutral oxalate of potash in the proportion of one part of the iron to the three parts of the oxalate; these are best when freshly mixed. If the plate has been rightly exposed, the image begins to make its appearance in about forty seconds, and grows under the action of the developer till it is full of detail. When the image shows faintly through the film on looking at the back of the plate, I stop the development, and wash the plate by a good rinsing in rain or distilled water, and then place it in the fixing bath, which consists of a solution of four ounces of hyposulphite of soda dissolved in a pint of water; this extracts all the silver which has not been acted upon by the light. The plate must now have a great deal of washing to rid it of the hyposulphite of soda; this is thoroughly done by placing it in running water under a tap for half an hour; if the film contains a trace of hyposulphite, it causes the image to fade out after a time.

Some plates have a tendency to frill; that is, the edges of the gelatine film, while wet, have a tendency to separate from the glass and to curl up. To prevent this, the plate may be soaked for about five minutes in a saturated solution of alum, and then again well washed and stood up on a sheet of blotting-paper to dry spontaneously.

Now I have thought it well, before giving you the demonstration, to tell you these details, that you may, bearing them in mind, follow the practical part with a clearer understanding of what I am doing, and why I do it, and at the same time the box and its brass contents have been getting warm, a not unimportant item in the proceedings, for if you begin your operations before this takes place, your glasses will become dewed with the moisture condensed on them, and your brass will be in a process of expansion from the heat, your image will accordingly be wanting in definition, and your plate assuredly spoiled.

DYNAMO-ELECTRIC MACHINERY.—V.*

By Prof. S. P. Thompson, B.A., D.Sc.

(*Continued from p.* 473.)

Armatures.

THE armatures of dynamos of the first class may be roughly classified in three groups, according to the manner of arranging the coils. These three groups are—

(1.) *Ring armatures*, in which the coils are grouped upon a ring, whose principal axis of symmetry is its axis of rotation also.

(2.) *Drum armatures*, in which the coils are wound longitudinally over the surface of a drum or cylinder.

(3.) *Pole armatures*, having coils wound on separate poles, projecting radially all round the periphery of a disc or central hub.

(To these we shall add a fourth form, namely, that of *Disc armatures*, when we deal with dynamos of the second class.)

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* Extracted from a paper read at the Quekett Microscopical Club.

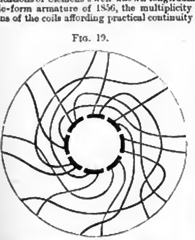
* Extracted from the Cantor Lectures, delivered before the Society of Arts.

The object of all these combinations is to obtain the practical continuity of current spoken of in section *t*, p. 425. Some of the individual coils should be moving through the position of maximum action, whilst others are passing the neutral point, and are temporarily idle. Hence a symmetrical arrangement around an axis is needed. Ring-armatures are adopted in practice in the dynamos of Pacinotti, Gramme, Schückert, Gütlcher, Fein, Heinrichs, De Meritens, Brush, Jürgensen, and others. Drum armatures are found in the Siemens (Alteneck), Edison, Elphinstone-Vincent, Laing and other machines. Pole-armatures are used in the dynamos of Allen and of Lontin. There are several intermediate forms. The Bürgin armature consists of eight or ten rings, side by side, so as to form a drum. The Lontin (continuous-current dynamo) has the radial poles affixed upon the surface of a cylinder. The Maxim armature is a hollow drum wound like a Gramme ring, and has therefore a great quantity of idle wire on the inner surface of the drum. The Weston armature has the drum surface cut up into longitudinal poles; there is a similar armature by Jablochkoff, in which the poles are oblique.

Ring armatures are found in many machines, but the ingenuity of inventors has been exercised chiefly in three directions:—The securing of practical continuity; the avoidance of Foucault currents in the cores; and the reduction of useless resistance. In the greater part of these machines, the coils that form the sections of the ring are connected in series, the end of one to the beginning of the next, so that there is a continuous circuit all round, an attachment being made between each pair to a bar or segment of the collector. Most inventors have been content to secure approximate continuity by making the number of sections numerous. One inventor, Professor Perry, has built up a ring with coils wound obliquely, so that the one coil reaches the neutral point before the preceding one has passed it. I cannot help doubting the advantage of this arrangement; which, moreover, presents mechanical difficulties in construction. Pacinotti's early dynamo had the coils wound between projecting teeth upon an iron ring. Gramme rejected these cogs, preferring that the coils should be wound round the entire surface of the endless core. To prevent wasteful currents in the cores, Gramme employed for that portion a coil of varnished iron wire of many turns. In Gülcher's latest dynamo, the ring-core is made up of thin flat rings cut out of sheet iron, furnished with projecting cogs, and laid upon one another. The parts of the coils which pass through the interior of the ring (in spite of the late M. Antoine Breguet's ingenious proof that some of the lines of force of the field bent round and turned back into the core in this interior region) are comparatively idle. They cut very few lines of force as they rotate, and therefore offer a wasteful resistance. Inventors have essayed to reduce this source of loss, by either fitting projecting flanges to the pole pieces (as in Fein's dynamo) or by using internal magnets (as in Jurgensen's dynamo), or else by flattening the ring into a disc-form, so as to reduce the interior parts of the ring-coils into an insignificant amount. This is done in the dynamos of Schückert and of Gülcher. In the latest form of Gülcher's, the field-magnets, front and back of the ring, are united on the right and left sides in a pair of hollow pole pieces, which form cases over the ring, covering a considerable part of it. The collector is identical with that of Gramme, but very substantial.

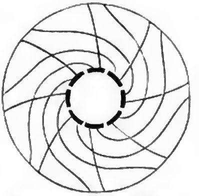
The drum-armatures may all be regarded as modifications of Siemens's well-known longitudinal shuttle-form armature of 1856, the multiplicity of sections of the coils affording practical continuity in the currents. In some of Siemens's machines the cores are of wood, overspun with iron wire circumferentially, before receiving the longitudinal windings. In another of their machines there is a stationary iron core, outside which the hollow drum revolves; in other machines, again, there is no iron in the armature beyond the driving-spindle. In all of the Siemens armatures the individual coils occupy a diametral position with respect to the cylindrical core, but the mode of connecting up the separate diametral sections is not the same in all. In the older of the Alteneck-Siemens windings the sections were not connected together symmetrically, the connections (for an eight-part collector) being as in Fig. 19. But in the more recent machines a symmetrical plan has been adhered to, as shown in Fig. 20.

FIG. 19.



ALTENECK-SIEMENS WINDING (OLD).

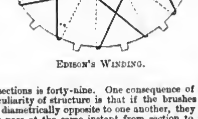
FIG. 20.



ALTENECK-SIEMENS WINDING (NEW).

In this system, as in the Gramme ring, the successive sections of coils ranged round the armature are connected together continuously, the end of one section and the beginning of the next being both united to one segment or bar of the collector. A symmetrical arrangement is, of course, preferable, not only for ease of construction, but because it is important that there should never be any great difference of potential between one segment of the collector and its next neighbour; otherwise there will be increased liability to spark, and form arcs across the intervening gap. In Edison's modification of the drum-armature, the winding, though symmetrical in one sense, is singular, inasmuch as the number of sections is an odd number. In the first machines there were seven paths, as shown in Fig. 21. In his latest giant machines, the number of sections is forty-nine. One consequence of this peculiarity of structure is that if the brushes are set diametrically opposite to one another, they will not pass at the same instant from section to section of the collector; one of them will be short-circuiting one of the sections, whilst the other is at the middle of the opposite collector. The armature of these latest of Edison's dynamos, which is not wound up with wire, but, like some of Siemens's electro-plating dynamos, is constructed of solid bars of copper, arranged around the periphery of a drum. The ends are connected across by washers or disks of copper, insulated from each other, and having projecting lugs, to which the copper bars are attached. Such discs present much less resistance than mere strips would do. The connections are in the following order:—Each of the forty-nine bars of the collector is connected to one of the forty-nine discs at the anterior end of the drum, which is connected by a lug-piece on one side to one of the ninety-eight copper bars. The current generated in this bar runs to the further end of the machine, enters a disc at that end, crosses the disc and returns along a bar diametrically opposite that along which it started. The anterior end of this bar is attached to a lug-piece of the next disc to that from which we began to trace the connections, it crosses this disc to the bar next but one to that first considered, and so round again. The two lug-pieces of the individual discs at the anterior end are, therefore, not exactly opposite each other, diametrically, as the connections advance through $\frac{1}{49}$th of the circumference at each of the forty-nine paths.

FIG. 21.



EDISON'S WINDING.

Before passing on from the subject of armatures, it is worth while to mention the peculiarity of form of the Bürgin armature, which has already been spoken of as consisting of eight, or in the newest Burgin machines, as constructed by Mr. R. E. Crompton, of ten rings, set side by side. Each ring is made of a hexagonal coil of iron wire, mounted upon light metal spokes, which meet the corners of the hexagon. Over this hexagonal frame six coils of covered copper wire are wound, being thickest at the six points intermediate between the spokes, thus making up the form of each ring to nearly a circle. Each of the six coils is separated from its neighbour, and each of the ten rings is fixed to the axis $\frac{1}{60}$th of the circumference in advance of its neighbour, so that the 60 separate coils are in fact arranged equidistantly (and symmetrically, as viewed from the end) around the axis. There is a 60-part collector, each bar of which is connected to the end of one coil and to the beginning of the coil that is one-sixtieth in advance—that is, to the corresponding coil of the next ring. This armature has the great practical advantages of being easy in construction, light, and with plenty of ventilation.

In the Elphinstone-Vincent dynamo there is a drum-armature of a somewhat distinct order, the separate coils being made of a rectangular form, and then laid upon the sides of a hollow papier-maché drum in an overlapping manner, and curved to fit it. The field is a complex one, with six external and six internal poles, and is very intense, owing to the proximity of these poles. The parallelogram-shaped coils are connected together so as to work as three machines, and feed three pairs of brushes; which may again be united, either in series or in parallel, or may be used to feed three separate circuits.

Collectors.

In a well-arranged dynamo of the first class, the sections of the collector are traversed by currents, which run from the negative brush in two directions round the successive coils, and meet at that bar of the collector which touches the positive brush. Each section of the coil thus traversed adds its own electromotive force to the current passing through it. Consequently, if one measures the difference of potential between the negative brush and the successive bars of the collector, one finds that the potential increases regularly all the way round the collecting cylinder, in both directions, becoming a maximum at the opposite side where the positive brush is. This can be verified by connecting one terminal of a voltmeter to the negative brush, and touching the rotating collector at different points of its circumference with a small metallic brush or spring attached by a wire to the other terminal of the voltmeter. If the indications thus obtained are plotted out round a circle corresponding to the circumference of the collector, the values give a curve like that shown in Fig. 22, which is plotted out from observations taken upon a Gramme dynamo.*

It can be seen that, taking the negative brush as the lowest point of the circle, the potential rises perfectly regularly to a maximum at the positive brush. The same values are also plotted out as ordinates upon a horizontal line in Fig. 23. This form of diagram shows very clearly that the rise of potential is not equal between each pair of bars, otherwise the curve would consist merely of two oblique straight lines, sloping right and left from the central point. On the contrary, there is very little difference of potential between the collector bars close to the + brush on its right and left respectively. The greatest difference of potential occurs where the curve is steepest, at a position nearly 90° from the brushes, in fact, at that part of the circumference of the collector which is in connection with the coils that are passing through the position of best action. Were the field perfectly uniform, the number of lines of force that pass through a coil ought to be proportional to the sine of the angle which the plane of that coil makes with the resultant direction of the lines of force in the field, and the rate of cutting the lines of force should be proportional to the cosine of this angle. Now the cosine is a maximum when this angle = 0°; hence when the coil is parallel to the lines of force, or at 90° from the brushes, the increase of potential should be at its greatest—as is very nearly realised in the diagram of Fig. 23, which, indeed, is very nearly a true "sinuscidal" curve. Such curves, plotted out from measurements of the distribution of potential at the collector, show not only where to place the brushes to get the best effect, but enable us to judge of the relative "idleness" or "activity" of coils in different parts of the field, and to gauge the actual intensity of different parts of the field while the machine is running. If the brushes are badly set, or if the pole-pieces are not judiciously shaped, the rise of potential will be irregular, and there will be maxima and minima of potential at other points. An actual diagram, taken from a dynamo in which these arrangements were faulty, is shown in Fig. 24, and again is plotted horizontally in Fig. 25; from which it will be seen, not only that the rise of potential was irregular, but that one part of the collector was more positive than the positive brush, and another part more negative than the negative. The brushes, therefore, were not getting their proper difference of potential; and in part of the coils, the currents were actually being forced against an opposing electromotive force.

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* This diagram was plotted for me, and the measurements made at my request, by Mr. W. M. Mordey, who first drew my attention to some of the abnormal phenomena mentioned later.

FIG. 22

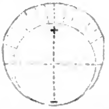


FIG. 23.

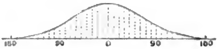
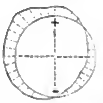
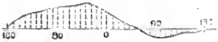


FIG. 24.



I believe that this method of plotting the distribution of potential round the collector will prove very useful in practice, and will explain various puzzling and anomalous results found by experimenters who have not known how to explain them. In a badly-arranged dynamo, such as that giving such a diagram as Fig. 24, a second pair of brushes, applied at the points showing maximum and minimum potential, could draw a good current without interfering greatly with the current flowing through the existing brushes.

FIG. 25.



Curves, similar to those given, can be obtained from the collectors of any dynamo of the first class—Gramme, Siemens, Edison, &c.—saving only from the Brush machine, which, having no such collector, gives diagrams of quite a different kind. It is, of course, not needful in taking such diagrams that the actual brushes of the machine should be in contact, or that there should be any circuit between them, though in such cases the field-magnets must be separately excited. It should also be remembered that the presence of brushes, drawing a current at any point of the collector, will alter the distribution of potential in the collector; and the manner and amount of such alteration will depend on the position of the brushes, and the resistance of the circuit between them.

(*To be continued.*)

LANTERNS AND SLIDES.*

(*Continued from page* 448.)

IN the making of gelatine transparencies it will be found absolutely essential to mask the edges of the negative with black paper—preferably a mask cut out of a piece the full size of the pressure-frame. This will have the double advantage of producing a clear margin round the transparency, invaluable both as a guide during development and as a test for perfect transparency of the whites, and also of preventing stray light from passing through the edges of the plates. It is astonishing how far light will travel through the edges, as may be seen by putting a pile of negatives together, or plain glass with opaque paper between each, near a window. Any accidental striæ or bubbles in the glass would be quite sufficient to make a portion of this light strike upwards, and so mark the print.

The carbon process is in poor favour—most undeservedly; for it is the most charming and fascinating of all when its difficulties are once mastered. Its difficulties, however, are many, and are principally dependent upon the many varieties and apparent vagaries of gelatine. These properties of gelatine are far from being understood, consequently the commercial carbon tissue leaves much yet to be desired. The preparation of the tissue in the small quantities required for lantern slides does not present any real difficulty to the amateur who will take the trouble to prepare it for himself. Nelson's amber gelatine is always reliable: but see that it is Nelson's, as there are other amber gelatines which, for other purposes, may be in every way equal, but which are not equally suitable for work with bichromate. I can speak with the greatest certainty as to Nelson's, having used it almost daily for fourteen years. Samples will vary greatly as to certain qualities, but they are invariably sufficiently soluble.

All that is necessary is to make a thick solution coloured to the required depth and tone; carefully filter and free from air-bubbles, and coat the paper evenly with it. For this purpose it is put in a suitable vessel kept warm by a water bath. Small pieces of paper may be coated by floating—still longer strips by rolling the paper up and, commencing with one end, dexterously drawing the paper over the surface. This plan requires some experience and a steady hand to coat the paper well without soiling the upper surface.

Another excellent plan is to take two pieces of paper and, holding them quite evenly by two corners, plunge the two edges together right to the bottom of the dish and then draw the sheets upwards. If carefully done, the two sheets of paper being held firmly and strained tightly, not a drop will get in between the sheets, but a nice, even coating be obtained on either side. The two sheets will dry together perfectly flat and are easily separated afterwards. While draining, the lower edge is used as a skimmer to draw any bubbles which may be formed by the operation to the margin of the dish.

Coating the paper by damping it and pouring the coloured gelatine on is another plan. If this be adopted the paper must be well wetted and squeegeed on to a piece of plate-glass placed on a levelling stand. When the gelatine is poured on a number of minute bubbles will be sure to rise upon it from the interior of the paper. This must then be tipped off into another dish, and a second quantity of coloured gelatine poured on, which will be found quite free from bubbles. The first lot need not be wasted, as after remelting and filtering it will be as good as ever.

For colouring matter the liquid indian ink prepared by the artists' colourmen is perhaps the best commercial article, with the addition of red and blue to tone desired. One point, however, to which I would more particularly call attention, because I believe it has never yet been published, is the extraordinary effect which the amount of colouring matter has upon the sensitiveness of the tissue. The more colour the more sensitive. The exact relation of sensitiveness to depth of colour has not, as far as I am aware, been ever approximately estimated; but I can assert it to be a most positive fact that, if two tissues be made of exactly the same gelatine and sensitised with the same proportion of bichromate—the one being only lightly coloured and the other very deeply—the deep one will be fully exposed in a fraction of the time which would be required for the lighter tissue.

At first sight this might be attributed to the greater depth to which the light would have to penetrate in the lighter film in order to produce the necessary insolubility; but further reflection will prove that this is not the case. Exposure is continued—not until the darker parts have the required depth, but until the high lights are just touched. It is, therefore, the exterior surface only which has to be rendered insoluble in the high lights which is in question; and this effect is obtained, as I have said, in a much shorter time in proportion as the colour is deeper. Most of the carbon transparencies which I have seen put upon the screen have been wanting in vigour. This arises simply from the tissue not having been suited to the negative—that is, the tissue has not been deep enough in colour, or, what is quite as likely, the negative has been foggy or wanting in pluck.

In a previous paper I have insisted on a bit of clear glass in the shadows as one of the essentials of a good negative. If the carbon process is to be used for producing the transparencies the bit of clear glass will be found of great service in giving depth and vigour to the picture. The details in the shadows, which would be quite lost by bronzing in a print on albumenised paper, will be clearly brought out in carbon. With a great many existing negatives, where the required contrast is wanting, vigour can still be obtained in three different ways:—First, by printing in a stronger light; second, by reducing the proportion of bichromate with proportionately longer exposure: and, third, if these two expedients still fail, by using a tissue of deeper colour. On the other hand, should the negative be too hard, choose a tissue lighter in colour, increase the quantity of bichromate, and print in a weaker light. It will be noticed that the strength of light in which the negative should be exposed is exactly the opposite to the conditions which must be observed in ordinary silver printing.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE fourth meeting of the session of this Society was held on the 10th ult., at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.) in the chair.

Mr. Crisp exhibited (1) An improved form of Leiter's Stomach Microscope: and (2) Ainch's Portable Histological Microscope.

A letter was read from Mr. Chadwick describing a slide (sent for exhibition), of *Bugula turbinata*, mounted in balsam, with the tentacles extended and stained.

Mr. J. D. Hardy read a note "On a Method of Illumination by means of the Chromatiscope," a piece of apparatus by which differently coloured glasses could be placed beneath the condenser, and rotated, producing very striking effects with crystals and other objects.

Mr. Stewart said that, no doubt, most of the Fellows who were present at their last *conversazione* saw this apparatus exhibited, and observed that it did most efficiently add to the beauty of objects shown, which were not amenable to the action of the polariscope. It was not demonstrated, however, that it enabled anyone to find out the structure of objects better, though it certainly added to their beauty.

The President said that several of the Fellows had been in the habit of using different tinted glasses, and there could be no doubt that a blue or red, and, perhaps, even a violet glass placed on the mirror or bull's-eye was of great use in many examinations. The violet tint seemed to be of less use than the others because this colour was not so favourable to the eye. He had, himself, frequently used green with opaque illumination, and found it enabled him to examine objects for a longer time than was possible by ordinary yellow light. There was, however, this important difference between the use of tinted light and polarised light—that it did not enable anyone to see hidden structures which polarised light so often displayed. In corals, for instance, the coloured light was much better for their examination than common yellow light; but polarised light gave an insight into their structural peculiarities—showing how the object had been originally built up—in a way which mere variety of tint was quite incapable of doing. He was glad to see this effort on the part of Mr. Hardy to add to the beauty of some of their favourite objects, especially as he felt that the attention given of late to high powers had caused the æsthetics of the microscope to become somwhat neglected.

Mr. J. Mayall, jun., exhibited the stage by R. B. Tolles, of Boston, U.S.A., which, he thought, would be of interest to the Fellows after the recent description of it which appeared in the *Journal*. Mr. Powell, jun., had remarked to him one point in the construction which was obviously an improvement on the usual arrangement of the graduated rotating stage as applied in England. Generally the graduations were on the fixed ring, so that the index and vernier rotated; hence, in reading the angle, the observer was obliged to follow the movement of rotation. In Tolles's stage the graduations were on the rotating plate, the index and vernier were on the fixed ring, hence the reading was taken always at the same place.

Mr. Crisp remarked that in the Continental models of Petrological microscopes the index and vernier were generally placed on the fixed ring.

Mr. Beck exhibited an objective (without adjustment collar) of ⅛in. focus, made specially for the binocular, with very short setting, so that the back lens would be close to the prism.

Mr. Ingpen remarked that the difficulty of obtaining any adjustment for cover-glass was the great stumbling-block in the way of the manufacture of such lenses.

Mr. C. H. Stearn read his paper "On the Use of Incandescence (Electric) Lamps as Accessories to the Microscope," the subject being illustrated by the exhibition of the arrangements described, which consisted of minute Swan incandescent lamps, specially designed for microscopical illumination. The carbon loop was inclosed in a very small exhausted pear-shaped glass receiver, the size of a small filbert, so that the light could be brought quite close to an opaque object. For this purpose it was mounted on a jointed rotating arm attached to the nosepiece. A second lamp was attached to the substage, and could be used either centrally, or could be rotated excentrically to the axis of the microscope. A third was placed in the position of the ordinary mirror for use with the polariser. With a $\frac{1}{12}$in. objective, and *Pleurosigma formosum*, excellent results were obtained. By mounting the two lamps, one above and the other below the stage, an instantaneous change in the illumination could be effected by merely pressing a button.

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* Extracted from a paper by MR. GEORGE SMITH, in the *British Journal of Photography*.

Mr. Stearn said that a battery of five Bunsen cells could be used, or two or three small accumulators, an accumulator weighing only 5lb. being sufficient to light one lamp continuously for two hours. This is very useful, not only for the ordinary purposes of illumination, but for photomicrography also.

[Mr. Stearn's paper will be printed in our next issue.]

The President said he felt sure the Society was very much obliged to Mr. Stearn for having shown them this very excellent adaptation of electric-lighting to the microscope. It showed them very plainly what they would have to come to, and he hoped it pointed to a speedy annihilation of all rock-oil abominations. The great convenience of having a light so completely under command struck him as an important point about it, for in examining such objects as echinoderms with a 2in. objective, what was specially wanted was a light that could be twisted and twirled round the object in the way shown by Mr. Stearn. He sincerely hoped that the idea would be fully worked out, and that it would be taken up by some of the leading makers. No doubt those who saw these little lamps exhibited at their last *conversazione* would agree with him in thinking that it was one of the most interesting exhibitions ever brought before them.

Mr. Stearn, in reply to a question from Mr. Crisp, said that the accumulators which were under the table in the room would work the lamps for several hours consecutively, but he was unable to say how long they would last without recharging if they were put on one side and not used for some days. He thought a good deal of the current might be dissipated meanwhile.

Mr. Beck inquired if Mr. Stearn had ascertained how far it was possible to recharge these accumulators? He believed that the Faure Company said that they could not get the same amount of work out of them after they had been used some time, so that, if at the first charging they would yield 80 per cent. of the energy put into them, they would afterwards only give out, say, 40 per cent. So that it seemed to him that if they got weaker each time they were charged, a time would very soon come when it would be necessary to get new ones.

Mr. Stearn thought the real question of importance was to ascertain how long they would last after being charged in the event of their being out of use? This question he could not answer at present, the short time the accumulators had been in his hands preventing much experience from being gained.

Mr. A. D. Michael read a paper "On the Anatomy of the Oribatidæ," the subject being illustrated by diagrams, and specimens shewn under the microscope.

Mr. Stewart said, when he considered the hardness of the cuticle of these creatures, and the softness of their internal structures, he could only express his admiration at the skill with which Mr. Michael had overcome the difficulties in the way of such investigations.

Dr. G. C. Wallich read some "Notes on the Rhizopods," promising to continue the subject on a future occasion.

Mr. Crisp said that the question of symbiosis between animals and plants was one which was exciting a great deal of attention at the present time, and Dr. Wallich's remarks on the subject were of special interest.

The meeting was then declared by the President special, in pursuance of notice given at the previous meeting; and it was then moved by Dr. Millar, and seconded by Mr. Crisp, that the by-laws be suspended to enable the council to nominate the President for election to a further term of office.

The proposal having been put to the meeting, was carried unanimously.

The President thanked the meeting for the resolution, at the same time expressing his opinion that it was not advisable to have a President too long in office.

Mr. Crisp read a list of Fellows who had been nominated by the council for election at the preliminary meeting as officers and council for the ensuing year. Mr. Badcock and Mr. Curties were elected auditors of the treasurer's accounts.

The President then adjourned the meeting to the 14th inst.

SCIENTIFIC NEWS.

In the *Astronomische Nachrichten*, Dr. Kreutz, of Berlin, publishes a determination of the orbit of the great comet of 1882, which agrees well with that of Prof. Frisby, of Washington. The observations extended from Sept. 8 to November 14, and the period found is 843·1 years, while Prof. Frisby made it 794. The comet may thus be a return of a visitor which appeared in 1049 or in 1106. Dr. Krentz gives the perihelion distance on Sept. 17 as about 716,000 miles, and he states that the comet does not appear to have undergone any essential change in its orbit by its near approach to the sun.

M. Paul Henry has named the small planet discovered by him on August 12 last Philosophia (No. 227), while the name Athamantis has been given to No. 230, discovered by Dr. de Ball at Bothkamp on Sept. 3.

The Academicians of the Nuovi Lincei have appointed a committee to superintend the erection of a monument in Rome to Father Secchi.

A new comet near Jupiter is said to have been observed from the Puebla Observatory, Mexico.

An index to the *Journal* of the Society of Telegraph Engineers and of Electricians has been compiled by Mr. A. J. Frost, and published by E. and F. N. Spon. It includes all the papers, &c., in the volumes from 1872 to 1882, and will be of great value to electricians and others.

We mentioned some time ago that Mr. Ellis Lever, of Culcheth Hall, Bowdon, Cheshire, had offered the sum of £500 as a premium to any one who should invent a portable electric lamp to be used in mines. It appears now that the reward is offered for an electric or other safety-lamp. The lamp must be capable of being carried from places, and under no conditions be capable of causing an explosion of gas. The money is to be invested in the names of three trustees, of whom Mr. T. Burt, M.P., is one, and the efficiency of the lamps is to be tested by a committee of five (three scientists, a representative of the mining engineers, and a representative of the workmen chosen by the central board of the Miners' National Union). The offer remains open until the end of the present year, when, if a lamp meeting the requirements has not been invented, the money will revert to Mr. Lever.

The *Lancet* calls attention to some cases of lead-poisoning amongst the workmen of an electric storage factory in the East-end of London. The "paste" is said to be made of a powder containing lead which is mixed with strong sulphuric acid, and fumes are given off. Our contemporary suggests the use of masks by those who mix the paste, and of gloves by those who apply it to the plates.

Prof. D. E. Hughes, F.R.S., recently read an important paper on the molecular rigidity of tempered steel before the Institution of Mechanical Engineers. From the experiments he has made, he strongly favours the view that steel, when tempered, is an alloy containing fixed carbon in a far greater quantity than when soft. Prof. Hughes promises another paper on the effect of different tempers on the same steel.

In the course of a lecture at Leeds, on the Technical Application of Electricity, Prof. Rucker stated that some dynamo-electric machines converted not less than 97 per cent. of the work put into them into electric energy.

The artesian well on Southampton Common, which had reached a depth of 1371ft. when the boring was stopped in 1851, is to be continued until the lower greensand is reached. The well proper is 563ft. deep, and the boring is partly stopped with chalk mud, but is clear to 1,210ft. A temperature of 79° Fahr. was found the other day on lowering a thermometer to the bottom, the surface temperature being 49° Fahr.

Attention is being given in various quarters to improvement of air-pumps (partly, no doubt, because of the growth of the incandescent system of electric lighting). In an improved form of the Geissler pump, by Herren Goebel and Kulenkamp, the movable mercury vessel is connected by means of two flexible tubes, instead of one, with the fixed one. When the former is raised, the inclosed air is driven through a valve at the top of the fixed vessel into a tube, from which the mercury in excess flows back through the second flexible tube to the movable vessel. The closure of the valve is worked with residual mercury. In a new double-action air-pump of Signor Serravalle, two vessels of mercury, connected at their lower parts by a flexible tube, are worked alternately up and down on opposite sides of a wooden support. Their tops have three-way cocks worked automatically—one of the ways leading into a small vessel for excess of mercury, and another into a tube, by which each vessel is connected with a small hollow sphere at the middle of the stand, which sphere is connected with the space to be evacuated. In a recent paper to the Russian Physico-Chemical Society, M. Kraievitsch says the tension of mercury vapour depends only on the temperature, and insists on the value of low temperature in rarefaction. He procured a Geissler tube fitted with a cylindrical appendage and emptied of air by the same means as water-hammers. At ordinary temperature it gave only a luminous line during electric discharge; but when the appendage was cooled, the line widened, and at—20° or—25° C., it took the appearance of stratified light. In the Töpler-pump, he adds a small reservoir at the top of the drawing-off tube: bubbles conveyed by the mercury, but too small to be carried to the end without attachment to the tube, accumulate in this reservoir, and may be removed by a stronger current of mercury.

The causes of impoverishment of soils as regards nitrogen have been made a subject of experimental study lately, by M. Deherain, at Grignon. He finds that the quantity of nitrogen removed by successive crops of maize, potatoes, wheat, &c., is but a small part of the nitrogen that disappears. On the other hand, a piece of land bearing the nutritious fodder called sainfoin, instead of growing poorer in nitrogen, acquires more of it. The essential difference in the two cases is that one involves large disturbances of the soil by ploughing, &c., whereas in the other the soil is let rest. In the former case, oxidation is favoured; in the latter it is not. Thus, M. Deherain, noting the constant coincidence in loss of the soil in nitrogen, and its impoverishment in carbon, concludes that the losses in land often moved are due to exaggerated nitrification, continuing while the land is deprived of crops. A practical consequence is that soil is better enriched by keeping it as a meadow, than by lavishing manure on it.

La Nature states that, on the French coast in the Channel, where the tide has a mean range of about 37ft. (in some cases it amounts to 56ft.), tidal mills are used at various places. They are favoured not only by the range of tide, but also by the long estuaries of irregular border at the mouths of the unimportant water-courses (which have no proper current). The dams are small and badly built. The motors are generally water-wheels, which are immersed at high tide, and begin work when the tide is half-way down; none of them are arranged to work with the flow of the tide. The principal work done by the mills is the grinding of wheat; some drive small saw-mills, or manufactories of artificial cement. The useful effect hardly reaches 30 per cent. It seems that the system might be greatly improved. The writer in *La Nature* calls attention to the topography of the port of Saint Jean, which is about midway in one of those estuaries, and where there is a large natural reservoir, capable of storing, every 12 hours, 16 million cubic metres of water. Vessels might be allowed passage during three hours at full tide. Six hours' tidal work might be had easily. A turbine, which would work when immersed, and both in ebb and flow, would appear to be most suitable. At present, the idea is of little advantage, owing to small use for the force in that region; but, with improved electric transport of force, it is thought, a tide-mill at Saint Jean might be of great service to neighbouring towns, such as Dinan, Saint Malo, Dinard, &c.

A case recently reported by Prof. Nothnagel in a German medical paper is supposed to afford some light as to the nerve-centres of thirst. A groom was kicked in the abdomen by a horse, and fell, striking the back of his head. He was stunned, but not made insensible. Half an hour after, he began to experience extreme thirst, and this persisted during the 18 days he was in the hospital. Pain in the back of the head, increased by pressure, was a prominent symptom; but it lasted only a few days. Apart from this injury, there was nothing in the case, as fever, diarrhœa, or vomiting, which would cause the thirst. Any excitation of nerve-ends of the palate and fauces, considered by many a cause of thirst, is excluded; and the nature of the injury points directly to a central disturbance. The pain indicated some posterior part as the seat of disturbance. Severe pain in the back of the head and neck is specially noticed in disease of posterior parts of the brain—e.g., the medulla. A sensation of the necessity of air, it is noted, may occur in course of a disease of the medulla, without the lungs being any way affected. In the case of thirst arising from excitation of the outer ends of nerves, we must suppose the influence transmitted to a centre, and there appears to be no difficulty in supposing this centre affected directly.

A new law, similar to that of Avogadro, has lately been developed by Herr Grosshans. It is that, "At the boiling-points the densities of bodies are proportional to the respective sums of their atoms." He deduced it from the consideration of bodies composed of H, C, and O. It is applicable to two states—the liquid and the gaseous, and the same behaviour is observed at corresponding temperatures (as well as boiling points). In extending the law to other compounds, the number n (atom sum) has to be modified in a certain way, and the author has calculated for a number of elements this modified n, which he denotes as a physical constant for the element in question, with the name "density number." In the case of aqueous solutions, $n = 3A + B$, where B is the density number of the dissolved body, and A the number of water molecules (see *Wied. Beibl. II.*)

Töpler's principle, according to which all light-rays from a point that are regularly refracted in a lens, are cut off by a slide, so that only those rays remain which have undergone irregular refraction, has been recently applied by Herr Seibert to the microscope. The central screen, directly under the object-carrier, is of semicircular form. A real image of it is produced, in the plane of which, with an opaque slide, the image may be reduced to a fine line, or wholly. All parts of the object, which have a greater or less refractive power, then appear bright on a dark ground.

Hitherto, it has been supposed that the hardening of lime and hydraulic cements is due to the hydration of silicates and aluminates of lime, which are formed in burning. Recent observations by M. Landrin, however, lead him to attribute it to the presence, in all hydraulic compounds, of an allotropic variety of silica, which he calls *hydraulic silica*. He prepares this silica either by decomposing silicate of potash with concentrated acids, or by extracting it directly from Theil's limestone, by treating with very dilute acidulated water. Hydraulic silica, with lime, furnishes mixtures which harden under water; at the same time, this silica, originally insoluble in concentrated hydrochloric acid, becomes soluble in it under the influence of lime. Immersed in the water of lime, it removes this water, slowly absorbs the lime, and hardens. M. Landrin has also shown that aluminates of lime are at least as soluble in water as plaster, and consequently, that they play an essentially injurious *rôle* in the final hardening of hydraulic materials.

The results of experiments on the apparent contraction of stretched caoutchouc under heat, have not shown whether this occurs in all directions, or only in that of the stretching force. M. Lebedeff finds that the latter supposition is the correct one. In a first experiment, he determined the density of a thread of caoutchouc wound round a small frame furnished with a screw, so that the length of the thread could be doubled, or the tension entirely removed; the temperature of the water varying from 15° to 35°. The results being unsatisfactory, he made a sort of thermometer, with reservoir formed of a long tube of caoutchouc, which could be stretched and heated in a water-bath (from 15° to 41° C.). The level of water in the capillary tube always fell when the temperature was raised. When the tube was stretched, the phenomenon was even more marked.

A GERMAN brewer in Nevada, having heard of the lime process for mining coal, proposes to use *yeast* as an agent for rending rocks. He has in his experiments blown strongly-hooped casks to pieces, and forced out one end of his brewery. He desires to make experiments in the Comstock mines, the heat of which will set up fermentation the moment the yeast charge is tamped, which will soon become so active as to overcome every resistance.

LETTERS TO THE EDITOR.

◆

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

ERRATUM—CASSINI'S DIVISION IN SATURN'S RING, AND THE SEPARATING POWER OF A TELESCOPE—SPECTRUM OF PETROLEUM FLAME—SPECTROSCOPE FOR A 9in. REFLECTOR—MR. COMMON'S GREAT REFLECTOR.—THE COMETS OF 1811 AND 1812—THE "TIMES" ON SOLAR PHYSICS—EARLIER VOLUMES OF THE "ENGLISH MECHANIC," AND LATER "DISCOVERIES"—GREGORIAN TELESCOPE—TESTS FOR A 2in. TELESCOPE—JOSHUA COMMANDING THE SUN TO STAND STILL—THE RED SPOT ON JUPITER—CALCULATION OF ECLIPSES AND OCCULTATIONS—SPECTROSCOPIC WORK IN MADEIRA.

[21004.]—IN letter 20953, p. 451, column 1, line 28, "observers" should be observer, and the comma should be placed after the name "Burnham."

I must begin by setting Mr. Hanneford (letter 20958, p. 452) right as to a matter of fact. If he will turn to p. 43 of Vol. XVI. of the R.A.S. *Monthly Notices*, he will find the results of an elaborate series of measures of the Saturnian System by Mr. De la Rue, in which the breadth of the principal (or Cassini's) division in the ring is given as 1·88" a quantity differing very materially indeed, from any one which can be legitimately described as about "half a second." But, even were the division narrower than it really is, the light from Saturn's ring is very much less brilliant than that from a star, and is, moreover, diffused and not concentrated in a point, so that nothing akin to the encroachment of the two spurious optical discs of a close double star occurs in viewing it. Added to this, a line is perceptible where a disc having that line's width for its diameter is wholly imperceptible. But, even taking all these considerations into account, the story of the observation of this division with 1¾in. of aperture is a strange one. Of course, as my querist so saw it, I believe it; but I should not have believed it had I seen it myself. I may mention, too, as a detail, that the separating power of a telescope is obtained by dividing 4·56 by the aperture in inches—not the aperture in inches by 4·56. As for the lines Mr. H. sees with his spectroscope in the petroleum flame, they do not belong to hydrogen, but to some hydro-carbon. I have never seen one of Horne and Thornthwaite's miniature spectroscopes; but any spectroscope ought (if in proper adjustment) to show the stellar spectra with a 9in. reflector. If Mr. Hanneford's object be merely to see spectra of stars without measuring them, he will find McLean's star spectroscope singularly simple and effective in use. I have not heard of any discoveries in Saturnian detail having been made with Mr. Common's great reflector. Our *Monthly Notices* contain accounts of various observations made with it. Mr. Common has used it for celestial photography with most admirable results; a recent really marvellous photograph of the great nebula surrounding θ Orionis being among them.

A Coddington lens would be as unobjectionable a form as any for a very high-power single-lens eyepiece; but I should advise your correspondent to stick to the Huyghenian eyepiece as affording all the power that can ever usefully be employed.

I do not know apropos of what allusions have been made in these columns to "the Great Comet of 1812," as stated by "H. O'B." in query 49270 (p. 464); but the solitary comet which appeared during that year was discovered by Pons on July 20th, and its tail was only 2° long. Its orbit, as calculated by Encke, was elliptical, and it had a period of 70·68 years. If the computed elements were correct, it ought (neglecting possible perturbations) to come into perihelion again about the 19th of next May. What is it that "H. O'B." wishes to know about the Comet of 1811, beyond the fact that it had a period of 3,065 years?

I welcome, heartily and sincerely, an article on "Great Sunspots" which appeared in the *Times* for January 23rd. It has been, upon several occasions, my unpleasant duty to invite attention in these columns to the manner in which those of the (so-called) "leading journal" have been misused for an impudent system of advertising, under the thinly-veiled pretence of instructing the public on the subject of solar physics. It is, then, a real pleasure to me to find the contributor to your contemporary approaching that subject, on the present occasion, in a strictly scientific spirit; and giving really sound information without any *arrière pensée*, or open or covert commendation of himself and friends to the national liberality. It is intimated, truly enough, that problems of high scientific interest in connection with the physical constitution of the Sun await solution; but it is no longer insinuated that if a costly and lavishly-endowed Solar Physical Observatory were instituted, and that "celebrated astronomer," Mr. Smith (let us say), were appointed its director, that the weather would, in course of time, be unerringly foretold; and that shipwrecks, famines, and commercial panics might soon be predicted with practical infallibility. On the contrary, the writer says definitely: "But the rain and wind cycles, the famine and financial crisis periods, the recurrence of disasters and shipwrecks, bad vine years, and so forth, in harmony with the sunspot waves—these have not yet been established." Nay, he goes on further to notice, with quite judicial impartiality, how, in the extraordinary diversity of our terrestrial meteorological conditions, any and every advocate of the most diverse theories must find perfect corroboration of his or their particular ideas. Would that the subject of Solar Physics had been brought before the public, *ab initio*, in this tone and temper. It would have spared the necessity for a good deal of energetic denunciation of something undistinguishable from a demand that astrology should be subsidised by the State in the XIXth Century. In one sense, though, it might have involved a philological loss; inasmuch as the English language would never have been enriched by the word "Sunspottery"!

With reference to the very pertinent letter (20980) of Mr. Buffham on p. 476, I would remark that the "discovery" to which he invites attention is by no means the first or only one that has been "first announced some years since in the ENGLISH MECHANIC." Any one who may happily possess a complete series of your wonderful Encyclopædia will find, on the perusal of its back volumes, that a good many other recent and cognate "discoveries" have been anticipated in these columns. I sometimes wonder at the folly of advertisers who announce complete sets for sale. I do not think that my own scientific library would suffer much from comparison with those of a very large proportion of my brother readers; but it contains but few works, indeed, that I value more than I do my series of the ENGLISH MECHANIC, extending uninterruptedly from No. 1 to No. 931.

Has "Puzzled" (query 49289, p. 486) taken the precaution of so mounting his two mirrors that they may be separated by an interval of something more than 21in.?

"J. R." (query 49319, p. 487) may congratulate himself on the possession of a really good 2in. object-glass, if it will fairly divide γ Leonis. Of course, the division of close stars and the perception of faint *comites* are two very different things. The companion to Vega is certainly out of his reach; but he ought to see the acolyte of the Pole Star, and, *à fortiori*, that of Rigel, on a sufficiently fine night. As I have tried to explain above, the power to see Cassini's division in Saturn's ring does not depend upon what is ordinarily known as the separating power of the objective at all. As tests for the latter he may try 11 Monocerotis, λ Equulei, ζ Orionis, ξ Ursa Majoris, &c. These are at the very limit of his optical capabilities. He had better consult your back volumes, too, in which he will find numerous tests for instruments of every aperture, that of his own included.

I am not myself a Jew, but perhaps may be forgiven for counselling "Nun. Dor." (query 94324, p. 487) to accept the interpretation of the passage to which his question relates put upon it by (int. al.) Jahn among the Roman Catholics, and the late Dean Milman among English Churchmen; the former regarding it as a sublime poetical trope, and the latter speaking of it *totidem verbis* as "pure poetry." The standing still of the Sun and Moon means, of course, the arresting of the Earth's diurnal rotation. To say nothing of the cosmical result of this, its obvious immediate effect must have been the projection of everything on the Earth's surface into space with an initial velocity varying as the cosine of the latitude; objects at the equator being flirted off (like water off a mop) at upwards of 1,037 miles an hour, while the Gibeonites and

Israelites, in lat. 31° 51′, would have been propelled at the comparatively moderate, but still abundantly sufficiently destructive, rate of 881¼ miles an hour. I don't fancy that the fight could have persisted long under these circumstances.

If "F. T." (query 49340, p. 488) will turn back to letter 20610 (p. 134), he will find that the rapid paling of the once so conspicuous red spot on Jupiter is a very old story by this time.

"Archimedes" (query 49353, p. 488) will simply need a competent acquaintance with spherical trigonometry, and familiarity with the use of logarithmic tables, to make the calculations to which he refers. They are terribly long and tedious, notably in the case of Occultation and Eclipse work.

That somewhat erratic genius, the Astronomer Royal for Scotland, has recently produced, under the title of "Madeira Spectroscopic," a work of the greatest interest and importance to all interested in Solar Spectroscopy. It is the outcome of a series of most painstaking observations made by the author at Madeira during the summer of 1881; the spectroscope employed being furnished with a superb Rutherfurd diffraction grating and a powerful collimator and observing telescope. Prof. Piazzi Smyth wisely, as I think, confined his researches to a comparatively limited portion of the spectrum, with the result that his attention being thus concentrated on a region of relatively small extent, he was enabled to map the selected portions in a manner as remarkable for its beauty and mass of detail, as for its truth. In each of his plates he gives typical representations of the region he is describing arranged in chronological order. To take plate I. as an illustrative example. The top division shows the preliminary band of great A in the Red, as mapped by Sir David Brewster and Dr. Gladstone in 1860. Beneath this is its map as delineated by Kirchhoff and Professor Roscoe. Then comes the map of the Royal Society of 1875. This is followed by Captain Abney's photograph, which is itself succeeded by the splendid chart constructed by Professor Langley at the Alleghaney Observatory, U.S., in 1878. Finally, two of Professor Smyth's own, equally beautiful, drawings form the remainder of the plate. And so on through 17 plates to the "Near G," or violet hydrogen region: the concluding or 18th plate of the volume representing in a very striking manner the distribution of the spectral colours. It is impossible to give even a *résumé* of so important a work, or of the conclusioos drawn by its author, within the limits of a paragraph in a letter like this; so I can only say here that the results arrived at by Professor Smyth with reference to the terrestrial, or extra-terrestrial nature of certain groups of lines, deserve the most serious attention on the part of spectroscopists. It may not be unworthy of notice that the Scottish Astronomer Royal speaks with the most withering contempt of the Spectral Map of the Royal Society of 1875; nor (judging from the poverty of the fac-similes of it, which appear on page after page of his book) without reason. The contrast between their scene-painting style of delineation and the exquisite reproductions of Professor Langley and himself, must strike the eye of everyone who glances at a single one of the illustrations. Every one interested in spectroscopic work should obtain this beautiful volume. It is published in Edinburgh, by W. and A. K. Johnston.

A Fellow of the Royal Astronomical Society.

DIVIDING POWER OF TELESCOPE.

[21005.]—Referring to the visibility of the chief division in Saturn's rings with a small aperture, I think the remarks of "Amateur" (20984) are likely to mislead in saying that the reasoning respecting the "spurious" discs of stars does not apply to the planet. Would not the visibility of the division be due rather *to the small intrinsic brightness of the planet as compared with a star!* With the latter the brightness is supposed to fade gradually from the centre to the first dark ring. This is why a faint *dusky* division may be seen in a close double star of *high* magnitude (with a given aperture), when a *brighter* star of the *same* distance seems only an oval blotch of light. **Herbert Ingall.**

Champion Hill, Jan. 26th.

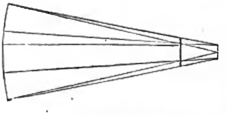
SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[21006.]—Thanks to "A. S. L." (20982) and "F. M. C." (20983) for their letters. We are now, I think, in a position to state the sizes of flats which are required for different purposes. I would premise, in reply to "A. S. L.," that the object is not to find the flat which is large enough for large images, and therefore will suffice for small ones; but to ascertain how small the flat may be, to reflect perfectly the image which you are observing; and to "F. M. C.," although the double stars are not absolutely a point at the focus, the question is, does their being otherwise affect the size of the flat?

Taking the formula of "F.R.A.S." (Dec. 8), and the sun and moon to be 32′ angular diam., we have for 9ft. 3in. focus, an image at the focus 1·033in. Jupiter having diam. 44″ gives a focal image ·0236in.; Saturn, with 18″ diam., an image ·0097in.; and Rigel, with *comes* 10″, ·0054in.

With Mr. Vallance's 15in. mirror, 8ft. 4in. focus, the focal image of the sun and moon will be ·9308in.

We will take first Mr. Vallance's 17¼in. mirror, 9ft. 3in. focus. When viewing the sun or moon with the flat at 11¼in. from the focus, he will require one 2¾in., and his 2in. flat will reduce the size of his mirror to 10¾in. (see fig.), which I have



drawn not to any proportion, but simply as an illustration.

In this we have represented—1st, the flat which is necessary when the focus of the cone is a point; 2nd, that which is required when it is a measurable image; and 3rd, the effect which the small flat, under these circumstances, has on the size of the mirror.

My own 12½in. mirror, 9ft. 3in. focus, requires, at 12in. from the focus, a flat 2 5/16in.; so that Mr. Calver, in sending me a 2¾in., supplied, as "F. M. C." says, the right one for a maker to send with an instrument. My 1¾in. reduces the size of my mirror to 9in.

Mr. Vallance's 15in. mirror, 8ft. 4in. focus, has a cone, the diameter of which (supposing the focus to be a point such as is observed in the day-time when looking at the sky through the adjusting eyepiece) is 1½in. at 10in. from the focus, and 1¼in. at 8¼in. To observe the sun, moon, or star cluster of the same size, 32′, he will require a 2¼in. flat at 10in. from the focus, and his 1½in. flat reduces the size of his mirror to 6½in.

These sizes are taken from measurement, and not from calculation; but I believe they will be found about correct.

In viewing Jupiter, Saturn, or double stars, however, the case is different. The focal images are virtually points—that of Jupiter being only a fraction over 1/40 of an inch; so that if the flat has a little margin—say, ¼in. or ⅛in. larger than the cone of rays, as observed when adjusting in the daytime, it will be amply large enough, and the very valuable part of the mirror preserved.

I would also mention that, although the loss in looking at the moon seems to be so great by reducing the size of the mirror, yet when observing an individual object, such as a crater, &c., you have here a virtual point, and all the advantages to be derived from a small flat. My impression of the nebula in Orion is, that it is decidedly finer through the 1¾in. I should not part with my 2¾in., though I should only use it on special occasions, when I wished to observe large objects simultaneously—i.e., at one glance.

Fordingbridge. **T. Westlake.**

[21007.]—As to the remark in letter 20900, "that the flat should be large enough to reflect the image of the Sun," it is not "erroneous" as therein described. The flat ought, and must be, large enough to gather all the light that can be sent to it. Also that "the longer the focus the larger the flat ought to be" in this case. The fact is, the longer the focus the smaller the flat is. The size of a flat depends upon three things: diameter of mirror, focal length, and diameter of sun's image, also the distance of the flat within the focus. The ratios of these conditions vary with each mirror. The point I maintain is, that a flat just large enough to take cone of stellar rays is too small to take cone of solar rays, and is not the correct size.

First take three mirrors, each 8ft. focus, and 6in., 12in., and 15in. diameter; the same sized flat will not suit the whole three stellar rays, or rays converging to a point. The flat to be same distance within focus in each case—say, 10in. Now look at Fig. 1. The flat at A is just large enough for 6in., evidently too small for 12in. or 15in. This clearly proves that focal length does not alone decide size of flat.

Next take any mirror, Fig. 2. Let the flat A be large enough to catch stellar rays coming to a point at F; it is manifestly too small to catch the solar rays which come to focus over a visible surface at F. How, by any possible theory, can the flat A be large enough to catch all the light the mirror can send to it.

How does Mr. Vallance prove his theory that the longer the focus the larger the flat. Suppose Fig. 2 to be 16ft. instead of 8ft.; would not the angle A be smaller in that case, and the flat consequently less?—the mirror in each case being the same size.

FIG. 1.

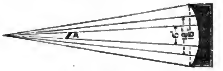
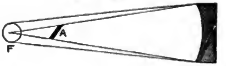


FIG. 2



My opinion from a practical point of view is that this small flat theory is like "straining at a gnat, and swallowing a camel."

What is the loss of light sent to the mirror by the interposition of the flat, or rather the difference between two flats to take in stellar and solar rays? Take a 15in. mirror and 1½in. flat, area of mirror 176¾in., area of flat 1¾in. Suppose a 2in. flat necessary, its area 3 1/16in.; difference of area of the two flats 1 5/16in., in 176¾in. Now, is this loss of light practically worth all the fuss that is made about it?—especially when it is taken out of that part of the mirror where you can best afford to lose it; and the larger the mirror and flat, the less the loss of light in proportion.

The size of focal image depends upon the focal length only, the size of mirror being immaterial; but the amount of light condensed into the image does depend upon area of mirror and flat conjointly. In Fig. 1 the image will be the same size for each, but the light and detail will be very different.

My humble advice is: Have the flats large enough to catch every ray the mirror can send to it, whether from the stars, sun, or moon, and then you will not have it too large. I assert that a flat in one fixed position, that will just take in the cone of stellar rays, is too small to take in the whole of the solar rays, and I challenge any one to prove to the contrary.

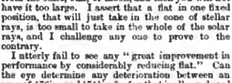
I utterly fail to see any "great improvement in performance by considerably reducing flat." Can the eye determine any deterioration between an area of 176in. and 174½in.?—for that is all a reduced flat amounts to, provided the lesser flat gets all the light. I trust I have been able to show that this "fight of the flats" is only splitting hairs for no possible advantage.

Newcastle. **John S. B. Bell, C.E.**

[21008.]—Mr. Vallance contends that a plane that is large enough for stars is also large enough for the moon, and he asks to be corrected if wrong. Of course he is wrong, and the following ought to convince him.

The image of stars at the focus of our mirrors has no diameter, practically it is a point; while the image of the moon may be ⅛in., ¼in., or more, according to the focus; consequently the diameter of the cone of rays when observing the moon is larger at every part than when we are observing a star. Therefore, the plane that will just take the cone from the star, will lose some of the cone from the moon.

If Mr. Vallance will find out the exact diameter of the cone where he wishes to place his plane, and add for every foot of focus ⅛in. to such diameter, it will give him the exact size of the plane needed for



the moon; but he had better add ⅛in. Example—suppose a 12in. mirror of 6ft. focus, a 2in. plane at 12in. from focal point will *just* do for stars, but for the moon it must be 2⅜in., better 2⅝in. The sketch—where the outer cone represents the rays from the moon and inner from star—will show him. The lines B B represent (exaggerated, of course) the course of the rays from the moon, and form an image of a sensible diameter at C; the lines A A the rays from a star focussing to a point; the plane P just takes them in: the rest of the rays are lost through the plane not being able to receive them. Will Mr. Vallance kindly say where this sketch is wrong, and send us the correct drawing? We shall understand a sketch better, and see which is right. He is not to the point in suggesting planes large enough for larger objects than the moon; he might as well talk of observing whole constellations at once; the mark is rightly drawn by providing for such general fields and objects as the Moon and Sun. Neither is he to the point in his question to "A. S. L." It is not a question of what goes to the mirror; it is the size of flat for collecting what *comes* from it. Neither has the size of the image, as given by a small portion of the mirror or flat, to do with it. Cut off much of the plane, the size of image is the same; but do we utilise the whole of the mirror? I hope this may satisfy Mr. Vallance.

G. Calver.

SIZE OF FLAT IN NEWTONIAN TELESCOPES, AND EQUIVALENT FOCUS OF CASSEGRAINS AND GREGORIANS.

[21009.]—IN my letter on page 476 I notice a slight printer's error, which, however, alters the meaning of the sentence—"Mirror diameter of the flat," should read "*minor* diameter of the flat," &c.; also for "frustum" read "frustrum." As regards equivalent foci, will "A. N. H." do me the favour to run through my letters on this subject on pages 205, 317, and 406, in connection with the rule given in his letter on page 477? By the formula given on page 406 the focus in his example would come out considerably less than what he has deduced, and I should be glad to know which is right.

I do not think the vertex of the mirror could ever (practically) coincide with the position of the focal image, so that it seems more reasonable to employ rules which are applicable to the actual circumstances of the case, even if somewhat less convenient. This (as I pointed out before) seemed to diminish somewhat the accuracy of the formula originally given by "Orderic Vital," who also assumed the focal point to be at the vertex of large mirror. Would the correspondent just mentioned kindly inform us what curve the convex mirror should be, if (as in the instance quoted by "A. N. H." from Mr. Calver's practice) the concave is ground to an elliptical curve? I find, on referring back to his letter on page 206, that this case is not alluded to.

A. S. L.

[21010.]—As "A. S. L.," in 20982, has introduced the stops in the refractor, in illustration of the necessary size of flats in the reflector, I will ask him to notice that the optician in placing them cuts off all light but that proceeding from the object-glass to the eyepiece, not making any allowance for size of image of sun or moon or anything else. Just so, I contend that if the flat will reflect all the parallel rays that fall on the mirror into the eyepiece it is quite large enough, and a larger flat will do no more.

Even if a larger flat gave more light when looking at the sun or moon, what is the benefit? The light is too great with the smallest flat, and surely 'tis a needless expense to have a large flat to give more of that. But I believe you get no more light into the eyepiece, let the flat be ever so much larger.

Philip Vallance.

THE TELESCOPE, &c.

[21011.]—I SEE that Mr. Wray (jun.) has joined "Prismatique" in writing against the reflector; but do these correspondents think it can be talked down? if it has good merits it will outlive biased comments: if it has none, it would die a natural death. These correspondents appear to think it is not dying.

The scare-crow statements about the silver, non-permanence of adjustments, &c., have been made over and over, and, as often, by those who are familiar with them, shown to be over-strained exaggerations—they are stale and worn out.

I have left my productions to take care of themselves, relying on their merits in the hands of those who use them. I have had nothing to say against refractors. I think those who write about reflectors should neither make unjust nor absurd statements; not but what such a course always refutes and exposes itself. Still we are duty-bound to be fair towards each other.

I will leave Mr. Wray to his opinion on the taste or judgment, &c., of those who take to reflectors—"using them because they are cheap"; but I am not sure whether the wording of some parts of his letter is well chosen or considered.

He credits reflectors with one merit only—cheapness; but what will it avail of his calling them cheap and nasty, while the perfectly disinterested observers tell him they are cheap and good?

Mr. Wray concludes his second paragraph by telling us that "the reflector will have decayed and become useless when the achromatic made same time will be unaffected." Did he write this absurd statement to court our smiles? or does he not know that reflectors are not now made of speculum metal, as in the days Mr. Wray had to do with them; but are made of the same material as o.g.'s, viz., glass? If he had a wish to say something damaging he would have been more consistent to have said something with a shadow of reasonableness—something explainable—because it must be beyond the understanding of most persons to know how the reflector, made of the same material, is to "decay and become useless," while the o.g. remains unchanged? I hope this doleful little ditty of Mr. Wray's will not seriously affect the spirits of "those gentlemen who use them."

To take the best view of it, I will suppose Mr. Wray really does not know of what the mirror is made, or under what conditions it exists. It is this: The mirror is made of *glass* (harder than that of which an object-glass is made): there is only one optical surface (if he will allow such a dignified name); this surface does not at any time require to be wiped of dew during observations—or from dust These "deteriorating" influences are absent from the glass surface. This surface is chemically coated with silver, and lasts from two to 16 or more years, according to care and circumstances. This item *care* is also "cheap." It consists in keeping the mirror covered when not in use.

Now for the "deteriorating" and "continual" business of cleaning for resilvering, which our friend "Prismatique" has so exaggerated upon. It is done this way: A mop of pure cotton wool is wetted with nitric acid, and the silver is moistened with it and instantly dissolved. Friction does not help the acid to dissolve it. Even if it was required, there is nothing softer than cotton-wool; indeed, quite as soft and clean as the oft-used wash-leather used for the o.g.

It takes at most, say, a few seconds to dissolve the silver; the surface is then rinsed with plenty of water, and sponged once or twice over with another and fresh small handful of cotton-wool; it is then ready for another coat of silver, which seals it again from even the atmosphere for a like period.

Now, after this careful explanation, Mr. Wray cannot be, as before, supposed not to understand the details, and we will now ask him to explain to us the rapid "decay" and "useless" condition of the mirror, as contrasted with the comparatively everlasting endurance of the achromatic. I shall be glad of an explanation, because it will open my eyes to look out for something not so subject to "decay" as glass.

I would suggest also to "Prismatique," in the same good feeling I have to Mr. Wray, that he make good his case the next time he makes charges against the reflector, particularly when he is asked to explain. He stated that a 4in. achromatic was preferable to a reflector of 6in., which is over double the aperture. He was asked to explain *why*. This he did not do. If he had explained this and other matters he would have saved Mr. Holmes from concluding he did not much understand them. Mr. Holmes is not to be blamed for this conclusion, for he was influenced by "Prismatique's" own statements. Of course it is quite wrong to say a 4in. o.g. is superior to a 6in. mirror: and "Prismatique" ought to know it. This is really no fair comparison. Again, he said reflectors were "very well in large observatories, where there are assistants always in readiness to resilver them." I would ask him if his expression, "continual resilvering," can be reasonably explained to mean once in several years? He seems to think they want a fresh surface every week.

Another reckless statement was, "that the continual cleaning for resilvering deteriorated the surface"; and it appears that either he thought they were cleaned for resilvering by rubbing off the silver with rouge, or, having heard of Mr. Wassell saying that rubbing with rouge would spoil the figure, had unlawfully or inadvertently brought it forward as a fact to bear against them. Anyway, Mr. Wassell took this unlawful weapon out of his hands, and explained that the surface is "practically everlasting." I would like to observe also that those metal mirrors he helped in making which lasted only ten years were far from good metals, and do not by any means represent the duration of metal mirrors. I know of scores, many times older than ten years, in good condition. If the metal is good, they last for a long time, and they can be cleaned. I did not start this debate, and should have taken no part in it but for unjust and overstrained statements, and I don't see that such should go unchallenged. I wish to have nothing more to do with it.

G. Calver.

[This controversy—a very old one, by the bye—bids fair to degenerate into a squabble. We have no room for the recriminations of rival makers, and very little for anything more on the subject.—ED.]

REFLECTORS v. REFRACTORS.

[21012.]—WITH regard to Mr. Henry Wray's letter (20987), I think however valuable the opinion of a maker may be, he is necessarily prejudiced in favour of his own productions. Those who use telescopes of both kinds are the best judges of their comparative merits. Secondly, he appears to think cheapness an objection. This is admitting the reflectors are cheaper: purchasers, note this. Why does he think a glass mirror will decay and become useless while achromatics remain as good as new? Is not the flint portion of an o.g. softer and far more subject to decomposition than the much harder metal of which mirrors are made? His last paragraph admits that large refractors, are "things yet to be done," therefore the race stands, "reflectors first, refractors nowhere."

I do not think I know a person who has tried both and now prefers the refractor. I began with a strong prejudice the other way, but pure achromatism of image, power to use when refractor was dewed and useless, comfort in use, and evidence of permanence worked my conversion. I would only urge on all intending purchasers not to be rash.

Edwin Holmes.

[21013.]—MR. HENRY WRAY mistakes me. It is not necessary to have a personal acquaintance with a gentleman of Mr. Wray's eminence in order to become acquainted with his opinions; but if confirmation were required Mr. Wray supplies it in his letter 20987 by his adoption of all the objections of "Prismatique" *en bloc*.

Does Mr. Wray in his second paragraph wish us to understand his statements seriously, or has he only adopted the mode of expression he has because it is smart and telling? Does he think people make reflectors simply because they cannot make refractors, and use them only on account of cheapness? He appears rather to scorn cheapness, but why he should do so I know not, if performance does not suffer.

Will he excuse me in saying that his last sentence merely amounts to saying that a perfect 24in. refractor could be made if it could, but it cannot? As this is so, then as a perfect mirror can be made even of a much larger size, the reflector carries off the palm of victory. I want to ask one more question of Mr. Wray. Can even a 6in. object-glass be produced approaching the perfection of a 6in. mirror, or is not the outstanding colour offensive after using a reflector?

I thank "Amateur" (20984) for his attempt at explaining the difference betwixt separating a double star and dividing Saturn's rings; but I am obliged to ask if all telescopic and microscopic vision is not of the same nature, and if the image we perceive is not in the one case, as in the other, made up of diffraction fringes. I want to know on this point, and I see the drift of the explanation, but I cannot regard it as satisfactory.

Jan. 26. **John Hanneford.**

[21014.]—MR. HANNEFORD has received a well-merited rebuke in the manly and consistent statements of Mr. Henry Wray. Mr. H. Wray's statements are in thorough keeping with the experience of all those opticians who have worked among the two forms. As to 24in. o.g.'s, I, when in the North some years ago, saw through one by Messrs. Cooke." Mr. Grubb has made 27in. clear. I believe 40in. is now in course of construction. Mr. Wray, too, could make o.g.'s as big as they are good.

Prismatique.

[21015.]—WHATEVER be the relative merits of reflectors and refractors (a question which seems to crop up periodically and still remain undecided), the comparative cheapness of the former, compared aperture for aperture, with the latter, is, to the amateur of limited means, a strong point in favour of both beginning and carrying on astronomical studies with the aid of a good reflector. Some years ago I was, like many others, greatly prejudiced against reflectors of every kind, taking for granted all that was written against them from time to time. Having now, however, considerable experience in the use of both reflecting and refracting telescopes, I can speak with some degree of confidence with respect to both. My earlier knowledge of the stars was gained with refractors of 2¼, 3, 3½, 4, and finally 4¼in. apertures, the 4¼in. being now equatorially mounted in my observatory, and undoubtedly a good instrument. The desire for "more light" increased with each augmentation of aperture, and induced me to try the powers of reflection. From Mr. Calver I procured a first-class 6½in. mirror, and mounting it in the most inexpensive but effective manner, I soon found that, both in separating and light-grasping power, the mirror left the refractor far behind. Ever since, the reflector is my favourite instrument, and my 4¼ refractor stands comparatively neglected in my observatory save when used as a "finder," or for daylight views of Venus and Mercury. Still I would not wish to be without it, and I value it none the less, though I now observe with a good 8in. mirror, and with a 12¼in. when the nights are favourable for such large aperture. With regard to alleged difficulties in adjusting mirror and flat, they are very much exaggerated. It requires but a moment or two to put both in complete working order: a little experience and this difficulty vanishes to zero; and as to the deterioration of the silver coating, this too is exaggerated. A well silvered mirror I find will last, with care, for two or three years, and even when apparently mottled all over will still show out celestial objects with wonderful clearness and beauty. The process of silvering is so easy and inexpensive, that no amateur may feel alarmed to take all off when necessary and re-silver, and that without the least danger of altering the figure of the most perfect mirror, or injuring the surface in any manner whatever.

I have silvered, for experiment sake, dozens of times the same mirror, and never could detect the slightest change for the worse. I have no hesitation in giving it as my experience that a $6\frac{1}{2}$in. Calver mirror will give any real student of the heavens more light and better separating power on close double stars than any refractor up to $4\frac{1}{4}$in. aperture, be the maker even the very best. In refractors I have no experience of larger aperture, but the great cost of a first-rate 5in. or 6in. refracting object-glass, to say nothing of the greater expense in mounting, render it a matter of congratulation that Mr. Calver, With, and others have rendered the modern silver-on-glass reflector all that can be desired in an astronomical telescope.

Droylsden Rectory. **S. Mills, M.A.**

THE AMATEUR MECHANICAL SOCIETY.

[21016.]—I SEE, on p. 474, a report of a meeting that the above society has had, and of the result of a discussion about the amateur lathe-mandrel of the future. In the first paragraph it is stated that "An important report was then brought up by Dr. Edmunds upon the subject of screw-threads for the ornamental mandrel-nose, which are still screwed at the obsolete and inconvenient rate of 9·45 threads to the inch," that being the first count in the indictment; and secondly, that they "are so turned out at the base as to endanger their strength"; and then are mentioned two cases where the nose had been broken off, presumably from defect in strength.

Now, without asking whose report it may have been that Dr. Edmunds brought up to the committee, I wish to be made acquainted with the nature of the "inconvenience" that is supposed to arise from *still using an obsolete rate*—a slight contradiction, considering that the thread is still made and sold.

Now, in making the internal screw in a chuck to fit on to the nose of a mandrel—and mind, we are only discussing the suitability, for that sole purpose, of the 9·45 thread—there are, say, four ways or procedures in common practice.

Firstly, having bored out a hole in the "chuck," by striking the thread with the female screw-tool, and cutting up "flying," or by hand alone.

Secondly, by starting the thread with a tap, whose external diameter is about $\frac{1}{64}$in. greater than the boring-bit that is supplied for the purpose with this and the finishing plug-tap. Then, continuing the cutting as in the first instance, with the internal chaser, and then following the practice of all amateurs that have ever been born—viz., attempting to finish the screw in the chuck by forcibly twisting it on to the nose of the mandrel, instead of using the above-mentioned finishing plug-tap for the purpose.

Thirdly, in such lathes as have "pumping" or "traversing" mandrils (not *mandrels*, as it is a corruption of the French mandrin) the screw may be started at once under the influence of the "screw-guide," and afterwards completed as described under process "secondly."

Fourthly, with a tool in the self-acting screwing lathe.

Now, as my object in writing this letter is to prevent, or at any rate deprecate, the consigning to limbo of a very old and valued friend, on the sole ground that he is stated to be *inconvenient* and, as some say, *obsolete*, I wish to know in what respect the 9·45 thread is inconvenient. Certainly not in use, in any way that I can see, and I am not blind yet, and I did use one constantly from a time long before I left school, and for a period of at least 35 years. It must be, then, in the construction that it is so "obsolete, antiquated, and faulty, and inconvenient," that limbo is the only fit place for its manifold faults to be consigned to.

Now, taking that method of making the screw above called "firstly," next take "secondly," and then "thirdly"; can anyone point out any one respect in which the adoption of a thread of 10 to the inch is less inconvenient than the use of 9·45, as heretofore?

Now, as to "fourthly." The 9·45 thread is condemned, under "obsolete," and other endearing epithets. May I ask, Does it deserve it? It is *old*, truly, and so are the Arab numerals 9·45; but they are not effete on that account. Did it ever strike one of those who condemn the 9·45 to-an-inch thread, that it is not like the mètres, and grammes, and litres, that not very long ago we were near being obliged to choke withal; but that if you turn it into a vulgar fraction it is merely $9\frac{45}{100}$ or $9\frac{9}{20}$ threads to an inch, or $\frac{189}{20}$ threads to an inch, or $\frac{20}{189}$ths of an inch pitch, and that, unlike the mètre, it is perfectly commensurable with the inch?

I have some reason to think that the circumstance of Messrs. Holtzapffel and Co. having been in the habit of supplying with their sets of change-wheels, one of 53 teeth, for the purpose of approximating to the 9·45, giving 9·434, or thereabouts, has been the stumbling-block in the way of the amateurs, few of whom knew the use of the 53 wheel, and for many of whom nothing but mathematical accuracy (theoretically) will suffice; though I should be pleased, not to say amazed, to find a man among them who can fit a chuck to a lathe. I don't wish to deride their efforts, and I help them all round as much as I can; but I do say that I never yet saw a chuck quite well fitted by an amateur.

In order to cut 9·45 accurately, we must have one wheel containing the number 7, such as 21 or 63, which is 9 × 7, or 105, with any one of which it is easy to arrange a train; but I observe that the set of 15 wheels supplied by H. and Co. does not contain any multiple of 7, and therefore cannot cut a 14 thread.

The train that I use with a leading-screw of 8 to the inch is as follows, viz.:—

Mandrel.	Stud.	Screw.
32 —	27	
	40 —	56

but for a screw of 10 to an inch, either of the following will do:—

Mandrel.	Stud.	Screw.
viz., 40 —	27	
	50 —	70
or 40 —	21	
	50 —	90
or 50 —	105	
	100 —	45

or using H. and Co.'s numbers, which are mostly multiples of 6, we get

50 —	36		
	48 —	21	
		24 —	72

which gives a left-handed thread, and requires an idle wheel interposed on an extra stud. But a much better plan would be to have a 63 wheel = 7 × 9, instead of the otherwise useless 53, and then the train comes out very simple, thus:—

Mandrel.	Stud.	Screw.
50 —	36	
	48 —	63

and, moreover, 63 is a very good wheel to have, as it contains the number 3 twice over; or, in other words, is the square of 3 multiplied by 7.

As to leaving the neck of the mandrel larger than the thread of the screw, that is only running to the opposite extreme. It may be as large, but should be no bigger. Holtzapffel's noses are amply strong for all they ever were meant to do, and, as I said before, I used one for 35 years without its coming to grief.

Of the two cases mentioned in the report of noses breaking off, I know one pretty intimately, having had the pleasure of putting a new one in its place. It broke, not from inherent weakness, but from a large chuck into which the screw thread had been tapped crookedly, and which, consequently, bore on one side only, being caught by the hand-rest while the lathe was running, the result being, very naturally, a breakdown at the weakest place.

I may here mention that I recollect another case of another nose breaking off from the same accident many years ago, but in that instance I am sure the chuck was not a misfit, as it was the handiwork of one of the best men in England, from whom I got many of my early, not earliest, lessons, and was made, not for sale, but for his own use. I have a strong suspicion that if I looked into the other "reported" case I should find some reason for deciding that the fault did not lie in the mandrel. Also, let me point out that the adoption of the 10 to an inch thread involves just as many special appliances as, *e.g.*, a boring bit, taps, and chasing tools, as the 9·45 does; and, moreover, in the case of one who has an ordinary H. and Co. lathe for roughing out, and at length becomes the happy owner of a superior tool, the chucks from one lathe will not go on to the other.

Then, again, there is a practical objection to the use of a thread so fine as 10 per inch on a $\frac{3}{4}$in. nose; 9 is a much better number, and then we have Whitworth's bolt-thread, for which you can purchase a tap right away from Manchester for four shillings, and I should like to see the London lathe-maker who would supply such a tool to special order at anything like that price. I have a sort of recollection of ordering a pair of taps about that size and thread with a boring bit to correspond, from a country maker, and of the remarks that I felt bound to indulge in as to their price and quality. I remember the taps would not cut until I had annealed them and milled out the grooves wider and deeper, and the bit was so made that if it had been ground for cutting with the lathe running backwards it might have been made to work, but nohow else. I am strongly inclined to a coarse pitch on mandrels; indeed, I have often said that a plain bayonet fixing would suit well, equivalent to about a quarter-turn of a coarse screw of double thread.

The angle of H. and Co.'s deep thread, which has been spoken of several times as 50°, is, in that which I have, not 50°, but 45°, and I noted 45° as the angle of a 5in. Whitworth lathe belonging to a friend for whom I fitted a two-die chuck, as described and figured in the ENGLISH MECHANIC, Oct. 22, 1869, one of which I had had in use then for eight years, and have used ever since, to the entire exclusion of all kinds of American scroll chucks, and which, I confidently assert, has no equal. The last new-pattern dies that I have made to it take in discs up to 3in. diameter, and it will take solid rods from $1\frac{1}{2}$in. down to $\frac{1}{16}$in., and I use it constantly as a drill-chuck for all sizes. I have given the Britannia Company, at Colchester, full liberty to make and sell, but I suppose they cannot turn it out at a price to fetch the public. Making them singly, I consider about $5\frac{1}{2}$ guineas a fair price, but a company ought to be able to make them for half of that. **J. K. P.**

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—PYTHAGORAS.

[21017.]—DRINKS AGAIN.—"Anglo-Dane" is wrong in saying that I have unreservedly "condemned" tea and coffee as drinks. What I say is that strong tea or black coffee taken immediately after dinner is bad; that many people drink tea and coffee often when all that they need is a pure diluent, and that such habit is a bad one, and leads on to dyspepsia and various nervine disturbances, and to irritability and sleeplessness. But I think I said also that I often found myself in a difficulty as to finding a substitute for tea and coffee in those whom I found it injuring. It seems to me that at breakfast-time, on getting up with all one's sleep in one, and fully rested, one should not begin the day by taking a nervine stimulant such as tea or coffee. At breakfast time one wants a warm diluent drink and a meal of food to carry one on through the forenoon's work. Therefore, I think we err in using ourselves to strong tea or coffee at breakfast-time. At lunch or dinner, tea and coffee do not conduce to digestion, and the meal is better without them. As a diluent and solvent drink to be taken with the food, a glass of warm water flavoured with a little fresh lemon-juice will be found much more wholesome. But at the end of the afternoon's task there comes a distinct break in the day of any man who has done an honest seven or eight hours' work. Here comes the time for the pleasant and exhilarating bowl of tea, with some light food, a period of rest, and a little mental change. Tea thus taken will be more enjoyed than at any other time in the day; and, if taken only once in the day, it is very unlikely to fasten upon the system or injure it to any appreciable extent. The enlivening effect of the afternoon or evening tea carries one well on for the evening's amusement or occupation. Then, for those who take a midday dinner, at the close of the day comes a more substantial meal in the way of supper, but again best without tea or coffee. My own objections to a larger use of tea or coffee than this are based upon the nervine irritability, the irritation of the kidneys and bladder, and the indigestion which often follow. Green tea is much more injurious than black tea in its nervine effects. Green tea also contains more tannin than black tea—the tannin varying from 10 to 20 per cent.—but I do not recollect having based any argument upon the tannin thus taken. It must be recollected that the tannin of tea or coffee is not exactly the same substance as the tannin of oak-bark, and, without making special experiments, I am not prepared to say how far the coagulating effects of this tannin would be neutralised by the gastric juice. Indeed, the tannin of coffee (caffeic acid) does not precipitate gelatine. On this subject Mr. Allen is a great authority.

(49275).—Get personally examined and advised for your ailment.

DEPRAVED APPETITE (49321).—A rare affection, probably dependent upon some defect of the nervous system—not amenable to any very definite treatment. Restrict appetite to reasonable average quantity of food, and live largely upon vegetables.

NETTLE-RASH (49325).—Most probably due to indigestion or bad food. An emetic, consisting of thirty grains of powdered ipecacuanha, followed, when sickness commences, with copious draughts of warm water, to wash out the stomach, is the best remedy. A dose of castor-oil may follow, so as to clear out the bowels freely. In some cases, nettle-rash is a very intractable ailment, and, probably, due to some obscure nervous derangement, not definable and not amenable to treatment. Watchfulness as to food, and the avoidance of such foods as are followed by the nettle-rash, are the chief means of prevention. **James Edmunds, M.D., &c.**

Grafton-street, Bond-street.

THE SLIDE-RULE.

[21018.]—HAS "Gamma Sigma" seen Cherry's "Forget-me-Not Calculator?" which is a small handy card, 7in. by 3in., and yet has a radius of

100in., and consequently is much less obscure than many instruments. It is a slide-rule; but would be much improved if it were doubled in radius and had a duplicate of a transparent material, such as a gelatine card, as the slide. It is published at 31, Wills-street, Aston, Birmingham.

January 23. **Iota Pi.**

THE SLIDE-RULE.

[21019.]—In reply to Thos. Dixon (No. 21000, p. 480, Jan. 26, 1883), the slide-rule not being divided for *inches and fractions* for length, I cannot set it more than approximately for the dimensions he gives; but taking the length at 3ft. 9in., then on *inverted line* E to 17¾in. bring 13in. on upper line of slide to coincide: then *over* 3·75 on lower fixed line you find 6ft. and a *minute fraction* on lower line of slide, which remains intact for inspection, and which is correct. See working—viz.:

17·75
13

5325
1775

230·75
3·75

115375
161525
69225

144)865·3125(6 1·3125
864

1·3125

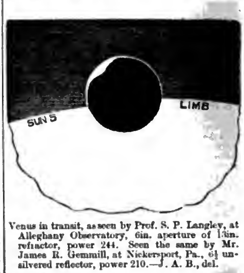
I beg to observe that what I stated as being a *desideratum* is an instrument, not complicated in action, that will read distinctly to five or six places of figures. I have no objection to any particular form of instrument that fulfils these conditions.

Gamma Sigma.

TO "PRISMATIQUE"—MR. CALVER—SILVERING MIRRORS—TRANSIT OF VENUS—DR. DRAPER—THE GREAT WASHINGTON TELESCOPE—PROF. ROWLAND'S DIFFRACTION GRATINGS, &c.

[21020.]—It seems so long since I had the pleasure of contributing to the pages of "our" journal, that I can no longer hesitate to respond to the numerous calls that have been made upon me, notwithstanding the fact that I am compelled to write while "bolstered up" in a sick-bed, where I have been laid up for a week. The number of December 8 has just been received and read, and I confess, in perusing its pages, I had almost forgotten I was an invalid. I am glad I never felt like a belligerent in discussing matters of our common interest, as I would be in a sorry plight now, for I confess I am not now feeling very belligerent. This, however, is not my nature, and I say, in all candour, my only reason for replying to my respected friend "Prismatique's" strictures on the colour test for flats was in simple defence of a method that is used by two of the foremost practical and theoretical opticians in the world—namely, Steinheil, of Munich, and Dr. Hastings, of the Johns Hopkins University, Baltimore. That Steinheil makes magnificent flats even the best French astronomers acknowledge, and I would say that I recently visited the workshops of the Johns Hopkins University of Baltimore, and found they were testing the flats for Prof. Rowland's magnificent diffraction gratings *by the colour test*, and although, as my friend "Prismatique" says, "there is danger connected with it," yet I think that danger is about as comparative as the relative merits of the refractor and reflector. I acknowledged that the objective test was all one could desire, and stated also that I had been kindly invited by Alvan Clark to test a 4in. prism in that way with him, he using at the time a fine 5in. objective. But herein lies the trouble when we come to the amateur of limited means. How is he to get the "objective" to test with? With the colour test he needs but three discs of ordinary plate glass, a very common and easily made tool, and then patience and earnestness, and I assure him he can produce flats such as the early professional optician never did make, unless by chance, and at a cost of about one shilling for the whole outfit; and I also say that the finest objective that was ever made could not detect errors in them if made according to the directions and answering the test required in the same. In regard to testing flats with an objective, I would kindly ask "Prismatique" if this does not hold good? Given an objective and a "flat" (?) and supposing there to be an error in one or the other of them, is it not impossible to tell in which the error lies unless one of them is *known* to be correct? Or, in other words, supposing you were testing a flat with an objective, and an error was seen, and suppose you had no previous knowledge of the accuracy of either of them, could you locate the error? I ask this not for argument sake, but from a desire to know, for I have recently been experimenting in that direction. I sincerely hope that all *hors du combat* arguments will be dropped by every contributor to "our" columns, for we can have our say without personal epithets or hard words of any kind. For my part, I love my pursuit too well to say aught against any one who will add even a mite to our knowledge of this grand subject. I know too well, in my early studies of the practical part of optics, how many rebuffs and unkind words I got from men whom John Phin calls *shopticians* when I asked them for advice. And now, after years of study and hard knocks, having learned some little of the *optician's* art, I find out that the shopticians did not tell me what I wanted to know, because they were ignorant of the facts themselves. I feel, then, much gratification when such practical men as "Prismatique," Mr. Calver, Mr. Wassell, and others take up and elaborate this work. Referring to the last way I named of making flats, I do not claim it to be new. Only an old way in a new dress. Just here, will "Prismatique" say whether he finds any advantage in washing over emeries that have been worked once. I note Wenham speaks very highly of "optician's mud," but I have never used any but newly and scrupulously washed emeries. In a valuable letter to me years ago by our dear departed Dr. Draper, he told me it was his plan to re-wash his emeries a *second time*, leaving them in suspension only a few minutes, so that any hard particles that might have escaped the first washing would be caught in the second. To show the value of this, I would say that my wife recently fined seven 6¼in., five 8¼in., two 9¼in., and two 12¼in. specula *without a single scratch*, which to me is something remarkable, though I must not give all the credit to the emeries, but a great deal to her *sensitive* touch, as every change of emery is rubbed down with the tip of the finger before the tool is put on the glass. Not one of these sixteen specula had to be re-fined. A word now about silvering mirrors. I thank Mr. Calver, Mr. Holmes, Rev. T. W. Webb, and others for the kind words said about the process I gave, and which seems to give general satisfaction. I have since tried very many processes, especially that of Mr. Common, in which he uses glucose as a reducing agent; but I have fallen back on the old process every time. Mr. Calver some time since advised the use of rock-candy instead of loaf-sugar in the reducing solution. I made up a batch in this way, but somehow did not succeed as with the loaf-sugar. Probably by reducing the amount of rock-candy, I would have had better results; but I now have such uniform success with the reducing solution, just as I gave it at first, that I use it entirely. Strange to say, I never have any trouble with the potash, generally using a little more than the amount of silver. The potash I almost always use seems to be excellent. It is imported from Germany, and I find the bottles marked, "E. Merck, Darmstadt." I never have what Mr. Calver calls a chalky deposit, unless there is some defect in cleaning. In fact, my mirrors come out so bright as to need scarcely any repolishing. Here's a hint I do not remember to have seen. If the silver is not sufficiently heavy when it comes from the bath, place it back immediately, before a spot has had time to dry, and leave it there until you have mixed up another bath of, say, one-third or half the amount used in the first. Raise the mirror out of the used bath, hold it face down, have an assistant, pour out the old bath, rinse it out (don't be particular about this part), pour in the new solution, and you will be surprised at the result of the second coat. If the mirror has not dried off in any part during the interval between the taking it out of the old and putting it in the new bath, the silver will deposit very evenly, and a splendid result is obtained. I recently silvered the mirrors of a Cassegrain, made by Mr. Calver, for the Alleghany Observatory, by doubling the film, and had a fine result. Professor Langley proposed to use it in measurements of the light of Venus on the side turned towards the Earth during transit, and required a very perfect film, so as to have no diffused light. Professor Langley was highly pleased with the silvering, though, unfortunately, he did not get to carry out his observations, from clouds obscuring the Sun after his other work was done. Here is another point I find good in this connection. After polishing silver films with a rouged pad, I find that an excellent way to get rid of microscopic scratches, made by even the finest rouge, is to use finally a new pad of very soft chamois, perfectly free from any polishing powder of any kind. I am about to undertake to put fifteen or twenty coats of silver on a flat I have made for Dr. Hastings, on which he proposes to rule a grating as an experiment. With Mr. Calver, I should like to know something of this new "commercial way of silvering"; I am about to try some new experiments in this line: the results I will give your readers.

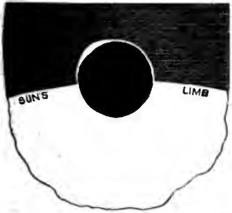
And now about the Transit of Venus. I give you an epitome of my own observations, as I was fortunate in seeing a phenomenon that, it seems, was not seen by many other observers, yet I am glad to say that the observers who did see it very closely agreed as to its existence and characteristics. The day promised poor, even "Old Prob," as we call the Weather Bureau, predicting rain. However, the day dawned with breaking clouds, and gave hope of a clear sky. I got two 6in. reflectors ready for use by taking silver films off, silvering lightly the front side of a long-focus concave lens placed in front of ocular as a Barlow. This gave the sun's image a cool pearly white appearance, perfectly easy on the eye. Chronometer and all accessories were ready, and a clear sky greeted first contact, which, however, was not well obtained by me. After the planet had entered on the sun's limb a close watch was kept for the first appearance of the atmospheric illumination around the disc of Venus. The planet had entered on the sun's limb about a quarter of its diameter when a glimmer of light was noticed on the upper left limb, as seen in the telescope. A brief period afterwards the light was seen encircling entirely around the planet outside of the sun; but at the point where it was first seen there was a much greater extension of the illumination,—as it were a kind of tidal swelling, which was seen extending for 25 or 30 degrees along the planet's circumference. So persistent, interesting, yet unlooked-for was this phenomenon, that I almost forgot to call time when to count chronometer beats, as it was not lost until it was absorbed in the overpowering light of the sun. At first internal contact the ligament was seen to break sharply and quickly off, and no appearance of a black drop was seen, except what some might call such, but which I traced as belonging only to the undulations of the sun's limb. The planet was observed for nearly three hours, when clouds put a stop to the grand spectacle. I was glad, indeed, to learn that not only had Prof. Langley, at the Observatory, seen the phenomenon, but his assistant, Mr. Keeler, also saw it independently. I have also received a note from one of your readers at Nickersport, Pa., who saw it almost exactly like Professor Langley, while my own observation accords closely with Mr. Keeler's. Dr. Herron, of Alleghany, one of your oldest subscribers in this State, had fine views of first and second contacts with a splendid Browning achromatic owned by him. I note that several other observers recorded that the atmosphere was not illuminated concentric with the planet while on the solar disc—notably Mr. Geo. Humphries, of Wilmington, Del. I offer no explanation of this interesting phase of the transit, leaving it to wiser theorists than myself. I append sketches of the phenomena.



Venus in transit, as seen by Prof. S. P. Langley, at Alleghany Observatory, 6in. aperture of 13in. refractor, power 244. Seen the same by Mr. James R. Gemmill, at Nickersport, Pa., 6¼ unsilvered reflector, power 210.—J. A. B., del.

I notice with great pleasure the remarks in your journal on our departed and loved Dr. Draper. I can only say that I found him the kindest of men; and never did I apply to him in my early studies for help but I received a kind and *satisfactory* reply, often at much greater length than his limited time would justify, and there was always a word of *cheer* and *commendation*. Oh, that the world had more such men!

As I may not be able soon to write again, I wish to say that I have had a pleasant trip among the observatories of the East, having an especially excellent time at Washington, where I was treated with the greatest kindness by Prof. Asaph Hall, who "turned the big telescope inside out" for my inspection. The objective was especially studied, and I was for the first time apprised of the fact that while the great telescope is A1 for work on *white* stars, it does not give good discs of *red* and yellow stars. Prof. Hall has recently published this fact in his late work on the "Parallax of α Lyræ and 61 Cygni." "Of course," said Prof. Hall to me, "on white stars the outstanding colour is very marked on such bright stars as α Lyræ; yet the spurious disc is so neat that it can easily and readily be bisected." I should like to know how such a star as *α* Lyræ looks with powers, say, of 400 or 500 in the Common 37in. made by Mr. Calver. At the Johns Hopkins University, Baltimore, I had the pleasure of seeing Prof. Rowland's ruling engine, by which so many fine flat and *concave* gratings are being ruled. One grating I saw was about 6in. long, 2¼in. wide, with 190,000 lines on it. Ay! but it was grand. I saw many fine photographs of spectra taken by it. I had intended visiting Princeton Observatory; but my time was too limited. Will I add in this epistle a word on "refractors *v.* reflectors?" I guess I had better not; I fear it will be an endless debate. I am glad to see in the number before me such generous words from "F.R.A.S.," Mr. Franks, and others, on the subject. The refractor will ever hold its place; but, alas, for the toiling amateur of limited means, when large apertures come into question! No, *not* alas!—the reflector is his friend, and does all it promises to do; and what it has done, will ever be to its honour. This is a long letter for a sick man to write; but I have not been sick while writing it —"I forgot that part." One thing I must add in closing, I would like to see the subject of "a cheap driving-clock" investigated in these columns. Not a "fluid clock," or a nondescript make-shift; but a *good, substantial, and cheap* clock, driven by weight. Who will be the first contributor?



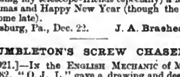
Venus, as seen about 10 minutes after first contact by Mr. J. E. Keeler, Alleghany Observatory, telescope 2in. achromatic, power 70. Seen the same by J. A. Brashear, Very Observatory, Pittsburg, Pa.; 6¼in. unsilvered reflector, with silvered Barlow lens in front of ocular, power 210. It will be noted that these four views were all obtained with different optical means.—B.

Wishing you, dear Editor, and all your readers, (including my telescope-friends especially) a Merry Christmas and Happy New Year (though the wish will come late).

Pittsburg, Pa., Dec. 22. **J. A. Brashear.**

DUMBLETON'S SCREW CHASER.

[21021.]—In the English Mechanic of March 10, 1882, "O. J. L." gave a drawing and description of Col. Dumbleton's screw chaser, which I have found to be a most serviceable little tool; and for the benefit of any brother-turner whom it may concern, I send description of an addition to the slotted frame, which I find saves time, and secures accurate fit. Its upper edge is V'd, to carry a brass and set-screw of this form. The long divisions are the exact distance apart of the diameter of cutter, the smaller $\frac{1}{50}$ths.



When the first thread is to be cut, either inside or out, and the cutter just grazes the surface of the work, the vernier is clamped with one or other of the long divisions *on*, with a mark on the carrier of pulley. The position of the centres for the other thread will, of course, be *on* with the other long division, less the depth of the thread of screw required, which is easily read off on the smaller divisions. The depth and clearance can thus be allowed for, and the second thread cut to fit without further trouble. **A. B. Cotton.**

Hartley Rectory, Alton, Hants, Jan. 18.

WHAT TO EAT, DRINK, AND AVOID.

[21022.]—I cannot help thinking that in a very large proportion of those who advocate total abstinence from liquor of any kind, it is a case of the fox without a tail. Their having lost their tails I can only account for by supposing that very often these writers are, or have been, among the few who have not been able to control their cravings for an unnecessary amount of drink, who could not trust themselves within sight of the bottle. But they must remember that, as I have before said—except among the lower classes—this is a condition which is almost unheard of nowadays. I think Dr. Edmunds rather illustrates this when he speaks of "'F.R.C.S.' and his usual glass of absinthe and sherry"; he seems to think that no one can talk of enjoying his wine at dinner without going to excess. I never tasted absinthe—and I detest sherry —but I always take with my dinner either three or four glasses of light claret—with or without water —or half a bottle of light hock, or else half a wineglass of pure brandy (such as Exshaw's No. 1) with soda-water; but unlike the old sea-captain in "Olivette," "I never mix"; and though I have strong gouty tendencies, I am never now troubled with an attack.

I quite agree with Dr. Edmunds in theory as to the benefit of warm water, but I prefer it for "external use only." There are a great many other things which are really very wholesome; but if we all regulated our lives on this principle, we should be a very miserable lot. I do not believe in talking of beer and ordinary wines as merely so much *alcohol* combined with certain quantities of this, that, and the other. We might almost as well speak of pure water as being so many parts of oxygen and hydrogen, and argue accordingly. For instance, how different is the result of a pint of ale taken at one or two draughts, and the same quantity sipped by teaspoonfuls. Let some of our readers try the latter and report. **F.R.C.S.**

P.S.—Your compositor, by the bye, who is probably a volunteer, makes me say, at p. 455, line 3 from top—"which obtains 'first score,'" instead of "just now."

[21023.]—I would point out on this matter that several of your correspondents are wishing to obtain results in direct opposition to a well-known law. Mechanics, in particular, well know that there is a law that speed cannot be had without a proportionate loss of power to obtain that speed. If you require speed, you cannot save power at the same time. Apply this to the subject in question, and the results must be the same whatever the machine be, either human or otherwise. **P. W. R.**

[21024.]—I think such a valuable discovery as how to live to 70 or 80 (barring accidents) without once being ill, is the greatest ever made by man, and ought to put Dr. Allinson in the foremost rank as a benefactor of the human race. Some time ago he informed us that the food which passed most quickly through the stomach was the best food, which itself was a wonderful fact, but nothing nearly equal to his wonderful discoveries in letter 20973. No such important claim has ever been made heretofore except by ignorant quacks, whose own lives generally falsified their assertions. But here we have a qualified medical man as authority. He can safely say "that I shall never be ill," and what is more, "shall not think of dying before 70 or 80." There is a loophole here—he may decide not to think about it. But people die who do not think about it, I am afraid. However, I shall, for one, be glad to learn something more from Dr. Allinson of the new panacea. He tells us few doctors can make such a statement. Any doctor could easily make it, but most of them no doubt would fail in performance. He goes on, "Allow me to feed a person, and I will make him dull and stupid, or clever and bright, always ailing or in uniform good health, and even long or short lived; and all by diet." Do I not wish Dr. A. had the dieting of the House of Commons! Or what an advantage if all dull and stupid boys could be dieted into cleverness! Of course, every one knew that food had a great effect upon human beings, but that it could set at naught all other considerations, such as original constitution, for instance, is most wonderful. "We are what we eat." "If we eat gross food we must think grossly, and have gross constitutions." May I ask Dr. Allinson if the matter is really so simple as that? If so, the sooner he is installed as a paternal despot the better for all of us. But I have a lively memory of some years of ill-health myself, and of being dieted, meat and alcohol being avoided, and of being at last restored to health in a fortnight by the simple prescription of—Meat three times a day, and generally eat more flesh—since doing which my ailments have vanished. I am afraid if I had been compelled to vegetarianism I should have tenanted Abney Park before now.

I do not believe in much alcohol; but if, as Dr. A. says, it "prevents the sensation of pain being carried to the brain," I am afraid it has its uses yet. A pain we cannot feel may "still be there all the same." It is easier to bear anyhow. I think, although a whip is an irritant and not a stimulant, it does make a horse travel faster, when the mild stimulant of "gee" would fail to accelerate his pace. And when Dr. A. makes a drink like beer by boiling water, hops, and barley, and adding alcohol, he would scarcely induce any but an abstainer to pass it for the genuine article. As to alcohol not being found in nature, it is, at any rate, found in bread. I should not like to drink "alcohol," but "alcohol" is no more beer or wine than nitrogen is meat or oxygen the air we breathe.

Edwin Holmes.

"DRINKS AGAIN."

[21025.]—There is much in the letter of "F.R.C.S." with which I cordially agree; but there is also much with which I cannot. "Drunkenness is a disease," says "F.R.C.S." I grant that the worst, the most hopeless, form of drunkenness is a disease; but, let me ask, What has created the disease? If alcoholics were simply used medicinally, it would soon become extinct. I believe, however, that the greatest amount of drunkenness takes place in public-houses at the end of the week, when men drink simply for the enjoyment of the thing.

It is true that the majority of moderate drinkers do not become drunkards; but by far the greater proportion that I know take more than is good for them. The quantity I have already indicated in my last letter—namely, about three-quarters of a pint of ale, is the amount allowed by the *Lancet*, and it has abundant testimony in its support. Do moderate (?) drinkers confine themselves within this limit?

I can sympathise with "F.R.C.S." in his non-enjoyment of dinner without the use of fermented liquor. When I habitually took a glass of ale with my dinner, and for months after I left it off, I did care for food without it; but I reasoned quite oppositely to "F.R.C.S." To use a sailor friend's expression, "I saw the red light." To me it appeared a strong reason for abstaining.

I do not want to dictate to "F.R.C.S."; but, speaking for myself alone, in the face of the misery caused by drink, I do not feel justified in taking anything intoxicating merely for the pleasure of it. Many a father who never exceeded in his life has had cause to mourn over a drunken son who first learned to "enjoy" alcoholics at his table.

It gives me great pleasure to find Dr. Edmunds so heartily in agreement with myself; but, certainly, I should never have gathered it from his previous articles. I only took "issue" with Dr. E. on one point—namely, his statement that doctors recommended the use of intoxicants, "because they knew no better." I endeavoured to show that the reverse was true, and now Dr. E. agrees with me. Comment is superfluous. In the remainder of my letter I don't think Dr. E. was in my mind. I was thinking of teetotalers generally, as I knew them. Dr. E. need not have put on the cap if it did not fit. Further, I was under the impression that a temperance hospital was an establishment where "cases" were treated without the use of alcoholics, and that about 25 per cent. more cures were effected there than anywhere else. At any rate, this is a favourite argument on "temperance" platforms.

The comparison which Dr. E. draws between Mrs. Gamp and myself, is a style of argument frequently used by second-class barristers at a police-court, when they have "no case," and it is unworthy of an M.D. It would be easy to ridicule Dr. E. on his partiality for hot water (by the bye, I wonder how Dickens would have treated the subject); but I think we have too much of this sort of thing in the "E.M."

Dr. E. takes the trouble to confute a silly argument which he states I used, but which I never did. I said "*ales and wines*" (not teetotal beers) frequently disordered the stomach.

Dr. E. holds "that the *nature* of the effect of alcohol is the same, whether taken in a small or large dose," and wishes me to show the contrary. I will do my best to do so. First, then, it is the "common" theory. This is admitted by my opponent. Moreover, I have Dr. Allinson on my side, though he chooses to call alcohol an "irritant." (How doctors differ, to be sure!) Secondly, "Like cures like" is a law which, though carried, I think, to extreme lengths by some people, is nevertheless true in the main. I believe there is not a single stimulant which is not also a depressant; and the reverse, with a few exceptions, also holds good. If, then, alcohol be *only* a depressant, it is an exception to a general law. Thirdly, I know by practical observation that usually a "little" of some alcoholic rouses and brightens a tired man, while a "lot" "muddles" him. But if these reasons do not satisfy Dr. E. that alcohol is a stimulant, I don't think he can show that a small quantity *diluted* is a depressant. But, after all, it is of very little consequence whether alcohol be a stimulant, an irritant, or a depressant; practically, we all know there is a mighty difference between a large and a small dose.

In T. R. Allinson, L.R.C.P. I meet an opponent who differs from any other I ever encountered. He apparently not only belongs to the extreme section of the "Devil in solution school" (see Dr. Richardson's lectures), but is an L.R.C.P. who thinks that all doctors who don't think as he does, are a lot of ignorant scoundrels; and he is going to make all who will put themselves in his hands live in perfect health to extreme old age, and that, too, without the use of medicine. He asks how many doctors can say that they will live in perfect health to be old men? I think I can tell him there is one. He opens his batteries on me by saying that I am a "temperate" man. Well, this I take as a decided compliment, which I heartily wish I could return. I have taken in the last six months one tablespoonful of brandy to relieve a bad headache. It is so long ago since I took anything else in the way of an alcoholic that I cannot remember it, so that I think I am fairly entitled to be called "temperate." But where's the argument? I cannot find it.

Doctors, says Dr. A., have been backward in their advocacy of temperance. Why? I think mainly because, like all thinking men, they have been repulsed by the extravagance and ignorance of the average temperance lecturer and his disciples. Moreover, the strength of the question never existed in its medical aspect, but in its moral and religious ones.

"Alcohol is neither a food nor a stimulant." Whether alcohol be a food or not is as yet undecided. There is quite as much—I think rather more—to be urged in support of the theory that it is a food as there is against it. To discuss this at length would occupy too much space. Dr. A. must be perfectly well aware of the fact. However, for the benefit of the general reader, I will just refer to Ringer's article on Alcohol (the best, I think, ever published), and also to the papers which deal with the investigation of Professors Biny and Wanklyn and Mr. Cooper. These gentlemen affirm that "alcohol of about the strength that it is taken by an ordinary consumer into the human body is changed into products which will act as heat-producing food." Facts being as I have stated, Dr. A. must pardon me if I decline accepting his simple negative. I attach, however, very little importance to this question.

For the sake of argument, suppose I allow that alcohol *is* an irritant. Well, what if it is? Let us pursue Dr. A.'s illustration of "Dobbin." If "Dobbin" be lazy, a "little" whipping will "stimulate" him without doing him any harm, and it may do him some good. But if "Dobbin" be flogged unmercifully, it will undoubtedly "depress" him. I am rather like "Dobbin."

Further, I am told that if I boil barley and hops, and add a little alcohol, I shall obtain "a drink like beer." Any schoolboy who has had a few lessons in chemistry knows better than this, and so must Dr. A., if he thinks about it. The decoction would be an insipid mess, as unlike good brisk ale as "chalk is to cheese."

Undiluted alcohol would unquestionably injure the stomach. There is, however, no proof that a small quantity *diluted* would do so. What I stated was that I never knew a small quantity of diluted alcohol "disorder the stomach," and I meant *my* stomach.

I was first made acquainted with the fact that alcohol, if pure, left no taint on the breath, by reading a notice in the "E.M." of Professor Wanklyn's investigation. I confirmed its truth by experiment. If Dr. A. has obtained contrary results, he has probably employed *impure* spirit or used a large quantity.

When shall we have done with the "poison" argument? Really, what does it prove? Granted that alcohol is a "poison," it is not poisonous when taken under proper conditions. Prussic acid is a "poison," I fancy quite as deadly as alcohol—are we to discard apples because their pips contain it? No less a man than the late Dr. Letheby suggested that the victim of a murder might have met her death by eating apple-pie, because he found prussic acid in her stomach. Of course, this hung the murderer. This instance is very instructive. Has Dr. A. ever heard the story of Dr. Johnson, who was remonstrated with by a lady for his tea-drinking propensities? "Do you know," said she, "that tea is a slow poison?" "I do, madam," said the Dr.; "I have been forty years dying of it."

There are no statistics available to show that total abstainers' lives are better than those of temperates; at least, I have never seen any. I have not a doubt but that a few fanatical teetotalers lose their lives every year because they ignore the medicinal clauses of their pledges.

Dandie Dinmont.

THE DRINK DISPUTE.

[21026.]—In reply to "F.R.C.S." (20972), it seems that the drink question resolves itself into the queries: (1) Is drink a food? (2) Does it do harm? I think it is proved, beyond doubt, that alcohol is not a food; it is the result of decomposition, and good, healthy food is turned to waste when liquor is produced. Alcohol is a chemical substance, and, if we sanction its use, we may sanction the use of ether, or any other product, and, goodness know where we shall stop if we once open the flood gates. As it does not give force to the system it is not food; but, on the contrary, helps to use up our reserve force, which is there for accidents or other unforeseen occurrences.

Does it do harm? That also has been shown in the positive; it is the cause of a terrible lot of disease and death in this, and every other country where it is known. The *British Medical Journal* recently calculated that about 40,000 are killed through it every year in England. Even in small daily quantities it is doing harm, and when we come to reckon up the two daily glasses, we find that in a few years we get enough to drown ourselves in. When alcohol is taken into the system, it has either a near or remote effect, but the effect must follow. Experience has shown that we are in the best health without it, and that if we take even a small quantity that we do harm; the more we take the more harm we suffer.

The habit of drinking alcoholics is pleasurable when acquired, so is the habit of smoking, snuffing, or chewing; but all are bad. When these habits lead to harm it is our duty as good citizens to avoid them; let us be real men, and not base imitations. It does not attack the lower classes only, but also the rich and the highly-educated. Adulterated liquor makes matters worse; but if "F.R.C.S." will look to accounts of a century ago, when every one drank, and not always in moderation, he will find a sad state of things. In those days it was no uncommon thing for a man to break his leg; mortification and death often resulted. If he got a fever or erysipelas it was known as sthenic—in other words, his system was in such a state from his drinking habits, that the fever ran high, and recovery was rarer than nowadays.

Other things they had not to contend against in those days were railways, the impure air of large towns, gas, and high-pressure living. Now we require all our acumen to get on, and we have often to keep our brain at full tension to live. Pure liquor is only part cure; the real cure is total abolition. As "F.R.C.S." says, moderation is good; but total abstinence is better. He says if you are a drunkard avoid alcoholics; but if you never touch alcohol, you cannot be a drunkard.

Thousands of men in Australia may use tea and seem no worse: whether they are or not is another question. If we want to compare the tea or beer-drinking habit, we must not compare men living in the purest of airs and working in it, with men working in an impure air and under wrong conditions. I can only finish up with the saying of Pythagoras, "Do what is right, and custom will make it pleasant."

In reply to "Sigma" (20976), I can say that drink reform is not a fad, but a good institution, and intended for the moral and physical welfare of the human race. Any practical person will not tell you that teetotalism and vegetarianism will cure all diseases or evils; but a careful observer will inform you that teetotalism will remove five-tenths and vegetarianism three-tenths more of the present diseases. I am afflicted with the teetotal mania, because I am aware of the immense damage drink is doing to this country—it is keeping us in poverty and ignorance, and depriving men of many of the pleasures of a beautiful world. Come with me amongst the poor, to the police stations, law-courts, assizes, asylums, and inquests, and then tell me am I wrong in advocating the abolition of a stuff that kills its hundred thousand a year.

Teetotallers are less afflicted with rheumatics than are drinkers, but I never knew a vegetarian with rheumatism. This complaint is caused by a definite poison in the blood, which poison is the result of meat-eating and drinking alcoholic fluids. Depressing causes, chills, &c., may cause the disease to show itself; but if we had not the poison in the system the disease would not appear. "Sigma" seems to think that "wine is the milk of old age," and when the recuperative powers are low, he advises a spur; if he would give them rest, he would make more progress, and live out the full term of his life. He says he has got into such a state that he is uncomfortable without his whisky. All I can say is, that he is a slave to a habit, and the sooner he gets free from it the better for himself. A great many of our most earnest and scientific workers are often cut off, from the addiction to some habit which, if they had it not, we might now have been enjoying the results of their discoveries.

I am glad someone has taken up the cudgels in this dispute, as it is very unfair when a discussion is one-sided. "Anglo-Dane" (letter 20997) makes some remarks worthy of consideration. He informs me that caffein is poisonous in large doses. Does it not, then, follow that it is mildly poisonous in smaller doses? As someone may question my statements, hear what Bartholow says: "If taken much at meal times, it gives rise to acidity, flatulence, indigestion, and pyrosis (water-brash); it produces headache, buzzing in the ears, giddiness, and a partial loss of memory." By its long-continued use it helps to produce a lot of nervous diseases. Tea is worse than coffee, since it contains thein, a stronger alkaloid than caffein; tea contains more tannin than does coffee, and is therefore more constipating and harmful. Tea is also more deleteriously adulterated than coffee, so that of two evils we must choose the lesser, which is coffee.

Both "Anglo-Dane" and "Nun Dor" (48914) take me to task about the tannic acid affair. I now quote from Kirke's "Physiology." He says that tannic acid is the best test for gelatin, and that it will detect one part of gelatin in 5,000 of water. The gelatin is thrown down as a heavy, dense precipitate, which is insoluble in water, and is known as tanno-gelatin. Another point I did not touch on before is that tannic acid precipitates pepsin, which is the active principle of the gastric juice, and so our food does not get properly digested. The stronger we take our coffee or tea, the more likely are the bad results above named to follow. Most people are content to have fair health: I like good health, and know of no pleasure so great as that of feeling in perfect health, to attain which I have to avoid many of the social habits which are only pleasures from habit.

I must have one more hit at the tea-drinkers, and it is this observation: that since tea has been introduced, nervous diseases have become more common, and are increasing with the increased consumption of tea.

I am sorry "A London Medical Student" (20998) has had to reply for his medical brethren. The medical men of any standing or of any acumen know what I say is true; or if they know the value of diet, they exclude themselves as being the few good ones. I am pleased to hear that they are taught all about foods at college; so was I, but at the wrong part of my studies. They taught me physiology in my second year, when a student is not in a fit state to receive it. The real time to teach this subject should be in the last year, when the student has facts which physiology explains for him. I will now inform "A London Medical Student" when I shall believe in his profession, and that is when the medical professors live up to their creed—when they renounce strong liquors, tobacco, and excessive meat meals. What use is it telling a student that such and such diseases are produced by liquor and tobacco if the professor asks you to his house, and sets these things before you and uses them himself? It is a practical contradiction. I will give him an illustration. A celebrated man for diseases of the heart was one day lecturing us students at the bedside of a patient on the ill effects of tobacco. One of his former pupils came in during the speech: at the end of it he told the lecturer that was not fair, for that he—the lecturer—was an ardent lover of the pipe. When doctors know more and practice more of the real prevention of disease, then will I give them praise; but not till then.

In conclusion, I ask my opponent to show how I cannot live until I am seventy, or any reasons why I should not (he must give me pure physical reasons—not throw in religion), or why I should be ill, as I imagine I can give him a hint or two?

What are the marks by which man can be shown not to be a vegetarian? I shall be much obliged if he will answer my questions, and let us see whether we are in the right or wrong.

T. R. Allinson, L.R.C.P. Ed., &c.

Jan. 27.

DIRECT-ACTION TRICYCLES.

[21027.]—Referring to the letters of "F.G.S." and "56in." in your issue of the 26th January, I have, during the last few months, ridden a "Monarch" tricycle upwards of a thousand miles over roads, good, bad, and indifferent; but have not found that the stirrup action has any one of the objections feared by your valued correspondents. I think it would be impossible to get the foot entangled in the stirrup; at any rate, I have never known it occur, either in my own case or in that of friends who ride the machine. The propulsive power may be applied as vertically as in any *rear-steering* tricycle, and probably more so than in the "Royal National," for the higher the centre of gravity is placed, the farther back it must be to prevent the hind wheel tilting up. I have often tried driving the "Monarch" direct from the cranks, when the action is the same as that of the "Royal National"; but certainly greatly prefer the stirrup action. Other things being equal, it is certain that the lower the centre of gravity is placed the safer the machine will be; in fact, chains, &c., were introduced because it was considered unsafe to ride too high. So the advantage of the stirrup is obvious; the centre of gravity is placed lower, without using the objectionable chains, &c. It would be very easy for "F. G. S." to try a stirrup pedal on his machine, and let us know the result. The stirrup is 5½in. long, and about 5in. broad.

For the encouragement of those who at present are non-riders, and "stand trembling on the brink," I may say that during the last two years I have ridden more than 5,000 miles without a single accident. And although for twenty years I have taken horse exercise almost daily, and do so now, riding the same distance fatigues me less on a tricycle than on horseback. Besides which, I find the tricycle riding the better exercise of the two.

R. P. G.

SIMPLE PROCESSES IN QUANTITATIVE ANALYSIS.

[21028.]—IN your issue of Jan. 12th an article appeared by "Esthos" entitled "Simple Processes in Quantitative Analysis." The methods given for the analysis of ironstones and limestones contain many glaring errors. Under B he gives the following method for estimating silica:—To 1 grm. ore add 50cc. water and 20 cc. hydrochloric acid, heat, and add 15 drops nitric acid, boil for twenty minutes, add more water, boil again; filter, wash, dry, burn off, and weigh precipitate × 100 = silica (sand). Now, by this means, he would not get the amount of silica at all, but the total insoluble matter, which is very different. His precipitate would consist of any silicate which happened to be present as sand, and also any insoluble silicates present as silicate of alumina; but a large amount of SiO_2 present in the substance would not be left with the residue at all, as all soluble silicates would pass into solution, and thus he would miss altogether part of the SiO_2, and what he returned as SiO_2 would be a mixture of sand and insoluble silicates. "Esthos" makes two great mistakes—first he omits to evaporate to dryness and afterwards take up with HCl, which is necessary to render *all* his SiO_2 insoluble, and to prevent it passing into his solution; 2nd, he does not decompose his insoluble silicates which are left with his SiO_2. To do this it is necessary to fuse the silicious matter left on the filter with five times its weight of fusion mixture (i.e., equal parts carbonate of soda and potash), digest with water, add hydrochloric acid in excess, evaporate to dryness, take up with hydrochloric acid, add water, and filter pp. = nothing but SiO_2; any silicate of alumina thus decomposed, and by evaporating all the SiO_2 rendered insoluble, while the alumina goes into the solution.

The SiO_2 in a limestone may be estimated as follows: calcine, 1 grm. at red heat for half hour in crucible, transfer to beaker, add water and hydrochloric acid, boil and evaporate to dryness, take up strong HCl, boil, add OH_2, filter pp. × 100 = SiO_2. By simply calcining any insoluble, silicates are decomposed, and converted into soluble silicates, so that, after evaporation, nothing but SiO_2 left insoluble, and the fusion with mixture not necessary.

Under C "Esthos" gives the following method for estimating the Fe_2O_3:—"To solution from B add few drops nitric acid, and then AmHO in excess, filter and wash; pp. consists of Fe_2O_3, and any phosphoric acid present."

Now, if we add little nitric acid, and then ammonia to a solution containing Fe, Al, Mn, Mg, and Cu; the Fe, Al, Mn, and Mg are all more or less precipitated together, and as some of these are *always* present in ores and limestones, the precipitate which "Esthos" would obtain, on adding ammonia, would consist of a mixture of all these bodies. Now, many ordinary ores contain 6 per cent. to 10 per cent. of Al_2O_3, and some aluminous ores as much as 30 per cent., besides several per cent. of Mn and Mg, all of which would be weighed and calculated as Fe_2O_3 by "Esthos."

His mistake here is again a most unfortunate omission. In case of ores, after adding a little nitric acid, to oxidise the Fe, ammonia should be added, *nearly*, but *not quite*, to precipitate the whole of the Fe; and then *ammonic acetate* in large excess. This latter reagent is most important, as it keeps the Mn and Mg in solution, and only the Fe_2O_3 and Al_2O_3 are precipitated together, which ignited and weighed as usual. To arrive at amount of Al_2O_3 in this pp., the iron is generally estimated on a separate portion, by a direct volumetric method, calculated into Fe_2O_3, and subtracted from pp., when difference equals Al_2O_3: thus (pp. $Fe_2O_3Al_2O_3$) − (Fe_2O_3, obtained by direct method) = Al_2O_3.

The Mn in solution may be pp. by adding Br, and then ammonia in excess, and boiling, when comes down as oxide. Ca and Mg can be estimated by methods given by "Esthos." In limestones there is never any Mn, and before adding ammonia, large excess of ammonic chloride must be added, which will prevent Mg coming down with Fe_2O_3 and Al_2O_3.

Here ammonic chloride used for the same purpose as the ammonic acetate in the analysis of the ore. To get Al_2O_3 in the pp., the iron must be estimated direct, and Fe_2O_3 subtracted as given above. Simple processes, when reliable, are what everybody desires; but methods which are so utterly misleading as those given by "Esthos" are simple nonsense.

Protest.

ESTIMATION OF SULPHUR IN PYRITES.

[21029.]—IN the method given by "Esthos," in this week's number of the ENGLISH MECHANIC (p. 469), for the estimation of sulphur in pyrites, he says: "Weigh out 2·0 grams, transfer to a flask, cover with fuming nitric acid, heat gently in a sand-bath to *dryness*, add more fuming nitric acid, and *re-dry*."

Now sulphur exists in pyrites as FeS_2, the result of the ultimate oxidation of which is sulphuric acid H_2SO_4, which combines with the various bases present to form sulphates. Taking the figures in "Esthos's" statement of results, and calculating the sulphur into sulphuric acid, we have in 2·0grm. 2·81grm. of H_2SO_4, which combines with the bases given in the following proportions:—Fe = 0·845grm., requires 2·218grm., H_2SO_4, Cu = 0·024grm. = 0·037grm. H_2SO_4. $CaCO_3$ = 0·048grm. = 0·047grm. H_2SO_4 and $MgCO_3$ = ·021grm. = ·024 H_2SO_4. Subtracting the H_2SO_4 required for the various bases from the total H_2SO_4 calculated from the sulphur = 2·81 — 2·326 gives us 0·484 grams. of H_2SO_4 existing in the free state, or without a base to fix it. It is evident what will become of this free H_2SO_4 on evaporating to *dryness*: it will be driven off, giving a loss of 5·6 per cent. of sulphur, thus reducing the sum total of "Esthos's" analysis to 94 per cent. The proper course is to treat the one with 1 part of nitric acid, and, say, 2 parts of hydrochloric, evaporating till chlorine ceases to be evolved, adding more HCl, if necessary, and not allowing it to go near dryness.

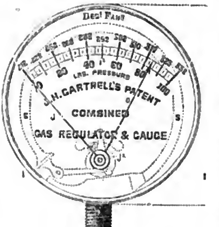
If 1·373grm. of the pyrites be worked on, each decigram of $BaSO_4$ will represent 1 per cent. of sulphur.

St. R.

AUTOMATIC REGULATORS FOR GAS.

[21030.]—MR. FLETCHER's criticism of my automatic regulator and gauge (letter 20925, page 410) is something new to me. It never struck me that anyone—especially one "familiar with it from the first introduction"—would imagine that it was not a temperature regulator. Mr. Fletcher has evidently mistaken the *means* I employ for the *object*. I make use of pressure as a *means* of indicating and regulating the temperature. An ordinary safety-valve to a locomotive is a pressure regulator, letting off steam to relieve the pressure. But my instrument acts very differently: no steam is let off, but the pressure acts directly on the gas-flame, and automatically regulates the temperature according to the degree of heat desired.

The instrument will regulate dry heat as well as steam heat. It will, for instance, indicate and regulate the temperature of a vessel of hot mercury, oil, or fusible metal, heated, say, by one of Mr. Fletcher's gas-burners. To do this, I should simply couple an hermetically-sealed siphon, partially filled with water, to gauge. The other end of siphon would be stuck into the mercury, oil, or fusible metal, and a rubber tube attached to regulator and gas-burner to convey gas. The temperature will be indicated on the gauge, as shown by the Fahr. scale on dial in the illustration, and automatically regulated at any point on scale to which the finger O in the figure may be set. The instrument will do this for years without the operator needing special or technical knowledge. Mr. Fletcher also adds that it is useless for dry heat celluloid vulcanisers; but as it happens the only two dry-heat vulcanisers for celluloid sold in this country have in both the heat indicated and regulated with my gauges.



Messrs. Cottrell, of Rodney-street, Liverpool, have had a lot of them for their dry-heat celluloid vulcanisers, and recommend it as the best for the purpose; and I supply it with my own dry-heat celluloid apparatus, which also vulcanises rubber by dry heat. All I have to do is to set the gauge, light the gas, set the clock, and go to bed; when I get down in the morning I find the rubber is perfectly cooked and that the clock has turned the gas tap to cut off the gas at the time that I set it to do so. What more does Mr. Fletcher want? I suppose he wants a regulator that can be sold for about two-and-sixpence; but mine can't be sold for that and pay the inventor for cudgelling his brains to design it. I think the instrument can be used successfully to indicate and regulate heat for various purposes, but I have not made any effort to introduce it outside of my own profession.

I fancy Mr. Fletcher's idea of the word "automatic" is rather vague, as I have lately bought one of his blowpipes having "automaton" writ on it in large letters; but where the automatic action comes in I have not been able to make out, as all the movements have to be made by hand.

Penzance. **J. H. Gartrell.**

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48467.]—**Egg-Preserving.**—Although I cannot give "I. B. O. S." any information about preserving eggs in limewater, I think he will probably be interested to hear that Barff's patent boroglyceride can be used for the same purpose. At a friend's house, a few weeks ago, we had for dinner some eggs poached, which had been kept in water containing about 3 per cent. boro-glyceride for three months. The eggs were perfectly good, although the white of them looked queer; but we found afterwards that this was due to the cooking; so we considered the experiment very satisfactory. The boro-glyceride is very easily prepared, and if "I. B. O. S." thinks it worth while to make some experiments with it, I advise him to buy the specification of the patent, and also a copy of the *Journal* of the Society of Arts for March 31st, 1882 (price 6½d.), which contains Professor Barff's paper on the subject. I presume it would also be advisable to obtain Professor Barff's permission to experiment with the substance. "I. B. O. S." must experiment on a tolerably small scale at first, as some of the eggs we put into the solution went bad after about ten weeks, from unknown causes.—EDWARD E. BERRY, Chemical Laboratory, Broad Plain Soap Works, Bristol. [Prof. Barff's process was fully described on p. 357, Vol. XXXIV.—ED.]

[48610.]—**Watchwork (U.Q.)**—Most probably the escape-wheel teeth touch either the top or bottom of cylinder, or rather notch in cylinder. This may be caused by escape-wheel being out of truth, or too much endshake to escape-wheel or cylinder—perhaps both; or the balance-arms may touch hairspring-stud, or the curbs through which it passes. In any case, the remedy is obvious.—C. M. R.

[48611.]—**Organic Analysis Table.**—If "Altair" merely wishes to know how to test for the organic acids, and he will advertise his address, I will post him a copy of Dr. Campbell Brown's table in his "Analytical Tables for Students of Practical Chemistry," which I have myself used with unvarying success.—A YOUNG ASTRONOMER.

[48729.]—**Oysters.**—"Ploni Almoni" again errs, and I have no doubt that he and I would go on erring so long as we continued writing on a subject of which the world is ignorant; and we two, such an infinitesimal portion of the world, what can we do "but sit down and learn all we can"? I endorse these words of "Ploni Almoni," but at the same time I don't altogether agree with the sitting down—I would rather be searching out truths for myself. I wrote, "The moment consciousness is *destroyed* the animal ceases to live;" and again, to which "Ploni Almoni" takes exception, "but unconscious life . . . . is not life to me." I don't believe that sleep produces unconsciousness. There are hundreds of cases—I have collected most interesting ones—in which there is evidence of a continuity in consciousness throughout the profoundest sleep. Mentioning a word in the ear of a man dead asleep, if you will so call it, awakes him instantly, when the thunder of artillery has not affected him in the least. I could cite case after case, all bearing out the same chain of ideas. But this has nothing to do with oysters. I wish I could find someone who could answer questions that as yet no one has answered. But we must wait patiently: the time will come—it must come—when the problem will be solved, and the mystery cleared away.—W. J. LANCASTER.

[48807.]—**Neuralgia.**—To "W. S. W."—Having seen your suggestion on neuralgia, I at once made up my mind to give it a trial, so I got 60 small tumblers, also the same number of pieces of copper and zinc, following your instructions as near as possible, with exception, not having a soldering-iron in my possession, I riveted copper and zinc together with copper rivets, and having placed them in the tumblers, I put the wire on my tongue, but I cannot get any current or shock. Will you kindly oblige by saying if coppers and zincs should be a certain distance from each other, or can you say where my mistake lay? By so doing you will greatly oblige.—F. J. P.

[48823.]—**Roman-Candle Stars.**—I regret that this query had escaped my notice. Procure a piece of brass tubing, the same as that which was used for rolling the cases upon (the stars will then be the correct fit for the bore of case), 2¼in. long, and at one end file a slit ½in. deep and ⅛in. wide. Round a piece of wood for 2¼in., which must be made to fit the tube well, and form a handle as in sketch, about 1½in. in diameter. It will be seen from this that when the wood former is placed in the tube, that the bottom of it will be level with the end of the tube. Withdraw the former to a distance that shall be greater than the diameter of tube, and at the handle end, and close to the top of the tube insert a small round nail, and that will complete your star pump. Suppose you make ½in. bore Romans, which size I should advise you to confine yourself to for this class of firework, withdraw your former ½in., and fix the nail for that distance. To use the pump, allow the nail to rest on the top of the tube as in sketch, and press firmly once or twice into the moistened compo.; then turn the handle until the peg is opposite slit, and expel the star by pressing the handle down. The size of star can be regulated by shifting peg, or having separate formers. For ¼lb. rockets this ½in. star is too large. Use the same pump, but alter the peg to $\frac{5}{16}$in., and your rocket will carry two dozen stars. The star pump is the most useful of all pyrotechnists' tools, as by its aid stars can be rapidly and beautifully made.—J. S. Rochard.

[48874.]—**Steam-Power.**—I have only received the "E. M." for January 5th, containing "Carmel's" letter, this week, so that will account for my silence. "Carmel" says that the result of increasing boiler pres. 10lb. and cutting off earlier is an increase in consumption of coal. Now I expected before he made any alterations he would have given more particulars of his engine, &c., so that he could have been advised with more certainty of success. With the meagre information contained in his query, it it could not be said what particular cut-off would best suit. He is quite right in saying that ⅓ of 3ft. stroke in 12in. If he will state full particulars I shall be happy to give him the best advice I can.—Labor Omnia Vincit.

[48904.]—**Magneto-Electric Machine.**—I am greatly obliged to Mr. Lancaster for having noticed my query. I am sorry that I cannot follow his advice (p. 436), as I don't know anyone of whom I could borrow a machine; so if Mr. Lancaster will kindly give me a few hints how to proceed in making the spindle and connections, I shall be thankful.—J. T. M.

[48915.] — **Jack-in-the-Box Gearing.** — Thanks to "T. P." for noticing this. If he will please refer to No. 900, June 23rd, 1882, he will find a part engraving of it, in a small dynamo described by Mr. Tolman. I addressed a query in the "E.M." to that gentleman headed "Dynamo Gearing," but it passed to the list of Unanswered Queries, and was never noticed.—M.M.I.Sc.S.

[48966.]—**Honeycombed Gunbarrel.**—If the amateur is wise, he will not attempt to remove the pitted appearance, as in all likelihood he will spoil the shooting qualities of the weapon.—J. G. N.

[48972.]—**Bleaching Fat.**—I believe this can be done by passing it whilst hot through animal charcoal; but the most commonly-practised process is to heat the fat in a vessel containing a 2 per cent. solution of sulphuric acid, agitating frequently. There are many patented processes.—S. M.

[48979.]—**Water-Motor.**—If this question were put to the makers of water-motors, they would be able to answer it in a very definite manner, and the querist would then be able to choose the motor that is best suited to his wants.—M. W.

[48981.]—**Street Medical Coil.**—To Mr. W. J. Lancaster.—I am obliged for your answer. Would you kindly give me particulars how to make and break contact for a swing and see-saw? I see how to do the clown, &c., and shall fix several on the base-board; and will not each require a separate battery?—M. R.

[48984.]—**Street Medical Coil.**—Will Mr. Lancaster kindly give me instructions how to make the dancing clown he speaks of, or anything likely to be attractive? I have a large coil with two bells, &c., but they have become so old, having used them at galas, shows, &c., so long; if W. J. L. can help me to rig up something fresh, I shall feel thankful. I have been racking my brains some time to no practical purpose. Seeing his reply in the "E. M." has made me bold to ask him to give me a lift. I can make, if I have proper instructions. Could I have a clown to stand between the two bells, and a drum-stick in each hand to strike them, and wag his head at same time? I think it could be done, though I have not the skill to invent it.—Little Dick

[48987.]—**Covering Strawboards.**—This question is answered by one of the largest makers of cardboard-boxes in London on p. 144, Vol. XXXI. No machinery is used, except the skilful fingers of girls and young women, who put the paper on with thin glue.—T. P.

[48992.]—**Drill for Glass and China.**—This question is addressed to a correspondent by name; but I suppose it is permissible to point out that the question has been answered on p. 547 of the last volume? In Vol. XIV., pp. 125, 233, there is very full and complete information. The drills there described are diamond "sparks," cemented into little tin tubes.—S. M.

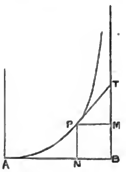
[48993.]—**Yellow and Red Timber.**—In reply to "Shipwright," the only difference between red pine timber and red pine deal is the difference common to all sorts of pine imported in two forms, and that is, the deals seem to be cut from smaller and generally inferior wood. In reference to these woods, the only confusion I have met with is in connection with yellow deal and red pine deal. A sharp distinction has always been drawn between fir and red pine. It is a fact, however, that where fir is specified red pine may be used, and conversely, generally to the satisfaction of architects and clerks of works. We put them in indifferently where the work is to be left rough or painted, but never mix them in stained work, as the contrast is very great. Red pine is selected where long timbers are required, as there is no difficulty in getting it at least 30ft. longer than fir.—W. J.

[49005.]—**Wines and Spirits.**—I am sorry your correspondent "Dandie Dinmont" seems unable and unwilling to allow that even a *small* quantity of ale or light wine is injurious, and that the sooner teetotalers acknowledge the good effects of a little beer the better for the cause. Now, although we are ready to acknowledge that in some diseases, as a drug, and administered as such, and such alone, it may do good, yet we are not prepared to allow that even a small quantity is required by healthy people. Alcohol is not good for over-work. Dr. Parkes has clearly proved this by his experiments with the soldiers at Netley. Alcohol is not good for indigestion. Many people who suffer from indigestion imagine that because the pain goes after taking a glass of brandy and water the alcohol has cured their indigestion, but this is not the case. The narcotic effects of the brandy have deadened the nerves of the stomach, and, therefore, for the time they feel better; not because the indigestion is cured, but because the pain has been relieved. Chloroform and most other anæsthetics would do this. There is another way in which alcohol acts on the digestive organs, and makes people think it has done them good. It weakens the pylorus, and allows the undigested food to pass through and out of the stomach without supplying the nourishment it ought to. There is yet a third way in which alcohol acts; it is to set up inflammation of the lining coat. This may continue day after day for some time without its being sufficient to attract our attention, until it has disorganised the tissue and we suffer disease. The result of experiments on Alexis St. Martin showed that even when he had only taken a glass of wine and felt no effect at all, the intestines became inflamed and irritated. Lastly, alcohol has a cumulative effect, and it is a serious matter for a man to begin to take stimulants, since he may not have the strength of mind to give them up when they have become pleasant to him, and are beginning to cause a craving for more.—John Norman.

[49011.]—**Whitening Ceilings.**—There is only the one method, varied in details. The ceiling is thoroughly washed and covered with two coats of whitewash. As to sizing walls, lay the size on when lukewarm with a broad soft brush. I believe some use what is called Paris white instead of whiting, while others prefer blue to black in toning the wash.—T. P.

[49026.]—**Geological Query.**—The issue on which I seek information is capitally expressed in the last sentence of Mr. Lancaster's reply, p. 458. He there says: "The cause of elevations and depressions are due, not to alteration of the surface stratum, but to alteration of strata more or less below the surface." The contention of the lecturer, to whom I referred, was essentially that alterations of surface stratum have had very much to do with causing depressions and elevations. He contended that, speaking generally, it was as true of continents as of other things amenable to the law of gravitation, that the heaviest parts sink, the lightest rise. It was noticed that these changes of level, consequent on extensive erosions and redistribution, pre-suppose the existence, far below the solid crust, of a plastic or semi-plastic condition; and he considered there was sufficient evidence to justify this assumption. Prof. Geikie refers to the existence of sandstone, ripple-marked and suncracked throughout a thickness of several thousand feet, as follows:—"These phenomena unequivocally point to shallow and even littoral waters. They can be interpreted only in one way—viz., that during their formation, the area of deposit gradually subsided for thousands of feet; yet that the rate of accumulation of sediment kept pace on the whole with this depression; and hence, that the original shallow-water character of the deposits remained, even after the original sea-bottom had been buried under a vast mass of sedimentary matters." The lecturer evidently regarded the continued deposition of sedimentary matter over a wide area as the cause of the continued depression. The last Glacial period in Britain was also referred to, to remark that, during the time that our country was covered with enormous masses of snow and ice a period of depression commenced; but that the melting of the glaciers was followed by an elevation of surface, and he suggested that the reason the former level was not reached after the Glacial period had passed, was, probably, owing to the drift or boulder clay, which remained as a permanent deposit. Whether this be so or not, I think Mr. Lancaster will see that I have not misstated the drift of the lecture.—H. T. W.

[49028.]—**Intrinsic Equation.**—In reply to "M.I.C.E." page 438, the equation to the curve referred to is obtained as follows:—Let A, the place of the dog, be taken as origin. A B = a, B being the place of the master at the beginning of the chase. Let, also P and T be corresponding places of the dog and its master at any time of the pursuit. A N = x, P N = y, and A P = s. Then, by supposition, the arc A P = 2 B T.



$$\text{But } BT = PN + MT = y + (a - x)\frac{dy}{dx}$$

$$\therefore s = 2y + 2(a - x)\frac{dy}{dx}$$

and $$\frac{ds}{dx} = 2(a - x)\frac{d^2y}{dx^2} = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}$$

Let $$\frac{dy}{dx} = p \therefore \frac{d^2y}{dx^2} = \frac{dp}{dx}$$

Hence $$2(a - x)\frac{dp}{dx} = \sqrt{1 + p^2}$$

$$\therefore \frac{dp}{\sqrt{1 + p^2}} = \frac{dx}{2(a - x)}, \text{ integrating.}$$

We have

$$\text{Log. } \left\{p + (1 + p^2)^{\frac{1}{2}}\right\} = \text{Log. } \frac{C}{\sqrt{a - x}}$$

$$\therefore p + \sqrt{1 + p^2} = \frac{C}{\sqrt{a - x}}.$$

To find the constant C, since when

$$x = o, p = o \therefore C = a^{\frac{1}{2}}$$

And the equation then becomes

$$p + \sqrt{1 + p^2}\sqrt{\frac{a}{a - x}}$$

from which we have, by squaring and reducing,

$$2p\sqrt{a} = \frac{x}{\sqrt{a - x}}$$

or $$2\sqrt{a}\cdot\frac{dy}{dx} = \frac{x}{\sqrt{a - x}}$$

Again, by integration the equation becomes,

$$y = C' - \frac{2}{3}(x + 2a)\sqrt{1 - \frac{x}{a}}$$

But when $$x = o, y = o \therefore C' = \frac{2a}{3}$$

Hence $$2a - 3y = (x + 2a)\sqrt{1 - \frac{x}{a}}$$

the equation to the required curve.—M.

[49060.]—**Vice for Bench.**—The weights of double-jawed vices 3in., 3½in., and 4in., are respectively about 25lb., 36lb., and 48lb., and the retail prices 42s., 48s., and 54s. each. They have solid boxes and screws. Bodies are made of best malleable iron, jaws of steel.—R. T. Lewis.

[49088.]—**Decoration of Room.**—The following suggestions applied to breakfast or dining-room may be of service:—The flat of ceiling a vellum tint, cornice of the same, but deeper in tone, in pleasing contrast with ceiling. The prominent members of cornice may be picked out in colour to harmonise with wall-paper. Ornamental cornices, with breaks and connecting-lines in colour, may be put upon flat of ceiling. The aspect of room should be considered in choice of wall-paper; if northerly, warmth of colour is advisable. As a background for pictures, paper should be low in tone, and of neutral tint. Bright colours interfere somewhat with pictures. Pine woodwork may be treated in the manners following:—Some of the members in mouldings round door-panels and skirting picked in black, to relieve it; or the stiles of door and skirting grained dark oak, with panels of door maroon, bearing flat ornament in gold. Mouldings should be relieved in gold. Or you may grain the whole of the woodwork a rich dark oak, relieving the mouldings with black or dark maroon, with gold beads round panels. If you require more costly decoration, I would suggest a dado of muralis, the pattern of which can be picked in colour. Instead of brass picture-rods, I would recommend a picture-moulding run round the room, a few inches below the cornice. This is more convenient than the rods, and with a neat frieze between it and the cornice, adds to the general appearance of the room. You may stain or varnish a margin of about 2ft. wide round the room, which is a saving of carpet, and is also convenient when desirous of removing carpet for cleaning purposes. Avoid large patterns or brilliant colours in your carpet. Oak furniture looks well on a rich, neutral green, laced with black and maroon. Your flat ornament should be governed by the style of your house.—A. Francois.

[49091.]—**Cold Feet.**—I wish to offer to "Clerk" a remedy which I have found beneficial; it is, to wear shoes or slippers well padded with some woollen substance, or cork soles with something woollen on; he will find this a practical remedy. Having been troubled with cold feet myself, and put up with it for a long time, I thought that the best way to make them as comfortable as I could, and the results are all that I could desire.—P. W. R.

[49092.]—**Constant Battery.**—To "Sigma."—Now I know what the querist wants, the reply is easy. He can use either a Daniell or a bichromate cell; the former by preference for constancy. The period would depend on two considerations easily calculated. It depends (1) on the rate of current desired; (2) on the quantity of copper salt available. An Ampère current will be maintained for 10 hours by one and three-quarters of copper sulphate, and so on in proportion. To get the current pretty constant there must be plenty of water to dissolve the salts as they are transferred; therefore, the cell should be large. To prevent loss by local action, the porous surface should only be large enough to allow the work to be done. I should advise a tall cell, a wide porous cell, a moderate-sized zinc at the top of the cell, and the lower part rendered non-porous by paraffin; the zinc solution to be half-saturated solution of its sulphate. I am preparing an article on "The Daniell Cell and its Peculiarities," which I have been studying a good while, and if the querist can wait a little he may learn something from that.—Sigma.

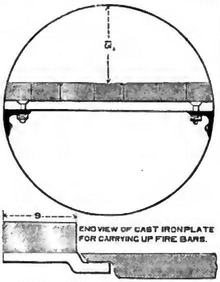
[49105.]—**Artificial Foot.**—Many thanks for kind offer. Should be very glad of any instructions for making the above. As my foot was removed about 6in. above the ankle, I am afraid I cannot take any bearing on end of stump. Can an ordinary country blacksmith make the steel strips? What width and thickness would be best? What sort of leather would be used?—Timber Toes.

[49118.]—**Brick Bridges for Boiler**—Build your bridges 2ft. long and not more than two bricks thick above the grate-bars.—Summit of England.

[49119.]—**To "Jack of All Trades."**—I can make nothing of the valve you give a description of.—Jack of All Trades.

[49120.]—**Violin Bow.**—I quickly clean mine by dissolving a teaspoonful of soda in ½ pint of warm water, unscrew, hold by the heel and point, so as the hair shall hang in a loop, the stick being held under the left arm; dip in solution, and gently rub with right-hand thumb and forefinger, until the dirt, &c., is removed; rinse in clean cold water, wipe with clean rag, hang in the sun, or a warm place, and in 15 minutes it will be ready for the rosin. I have treated mine in this way for many years, and it is as good as ever.—Lamplighter.

[49118.]—**Brick Bridges for Boilers.**—I would strongly advise "T. W." not to build brick bridges in the boilers he mentions. The following I have found to give entire satisfaction in Lancashire boilers 30ft. by 7ft., with 3ft. tubes:—Rivet pieces of angle-iron inside of tubes; to these bolt your cast-iron plates for carrying up the fire-bars, and on the top of this cast-iron plate, at flame-bridge, build one row of firebrick, leaving a space of 13in. or 14in. from top of tube. The space that is left under the flame-bridge, or end of ash-pit, fill up by putting in a piece of ¾in. plate. You will find the above, as per sketch, much less weight in the tube, easier removed, less dirt will lie about it, and give greater satisfaction.—Steam User.



[49130.]—**To "F.W." or "Alfojoe."**—A slight mistake crept into my reply to this query. Instead of "undershake," read "endshake."—C. M. R.

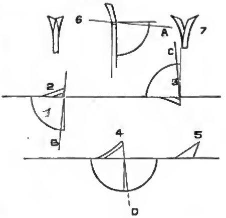
[49138.]—**Organ-Building.**—There is, to me, a little I cannot quite understand in this query. You want to know if you can save room on the platform, from "back to front," by "reducing the height of the keys from the level of platform." Perhaps you will explain a little further? The height of the underside of the framing supporting the keys of a pianoforte is about 2ft., but if the organ you propose having built is to have pedal keys, there must be a distance of 31in. from the top of the pedal natural key to the top of the manual natural key. If it is thought a saving of space to put the bellows under the floor, they can be so put, provided there is no damp, and at no extra cost.—Uranium.

[49147.]—**Ammonia.**—You would require 3 tons 4cwt. 1qr. 16lb. of the organic material you mention (containing 8 per cent. of NH_3) to obtain 1 ton of ammonium sulphate.—J. C. Belcher.

[49157.]—**Roller Skates.**—Thinking that the remarks of "Os" might be misleading to the querist, G. Fryer, I have decided to give my opinion in the matter. After 5 years' experience in the practical use of the skates of well-known makers, I can safely say that Plimpton's and other complicated (!) skates are not a mistake (having made for my own use various kinds of skates, among others Plimpton's, Malcolmson's, Spiller's, and last, but not least, Thackwaite's; which latter have 2¼in. diameter wheels). As "Os" says, it is possible to make a skate with the wheels in a line, so placed as to make the faces (or peripheries) of the wheels form a curve; but what is the result? After a very short time the centre-wheel, upon which all, or nearly all, the work is done, wears away, and the result is, the surfaces of the wheels are not in a curve as before, but all of them touch the floor at once. "Os" may say, Use metal wheels; but there are serious objections to them, for if you round the edges of the wheels, how are they going to grip the rink? If G. Fryer wishes for thorough enjoyment and exercise in the shape of roller-skating, let him go in for making or purchasing a pair of Plimpton's skates. With regard to the other skates mentioned above (Thackwaite's), they are more costly and difficult to make, perhaps, than Plimpton's; but I prefer them on account of the larger wheels, they being 2¼in. diameter against 1¾in. diameter wheels of Plimpton's. In reference to the query itself, G. Fryer must make all his wheels of the same diameter; they must revolve in the same direction, and the position of the wheels should be so that the axle of the front pair of wheels should be exactly below the tread of the foot, and the axle of the hind pair as far back as possible on the footboard (theoretically, directly below the centre of the heel). With the indulgence of the editor (if G. Fryer should want the particulars of the castings, footboard, heel-plates, straps, and also the position of wheels on the footboard, and will advertise his address in the Sale Column), I will send tracing of same direct to him, which I sent to a contemporary two or three years ago, and also any other information.—G. H. Strong.

[49177.]—**Sharpening and Setting Hand-Saws.**—Having been scouring the country in search of employment, and laid up with rheumatics, and not able to lay my hands on back numbers, hence my silence, and I cannot refer to the same respecting the saw query; but the following diagram will, perhaps, explain all you require, and you will be able to understand, though I think, on reference, it will only be found to be a repetition of what has been illustrated before. The process is to have the two outside edges prominent for cutting, and allowing a rake in the tooth, instead of a hook tooth. The former allow of the smooth passage of the saw in working; the latter causing it to work in jumps, or what we denominate kicking. The most useful angle for general use ranges from 80° to 85°. With this a saw may be used, either rip or cross-cutting. The set of saw should be about one-third of the thickness of saw-plate on both sides, leaving about a third in line. Where the saw is sharpened at a greater angle, and set too wide, it leaves it with a needle tooth and a channel down the centre, down which you might run a needle. This will not make good work, as the needle points drop into the grain and tear the fibre—not cut it—and the needle points coming in contact with a knot or curl get bent, and away your saw goes, cutting anything but straight or smooth. Fig. 1 gives transverse section, 2 and 3, the cutting edge; 4 and 5, face or cheeks. The transverse section of saw shows the set as it should be at 6, and not as it is seen in many instances, like 7. These are, of course, rather exaggerated, to convey the idea; but I have seen hand-saws quite as bad. The lines on the quadrants show you the angle and passage of file, A, B, C, D, the while the rake of tooth should be as shown at 4; and as in many cases, like 5, when sharping a saw, and your file at the angle specified here, you will find that your file will work smooth and well; when, if it is held at right-angles, and you attempt to sharpen it, you may want a plug of wool in your ears, and a piece of cork to hold between your teeth.—Jack of All Trades.

FIG. 1.



[49179.]—**Glass Sweating.**—The following I take from the *Stationery Trades Journal*:—"The following method of prevention is, according to an American exchange, the subject of a recent patent: It consists in the use of a liquid composition of methylated spirits at about 63 per cent. overproof, glycerine, and any of the essential oils, and, in some cases, amber dissolved in spirit, according to the state of the atmosphere. The proportions which the inventor has found to answer well in practice are the following: About 8oz. glycerine to about 1gal. of spirit, the quantity of essential oil depending upon the nature of the same; but it will be understood that these proportions may be varied. Spirits of wine may be exployed, but methylated spirits is preferable on account of cheapness. In combining the above-named ingredients, the essential is destroyed by being mixed with the methylated spirit, and the liquid is then incorporated with the glycerine. The combination is effected at the ordinary temperature, the employment of heat being unnecessary. This liquid composition is applied to the internal surface of the pane of glass, either by rubbing it on with felt or with cotton waste, and thus the dull and dimmed appearance of glass usually produced by condensation, known as steaming or sweating, is avoided."—E. O. B.

[49186.]—**Goods Lost at Sea.**—Many thanks to "Hammer," p. 484; but I alluded to the many thousands of packages that are now imported every year without either sender or consignee thinking of insuring. They are of small value, say from £10 to £40 each case, and the consignees receive them only one at a time. There is nothing hypothetical in the question, because, it being understood that consignee will not pay for goods he has not received, it resolves itself into this, What is the custom when cash or part of the cash is sent with order? Is the order filled by the shipping of the goods, or, in other words, at whose risk are the goods when not insured? Is there any custom? I know that many thousands of cases are imported in this way from America, but, so far, do not recollect any dispute—the Atlantic liners so rarely meeting with a disaster. —T. J. P.

[49209.]—**Chemical Charcoal.**—I should say that in all probability it is soaked in sodium or potassium nitrate.—J. C. Belcher.

[49213.]—**Ice.**—Messrs. Todhunter and Roscoe are both right to a certain extent. There are three different kinds of ice—1st, that which forms on the surface; 2nd, that which forms in the middle of the water and which afterwards rises to the top; and 3rd, ground-ice, which is produced at the bottom, and this only takes place in violent and sudden colds, where the water is shallow and the surface disturbed in such a manner that the congelation cannot take place. No. 2 kind of ice is like small hail, and on rising to the surface it unites in large masses. The ground-ice forms commonly in running streams, especially where there are any weeds at the bottom to which it can adhere. —Chas. E. M. Inch.

[49214.]—**Water Analysis.**—I should advise the querist to place the water under examination on a water-bath and place a paraffin lamp beneath, by which means, I should say, he could evaporate the water at a trifling expense, and the dishes would keep clean. The CaO is best estimated with $NH_4\bar{O}$. Mix the solution under examination with sufficient NH_4Cl (this is not necessary if a large excess of HCl be present) to prevent the formation of a precipitate by ammonia, which is added in very slight excess; add $NH_4\bar{O}$ as long as a ppt. forms, then a further portion of the same re-agent, about sufficient to convert the magnesia also into oxalate (which remains in solution). This excess is absolutely indispensable to insure complete precipitation of the lime, as CaC_2O_4 is slightly soluble in solution of magnesium chloride not mixed with $NH_4\bar{O}$. Let the mixture stand twelve hours in a moderately-warm place, decant the clear liquid on to a filter, wash by decantation, dry, ignite at a low red heat, and weigh. Now moisten with a little $(NH_4)_2CO_3$, dry in the water-oven, ignite gently at a low red heat, and again weigh; this should correspond with the first. The ppt. consists of $CaCO_3$. If the ppt. is small, it may with advantage be converted into CaO over a good blowpipe: but when there is, say, ·5 of a grm., then it is better to weigh as carbonate. I think you would not manage to reduce CaO over a spirit-lamp without a blowpipe; you might manage magnesium pyrophosphate.—J. C. Belcher.

[49215.]—**Mange in Dog.**—Give the dog a tablespoonful of the following mixture: syrup of buckthorn 3 parts, syrup of white poppies 1 part, castor-oil 2 parts; shake well. Rub the following well into the skin twice daily, viz.: green iodide of mercury 1 drachm to 7 drachms of lard. Do not leave any on the hair, or the dog may lick it off, and a large dose would be poisonous. Keep his bowels open with the buckthorn mixture as long as you continue the ointment, and restrict meat. Give plenty of boiled vegetables. Sulphur is not much use in this case. See to the kennel—disinfect it; and first of all—wash the parts of dog affected with soap-and-water, with a little carbonate of soda. Well dry.—Sefton.

[49217.]—**Testing Strength of Bleaching Solution.**—The solution may be analysed by the following method. Preparation of the iodide of starch-paper:—Stir 3grm. of potato-starch in 250cc. of water, boil with stirring; add a solution of 1grm. of potassium iodide, and 1grm. of crystallised sodium carbonate, and dilute to 500cc. Moisten fine white (unsized) paper with this fluid and dry. Preparation of the solution of arsenious acid: Dissolve 4·436grm. of pure As_2O_3 and 13grm. of pure crystallised sodium carbonate in 600—700cc. of water with the aid of heat; let the solution cool, then dilute with water to 1 litre. Each cb.c. of this solution contains ·001436grm. of As_2O_3, corresponding to 1cc. of chlorine gas at 0° C. As arsenite of sodium in alkaline solution is liable, when exposed to excess of air, to be gradually converted into arseniate of sodium, this solution should be kept in small bottles with glass stoppers filled to the top, and a fresh bottle used for every new series of experiments. The process: Measure off 50cc. of the solution of chloride of lime, transfer to a beaker, and add slowly, and, at last, drop by drop, the solution of arsenious acid from a burette holding 50cc., with constant stirring, till a drop of the mixture produces no longer a blue spot on the iodised paper. It is very easy to hit the point exactly, as the gradually increasing faintness of the blue spots made on the paper indicates the termination of the reaction, and warns the operator to confine the further addition of the solution of arsenious acid to a single drop at a time. The number of cubic centimetres used are read off and calculated 1cc. = 1cc. of Cl.—J. C. Belcher.

[49223.]—**Nettle-Rash or Similar.**—"Tormented" is troubled with a gouty constitution, which exhibits itself in an eczematous attack. He should try homœopathic Aconitum occasionally, and a course of arsenicum alb., say 2 drops, 3 times a day after a meal. This, however, should be persevered in for a considerable time. His only safe course is to consult a medical man, as constitutions differ so much.—Meph.

[49225.] — **Nettle-Rash.** — An extraordinary effect is sometimes produced by fish, especially shell-fish, and still more especially mussels. An eruption like nettle-rash is produced among other results, and in some cases it is extremely dangerous. My own wife suffered in this way one night, and had I not known the fact, and at once taken the necessary measures, without waiting for sending to look up doctors, I very much doubt if she would have lived to the morning. The remarkable thing on that occasion was that everyone in the house had eaten of the same lot of mussels, and she was the only one attacked. She woke about two in the morning, covered with spots and swelling all over, and in deadly pain. I at once administered emetics and warm water, and got her into a vapour-bath, and she was all right next day; but she never eats mussels now—a moral I should commend to H. Gornall, from what he says.—Sigma.

[49228.]—**Bookbinding.** — Take two slips of hard wood and bevel off one of the edges; place them by the side of your book about ¼in. from back, put book with slips in your hand-screw, put on a little thin glue, and hammer the back round; by the use of these slips a recess will be formed to take the cover.—Turbine.

[49230.]—**Softening Steel.**—You do not state how you have annealed it. You should get a metal box to hold your sheet-steel in, and put your steel in with charcoal, put in a furnace, give it a regular heat, say, dark red, and, if it is possible, let furnace and box cool of themselves. Your box must have a lid to it, a good fit.—Thos. Clarke.

[49232.]—**Eyes Glowing in the Dusk.**—Have noticed the appearance mentioned several times. I think it is caused by the pupils of the eyes being much dilated—the light and the eyes of the person viewing being at equal and opposite angles to the retina of the eye in which it is seen. You may produce the appearance by keeping the patient long enough in the dark to dilate the pupils, and try the effect with a small amount of light.—W. J. F.

[49235.]—**Black-Letter Bible.**—I have a quarto B. L. Bible, and like the one in the possession of our lady friend, the original title-page is missing; but the New Testament has a title-page, dated 1597. Has our friend's Bible a title page to the New Testament?—Lamplighter.

[49236.]—**Screw Propulsion.**—"R. A. S." is much obliged to "Shipwright" for his reply to Query No. 1, and he will now explain more fully No. 2. I wish to support 2 cwt., including myself, on a raft formed of two air-tight canoes, 4ft. apart, and to propel the same if possible by a Screw Propeller at the end of each, the canoes to be as small as the weight to be carried will allow and not to exceed 8 or 9 feet long and preferred from 7 to 9 inches wide (height of canoes not included). Now I want to know best section to make canoes, best size for screw-propellers, and number of revolutions of each required per minute to obtain five miles per hour speed by my own labour. Also should like to know if it is important for all the "screw" to be submerged, or what would be the effect if only half.—R. A. S.

[49245.]—**Packing Pumps.**—I pack my pump glands with asbestos patent packing soaked amongst tallow, and they give no trouble, except when the neck and gland brasses get too much worn, and then they have to be renewed. If asbestos packing won't answer, try whitelead and tallow melted together with your spunyarn.—Engineman.

[49246.]—**Steam-Cock.**—I have used ground-glass, but cannot make a job with it; it tears the plug into rings: the same with emery. Perhaps "L. O. V." will say if he used oil or water with the ground-glass and bath-brick.—J. C.

[49254.]—**L. and S.W. Engines.**—8, Vesta; 12, Jupiter; 14, Mercury; 50, Buffalo; 56, Mentor; 60, Sappho; 104, Tigress; 105, Leopard; 107, Gem; 109, Rocklia; 112, Trent; 161, Shannon: all six-coupled goods engines except Gem, which is four-coupled, with outside cylinders, like Goth.—Richmond.

[49258.]—**Electrolysis.**—The green liquid round the anode is due to copper chloride; the chlorine liberated from the NaCl combining with the copper. —J. C. Belcher.

[49262.]—**Locomotives.**—G.N.R.: 310 is one of the large mineral engines, built at Doncaster, 1872-3. It is 6-coupled, single framed; cyls. 19in. by 28in., wheels 5ft. 1in. No. 92 is a 7ft. 6in. single—the only one of its class; cyls. 17½in. by 24in.; it has inside frames to driving-wheels, outside to leading and trailing; built at Doncaster in 1870. No. 593 is a 4-coupled—leading and driving—mixed traffic engine, by Kitson, 1876; coupled wheels 5ft. 6in., cyls. 17½in. by 24in. L. and Y.: 56 is a 4-coupled side-tank, with trailing bogie, built by Dübs and Co., 1878; leading and driving-wheels 5ft. 8in., cyls. 17½in. by 26in. No. 423 is a 6-coupled goods, built by L. and N.W. Co., Crewe, for L. and Y. Co., in 1872; wheels 5ft. 2in., cyls. 17in. by 24in. "Holme," 302, and "Stuart," 288, are 4-coupled pass. engines, single frames to all wheels, built by L. and Y. Co., 1861; cyls. 15in. by 22in., wheels 5ft. 9in. N.B.R.: No. 479 is an express bogie-engine, 6ft. 6in. 4-coupled; cyls. 18in. by 26in. M.R.: 78 is a 4-coupled pass., built at Derby, 1874 (?); cyls. 17in. by 24in., wheels 6ft. 8in. 813—see back numbers. 608 and 980 are 6-coupled double-framed goods; 5ft. 2in. wheels. 608—Kitson, 1867—has 16½in. by 24in. cyls. 980 (Dübs, 1873), has 17in. by 24in. cyls. G.W.: 1651—Swindon, 1882—is a 6-coupled saddle-tank for main line goods traffic; cyls. 17in. by 24in., wheels either 4ft. 6in. or 5ft. (I believe 4ft. 6in.). 2015 is a B.G. 7ft. 6in. single. 2214—Swindon, 1882—is a 4-coupled engine; 6ft. 6in. wheels, cyls. 17in. by 24in. I have noticed lately names and numbers of L.B. and S.C. and L. and S.W. engines. Will the readers who have been kind enough to answer the queries in question give a few more particulars as to dates, makers, and dimensions, also stating whether double or single-framed? It will be more interesting to all "locomotive" readers. In my letter on "Brake Failures" (20974, p. 455), there is an error. At the head of one of the columns of the first table, "reduced vacuum owing to *strength* of piston," has been printed for "reduced vacuum owing to *stroke* of piston."—Meteor.

[49268.]—**Engine Quary.**—Providing that the 1¼in. pipe will drive your engine at a short distance, I do not see what is to hinder it from doing so at 70ft.; but in place of a cock I would advise you to have a 1¼in. wheel-valve to get rid of your condensed water. You must have ¼in. drain-cock at your lowest level of the steam-pipe.—Thos. Clarke.

[49277.]—**Watch.**—As soon as you open a watch the top plate is visible. If it is a full circle, with balance working above and through it, it is called a full-plate watch; if about a quarter has been removed, and the balance works there, it is called a three-quarter plate; if there is no top plate, but a series of bars or bridges instead, it is called a bar-movement. The name is usually engraved on the barrel-bar (name-plate) in English watches; but this is a matter of taste or caprice. If put on an enamel dial properly, there is no more danger of its removal than of the figures.—C. M. R.

[49277.]—**Watch.**—You must be a very young watchmaker indeed if you have not yet learnt to distinguish between a "¾ plate," a "full plate," and a "bar" movement. The terms really explain themselves. A ¾ plate is one such as is seen in Geneve watches or levers, where the cylinder and escape-wheel, or staff and pallets, are exposed only. A full plate covers the whole, and the balance staff only works through it. A bar movement is in detached pieces—i.e., each wheel has a separate bar. As regards the naming of watches, it is usual with watch-vendors who have watches made for them to order, to have their names put on the dial. It is painted or printed "under glaze," and that being so, will last as long as the dial, be it in wear 50 or 100 years. If painted "over glaze" it may be erased by wear. When the names are engraved on the barrel bar, you may opine that such watches are chiefly made for such as choose to buy them, and unless made throughout to order, are named after purchase.—Alfojok.

[49279.]—**Indicator Diagram.**—You omitted to give the scale of the diagram. Without knowing it, it is impossible to say with certainty whether the steam is wiredrawn or not. Give the scale and description of valve-gear and I will help you.—Labor Omnia Vincit.

[49279.] — **Indicator Diagram.** — You have omitted the most important data to enable anyone to form an opinion on the diagrams—viz., the atmo. line and the scale. The diagrams show excessive throttling somewhere. Most probably, additional lap has been given to the valve without altering the throw of the eccentric; the consequence of which is, the steam-ports are never properly opened. The remedy is to put on a new eccentric sheave, with sufficient throw to open the steam-ports their full width—of course first ascertaining that there is room in the steam-chest to do this.—W. J.

[49281.]—**Plaster Busts.**—Let the coats of size or varnish you have given the plaster busts peel off, or gently scrape them off, and then smooth them with No. 1 emery-cloth; when you have got all the old stuff off, and the busts are nice and smooth, then mix a small quantity of red-lead and turpentine together, and paint them over with the mixture. As you use it, keep stirring it with the brush, or the red-lead will settle to the bottom of the pot. After they are dry you can then paint them any colour you like, and varnish them with crystal paper varnish.—J. Poulson.

[49282.]—**Laxey Wheel, Isle of Man.**—This wheel was constructed in 1854, by Mr. John Casement, a native of Laxey. It is 72ft. in diam., 6ft. in breadth, contains 188 buckets, and 48 spokes. The balance at the wheel-shaft is 10tons, and the top balance 7tons. It is 200 h.p., and is supplied with water from a reservoir in Glen Drink, a short distance up the adjacent hills.—F. T. Bidlake.

[49282.]—**Laxey Wheel, Isle of Man.**—The following particulars of this monster wheel are taken from "Brown's Guide," p. 196. "On the 27th September, 1854, the Lady Isabella (as the wheel is named) made her first turn, and since then has been almost constantly at work, being stopped only for the necessary painting, &c. The diameter of the wheel is 72ft. 6in.; breadth, 6ft.; circumference, 217ft. 6in., and the number of revolutions, two per minute when required, by which it raises over 250 gallons of water per minute, from a depth of more than 200 fathoms. The wheel is an overshot, and is so truly set that even a deflection of ¼in. cannot be detected. The water to supply the wheel is brought in pipes from reservoirs upon the mountains, and ascends through the circular white pillar to the top of the wheel; round this pillar there is a winding staircase, which the majority of visitors ascend."—A Young Astronomer.

[49282.]—**Laxey Wheel.**—I have several times visited the Isle of Man, but never left without seeing that noble piece of work the "Laxey Wheel," of which the natives are so justly proud, it having been made at Laxey. The wheel is 72 feet in diameter, 6 feet wide, making 3 to 4 revolutions per minute when I have seen it. It is an overshot wheel. The water used for driving wheel is collected and stored on the hills surrounding the Laxey glen; the reservoir is much higher than the wheel; the water is carried through a main underground and up the centre of the stone pillar which forms the centre of the staircase, the water then leaves the pillar at the top and flows along a race under the platform over the wheel, along which visitors are allowed to pass and obtain a splendid view. The work done by wheel is to pump water from the mines; the pumps being in the mines, the water drawn from the mines and waste water from wheel are used to work other water wheels, and for ore-washing purposes. The natives do insist on telling visitors that the wheel is worked by the water it pumps from the mine, but this is too good—perpetual motion all out. "John Downe" had better go to the island for a holiday, as the wheel alone is worth a visit, as it would do credit to the finest engineering firm in the world, 72ft. dia. and true to ¼ of an inch all round. The mines are also worth a visit. Can give further information about the island if he desires it, although not a native.—Boswell.

[49290.]—**Obesity.**—This is Banting's diet. The patient may eat lean mutton, beef, veal, lamb, tongue, soups not thickened, beef-tea and broths, poultry, game, fish, cheese, eggs, bread in moderation, greens, spinach, watercress, mustard and cress, lettuce, asparagus, celery, radishes, French beans, peas, sprouts, cabbage, cauliflower, onions, seakale, jellies, flavoured but not sweetened, fresh fruit in moderation, without sugar or cream; pickles. May not eat: fat bacon and ham, fat of meat, butter, cream, sugar, potatoes, carrots, parsnips, beetroot, rice, arrowroot, sago, tapioca, macaroni, vermicelli, semolina, custard, pastry and puddings of all kinds, sweet cakes. May drink: tea, coffee, cocoa from nibs, with milk, but without cream or sugar; dry wines in moderation, light bitter beer, aërated waters. May not drink: milk, except sparingly; stout, sweet wines, and ales.—Nomen.

[49294.]—**Low-Pressure Air-Reservoir.**—What you want is a self-acting reducing valve. One I know would answer well is a patent, and if you like to advertise your address, I would put you in communication with the makers.—Labor Omnia Vincit.

[49294.]—**Low-Pressure Air-Reservoir.**—Providing the air flows from the small reservoir continuously and at the same rate per second, the pressure in it may be kept uniform by making the area of the passage between the two reservoirs such as to pass the necessary volume at the lesser density under the pressure which is the difference between the pressures in the two reservoirs. If the pressure in the larger reservoir varies, the variation may be made to increase or diminish the area of the passage by means of the motion of a piston acting on one end of a lever, the other end acting on the valve which regulates the area of the passage.—C. S.

[49295.]—**Cement.**—Glue swelled in cold water, and digested in linseed oil, is tenacious, and will resist moisture; red-lead may be added.—Nomen.

[49300.]—**Wimshurst Machine.**—It would not be dangerous (except probably to the machine) in the event of children meddling with it: they might give themselves a sharp shock, which would be beneficial and instructive, being experimental learning to let things alone. Neither it nor any other electric machine is of any use whatever for lighting, or for storing electricity, except in the way of charging a Leyden jar.—Sigma.

[49301.]—**Organ Stops.**—Opinions vary very much with regard to the utility of the various stops now used in organs. Some of the stops found in the older organs are being omitted in newer-built ones—whether wisely or not is individual opinion. Among those omitted "C. H. D." mentions the principal ones. I think the so-called "clarionet flute" is never now used, being only the upper part of a pierced stopped diapason. The "flute traverso" is made by a few builders, but I think not many. One builder uses a three-cornered pipe—that is, two sides, a front, and no back; of course, of wood. Another uses a double-length open metal pipe, with a hole in the side half-way up the pipe. Both call them flute traverso, the last being really a harmonic flute. So much for names. The clarionet flute has not the slightest claim to be allied to its namesake, for it has not an atom of clarionet tone, no more than an oboe flute is any approach to an oboe intonation. It is simply a cheaply-made, cheaply-voiced stopped wood register, generally only commencing at the tenor C key, with a pipe 1ft. long, and used in the cheapest of work. The flute traverso is a step higher, and should be properly made of wood, preferably of Swiss pine; or, if that is not obtainable, of white pine, varnished inside with spirit varnish, and outside with oak varnish. If properly made and voiced, the tone is very pleasant; but as I observed before, it is not often made. The most recent additions to organ registers are the gamba species, and in my opinion, the most serviceable of any, and the most useful. The gamba proper is a straight pipe with a longitudinal aperture at the side, and near the top of the pipe. Why the gamba is taking the place of the viol di gamba and simple cone gamba, is that, possessing the pungent tone of the viol di gamba, it has more body, and a quicker intonation, scale for scale; it is easier voiced, and does not cost so much making. The salcional is a smal edition of the gamba, and more delicately voiced. The keraulophon in tone is similar to a mild gamba, and in my opinion is neither one thing nor another. In its best-known form it has a slide of metal at the top, adjusted to move up or down for tuning, and every vibration in the organ has a tendency to cause these slides to slip, and so put the pipe out of tune. It is simply a slotted pipe, the same as a gamba, but with a slide which can be very easily dispensed with. The gamba species, that is, the straight tube with a slot, is known by various names, to distinguish the various scales—as gamba, viol, viola, salcional, vox angelica, and vox celestis. These all vary in scale, which makes the principal difference in tone. The tenor C varying from 3¼in. to 1⅞in. The two ranks of the vox celestis are made up of salcional and vox angelica. These small-scaled gamba pipes require very careful voicing, or the tone is simply nothing. Nothing is more beautiful than a nicely regulated and voiced small stop of the gamba species. In the smaller scales, the German bevel of the languid is best, and gives the best crisp tone. The languid edge must be hard, sharp, and clean, the notching so thin and widely-spaced as almost to escape casual observation. I certainly prefer the slotted gamba for general use, in place of the bell gamba and keraulophon, and consider it most decidedly a step in the right direction. It has been on my mind to write a short article on the various registers in use, their intonation in voicing, but, as yet, could not find sufficient spare time. The naming of the various stops is so different in the several builders' organs, that the name on the stop knob is often delusive, so that if "C H. D." finds a bad stop with "gamba" on the label, he must not conclude all stops are the same. Only yesterday I heard a vox angelica, by a well-known builder, which was an absolute disgrace, and showed a poor appreciation of the "voice angelic" on the voicer's part. I know an amateur who could produce better work.—Uranium.

[49303.]—**Pump.**—If you cannot get sufficient fall (2ft. to 3ft.) to work a small hydraulic ram, would not a windmill pump answer? The 1in. galvanised iron pipe, 12in. under the surface, is both too small for hand-pump suction pipe and too near the surface to be safe from frost unless you had a small air-cock below the bottom clack, so as to empty suction pipe every night. If you can get the fall, a small American pattern hydraulic ram would enable you to use your 1in. pipes, and you would have a constant water supply without pumping.—Labor Omnia Vincit.

[49308.] — **Siphon.** — It acts by atmospheric pressure, and consequently cannot be depended on for overcoming heights greater than about 30ft. near the level of the sea, and a less height at great elevations.—Nomen.

[49308.]—**Siphon.**—It works only by the difference of pressure in the two legs, that is, the relative lengths of the two columns of water. But as the water is only lifted in the entering leg by atmospheric pressure it can only work under 32ft. of lift. Beyond this the water charged in it would simply produce a vacuum in the bend.—Sigma.

[49310.]—**To "Fellow Workman" or "Alfojoe."**—I generally proceed as follows:—Put a peg or anything suitable between the arms of the centre or fourth wheel to prevent them turning, then remove hands, escape-wheel, pallets, dial, &c. When all is clear you can remove peg, and let it run down; or, as I prefer, place key on winding-square, grip it firmly with one hand, raise the click, and let it (the key) revolve gently until it is down.—C. M. R.

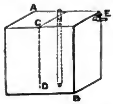
[49310.]—**Letting-down Spring of French Clock.**—To "F. W." or "Alfojoe."—Visible-escapement French clocks, being rather more intricate in their make than the ordinary French clocks, require just a little more care in their management, particularly when a novice attempts to clean them. After removing from the case, take off the hands and unpin the outer dial—*i.e.*, that having the figures upon it; next, place something pliant and small in the next wheel to the escape-wheel, and make it secure; then unscrew and take out the pallets. Now unscrew and remove the bridge in which the escape-wheel works, then remove the wheel and small inner dial. You will now be able to get at the clickwork. Give the click-screw a half-turn, just to free it; fix in the vice, or hold in the hand, a key secured on the arbor square. If you fix in the vice, invert the key, set the square in, release the click, and let the clock revolve gently until down, keeping a firm hold upon it meanwhile. Do the same with both springs. If you let it down by hand, hold the movement firmly between the knees, and, holding the key securely, release the click and allow the spring to uncoil as far as your hand can turn; then replace the click in the ratchet-wheel, and start afresh until the spring is down. It is easy to let a clock run down when the pallets are out, but a great risk attends this plan if it should happen that the pivots are in any way corroded up or rusty. In early days I ran several pivots off in this way, but know better now.—Alfojoe.

[49319.]—**Astronomical.**—"J. R." could not possibly have two better tests for his 2in. telescope than γ Leonis and Cassini's division in Saturn's Ring, and the fact that he has divided the one and seen the other, speaks volumes both for his eye and his instrument. It is, however, surprising that a telescope equal to the above performances will not show the companion to Polaris, which has been seen with telescopes from 1in. upwards. "J. R." must surely have looked for it under unfavourable circumstances. Let him try again, remembering that Webb says, "80 on a 2in. will show it if the eye and telescope are good." The companion to Rigel is a pretty fair test for his instrument, but that to Vega is much beyond his reach. In conclusion, it may assist "J. R." to know that the least theoretical distance at which two stars are separable by a telescope of his size is 2·28", and the magnitude of the smallest star fairly visible with such an aperture is 10·7 (Argelander's scale). These numbers, however, are almost invariably respectively in defect and in excess of the practical ones.—A Young Astronomer.

[49324.]—**Joshua and the Sun and Moon.**—The narrative is obviously a fictitious legend interpolated in the older books, probably first as a kind of note, and transferred to the text. There are lots of such interpolations. There is an evidence, which I have found for myself, that it is a mere legend. The writer of the Epistle to the Hebrews, now generally believed to have been Apollos, gives in chapter xi. a list of many things, some of no great import, accomplished by "faith." He says no word about this asserted wonder of Joshua's. I think we may conclude that he knew it was not true; for he and most of us would agree with the remark in the account, "There was no day like that before or after it that the Lord hearkened to the voice of a man." At all events, these words prove that the account itself was written ages after the alleged occurrence.—Sigma.

[49327.]—**Convulsions in Cats.**—"G. B.," if a merciful man and really fond of animals, will in this case procure an ounce of chloroform, and putting it on some cotton-wool at the bottom of a tumbler (half of it at first), hold it over the cat's nose when it has the next fit till a painless death supervenes.—F.R.C.S.

[49328.]—**Blowpipe Apparatus.**—I think the "water" blowpipe would suit "Fidelis." A B is a box of zinc or tin. C D is a watertight partition going across the middle of the box, and reaching to within half an inch of the bottom. The part C E is covered over with a watertight cover. A small tube goes through this (quarter-inch composition will do), reaching nearly to the bottom. At any part on or near the top a tap E is soldered in. The tube should be covered with a valve of oiled silk at the bottom, opening downwards. In use the tap E is closed, and the box filled with water through A D. The tap should then be turned on, and the air allowed to escape. A piece of indiarubber tube should be fitted on the projecting part of the tube. This should be blown through; the air bubbles up into the chamber D E forcing the water into the other chamber, A D, under the partition. The pressure of the water in A D upon the air in D E will force the air in a continuous stream through E. The box should have a wooden case, or the sides will bulge.—JAKAYEFF.



[49335.]—**Bi-Oxide of Barium.**—Binoxide of barium, or BaO_2, is produced by passing air over Baryta, or BaO, heated in a tube. The BaO absorbs the oxygen of the air, and so becomes converted into BaO_2.—TERRAS.

[49340.]—**Jupiter.**—The great red spot on Jupiter was central on Jan. 15 at about 4h. 27m. and 14h. 23m. Therefore, the object seen by him at about 10 p.m. on that date could not possibly have been the red spot. I believe that this spot is now so faint that it is beyond the reach of his 3¼in. refractor. He may, however, ascertain this definitely for himself by carefully examining Jupiter at some of the following times, when the great red spot will be crossing the central meridian of the planet:—

	h.		h.
Feb. 4	10·9	Feb. 12	7·6
„ 5	6·8	„ 13	13·3
„ 6	12·5	„ 14	9·2
„ 7	8·4	„ 15	5·1
„ 8	14·2	„ 16	10·8
„ 9	10·1	„ 17	6·7
„ 10	5·9	„ 18	12·5
„ 11	11·7	„ 19	8·3

The last time I saw the spot was on Jan. 23, when it was estimated central at 11h. 1m. It was very faint then. The equatoreal white spot was noted central at 12h. 33m. the same night. The latter was very brilliant, and is now a much easier object than the red spot.—W. F. DENNING, Bristol, Jan. 26.

[49343.]—**Crystoleum Pictures.**—"Photo" will find a process apparently identical with the "crystoleum" process described fully on p. 141 of this year's "Year-book of Photography."—CALCULUS.

[49344.]—**Violin Queries.**—The strings, both of the violin and violoncello, are tuned to perfect fifths. The pianoforte, harmonium, and organ will not admit of all the fifths in the scale being tuned perfect; but the degree of imperfection in the various intervals is so slight, that it does not objectionably interfere with the notes of the open strings on the violin. Some of the fifths on the pianoforte may be tuned perfect if preferred; but it is better to divide the deficiency from perfection among the various intervals of the scale. In the unequal method of tuning, the intervals of certain keys are tuned perfect, thus throwing greater imperfection among the remote keys; but this bad method of tuning is almost abandoned at the present time. When tuning the violin to chord with the pianoforte, it is only necessary to tune the A string to the middle A on the pianoforte. Then, if tuned in perfect fifths, and the piano is in good tune as well, all will go well. I do not quite understand the second part of this query. Middle C, or C on the first ledger-line above the bass clef, is the same on the violin as on any other instrument. To suppose that any note can be its octave below as well as its own note at the same time, is ridiculously absurd.—G. FRYER.

[49345.]—**Hoist.**—You ask for dimensions and probable cost of a hoist to lift 5cwt., but give no particulars of the building, class of goods to be hoisted, driving power, &c., &c., all of which must be known before any satisfactory reply can be given. I shall be pleased to be of any assistance to you if you will fully state your requirements.—LABOR OMNIA VINCIT.

[49348.]—**G.E. Engines.**—No. 56, tank 4ft. 10in., coupled wheels, 16½in. by 22in. cylinders; No. 72, tank 5ft. 3in., coupled wheels, 17in. by 24in. cylinders; No. 189, tank, 5ft. 6in., coupled wheels, 17in. by 24in. cylinders; No. 229, small saddle tank; Nos. 384, 400, 6ft., coupled wheels, 17in. by 24in. cylinders; No. 406, 6ft., coupled wheels, 17in. by 24in. cylinders, 3ft. bogie wheels.—H. S. P.

[49349.]—**Clock.**—As the escape-wheels of American clocks vary slightly in size and number of teeth, I cannot determine the exact number of teeth the pallets of your clock covered originally. It is a matter of little importance whether the new pallets cover one more or less. The general numbers are 7 to 10, I think. As there is a right and a wrong way to put the pallets on, just see the effect either way. The vertical pallet should be to the right and the oblique one to the left of you when placed on the pin, presuming that the pallets rock in a horizontal position below the escape-wheel. If placed vertically, the oblique pallet would be the lowest. In gauging for correctness of span when the point of a tooth is exactly on the edge of the oblique pallet face, the vertical pallet should be exactly central between two teeth a given number away, when held in a line with the wheel's circumference. This being correct, the "drop" alone has to be seen to. Should there be too much on one pallet (both should have the same amount of drop), shift the stud which carries the pallet-pin just a shade either up or down, to or away, from the escape-wheel. Replace pallets and try again. It may need moving one way or another, according to circumstances. The stud is very securely riveted, but will readily move when held firmly with a stout pair of pliers. If the span of the pallets is incorrect, another pair must be got. Don't attempt closing or opening by force, as, being very hard, they would break immediately. If they need a little cutting down, don't soften them for filing, but set them square to a fine grindstone and remove what is necessary, making smooth afterwards with Arkansas stone and oil. Be careful to leave no burr on the acting faces. The oblique pallet should be undercut, and the vertical feather-edged. This allows clearance in escaping.—ALFOJOE.

UNANSWERED QUERIES.

◆

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "C. M. R." has replied to 48610.

48655. Model Locomotive Coupling-rods, p. 281.
48656. Model Axle-boxes, 281.
48663. Printing on Bone, 282.
48664. The Laws of Moving Bodies, 282.
48665. Jams and Pickles, 282.
48669. Methyl and Ethyl Cacodyl, 282.
48673. French Locomotives, 282.
48677. Sharpening Gimlets, 282.
48680. Horizontal Slot Drilling Machine, 282.
48686. Saddles, 282.
48702. Model Loom, 283.
48707. Glass Colouring, 283.
48708. Wood Turning and Bobbin Making, 283.
48714. Hydraulics, 283.
48717. Screw Presses, 283.

48945. Rig for Small Boat, p. 367.
48949. Steam and Exhaust Ports of Compound Engines, 367.
48951. Drawing, 367.
48957. To Mr. G. Tolman, 367.
48958. Polygons, 367.
48959. Weighted Governors, 367.
48962. Safety-Valve Graduation, 367.
48965. Water-Wheel Grease, 367.
48967. Price for Weaving Cloth, 367.
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48975. Organ, 368.
48976. To Clean off Lacquered Gum, 368.
48978. Organs, 368.
48982. Gower-Bell Telephone, 368.
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48994. Screw Cutting, 368.
49000. Firewood Cutting, 368.
49003. Steam Blast Cupola, 368.
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49007. Heating by Steam, 368.
49008. Beer, 368.

THE relative longevity in various occupations has not yet been made out from the census returns of 1881. In 1851 it appears that out of every thousand persons between the ages of twenty-five and fifty-five, forty died on an average. Classified according to the most favourable mortality, and increasing downward, the returns gave the following tables:—Below the average (1) merchants; (2) weavers; (3) cobblers; (4) carpenters; (5) blacksmiths; (6) labourers. Above the average: (7) miners; (8) tailors; (9) bakers; (10) butchers; (11) liquor dealers.

MESSRS. TWENEY and Co., of Swansea, have issued a medallion portrait of Mr. W. E. Gladstone, Mr. H. Gladstone, and Mr. W. H. Gladstone, in commemoration of the first-named gentleman's Parliamentary jubilee. It is well executed, very cheap, and will please all admirers of the Prime Minister and his sons.

QUERIES.

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[49354.]—**Medical-Galvanism.**—I shall be glad of any advice from Dr. Edmunds, or anyone able to speak from experience on this subject. I have a daughter, age 13, who has always been afflicted with slight twitchings and trembling of her hands and head. Two or three years ago a doctor said he thought it was a form of St. Vitus' Dance, and advised Parish's food, bathing, and outdoor exercise, and that she would probably grow out of it. He also said it might be caused by worms. No benefit has resulted, and there is no sign of her symptoms lessening. She cannot write without pressing her hand on the paper, causing a slow cramped hand. Can only sew by holding her hands against her chest to steady them. She cannot, in short, do anything that requires a steady hand. Her wrists and ankles are weak, and she lacks the ordinary strength and control of all her muscles. Her walk is awkward, and her speech somewhat indistinct. To me these symptoms are painfully apparent; but to a casual observer she appears simply awkward and restless. Her general health is good, and she is of quite ordinary intelligence. She has never had any illness, except an occasional feverish cold, and then the trembling increases, and she can scarcely stand. I am at a loss to know what to do with her, or how she is to earn a living. Would galvanism be likely to do her good, and if so, what is the proper apparatus, and how should it be applied? I shall be grateful for any advice.—A. S. B.

[49355.]—**To "F.R.A.S."**—Your polite reply to my inquiry does not clear up the apparent discrepancy to my mind about the perihelion. Mr. Finlay first observed the comet on the 7th September, and again on the 8th and 9th, as I understood close to the sun; you say it was some degrees distant, which I think must have been, as its perihelion distance was 78,800. I calculate it would pass half round the sun (180°) in 3½ hours; as it was close up to the sun on the 17th, it would be some degrees distant nine days previously. I am perfectly aware that when the sun was in opposition to the comet, the earth must be in a straight line between them; but then (6 January) as the comet was, I presume, far beyond the orbit of Mars and moving away from the sun, its motion would be in the direction of its aphelion. I did not mean it was moving exactly in a line with the aphelion—that would be absurd. As the earth's longitude was on the 6th inst. 106°, that must be the longitude of the comet. The ordinate to the axis of its orbit at the distance I assume would subtend an angle from the sun of only a few degrees from the aphelion, its perihelion would, of course, be 180° distant, or in longitude about 290° not 55°. I am, therefore, under the impression there must be some mistake in the elements given. Mr. Penrose says the early observations are totally discordant with recent observations. The comet's period was first stated to be only a few months, it is now stated to be some three or four thousand years.—C. A. B.

[49356.]—**Legal.**—Some time back, say 5 or 6 years, new roads have been found in this town (that is in the rough) and built upon—the corporation has laid down their water main and sewage main, and the gas company their main; of course, the roads by building materials being used has made it very rough and muddy, and during all this time, all rates has been paid by the residents in these new roads. The corporation has now about to kerb and make the road properly, and gravel it and channel it for rain water, are given or about to give notice to the owners, or supposed owners, that they will have to pay the corporation the entire outlay of the road. I ought to state, last year, they (the corporation) has had an Act of Parliament passed, and on the strength of this, they intend to enforce the payment. Can they make the owners pay the outlay?—POOR OWNER.

[49357.]—**Ventilation of Room.**—Every ordinary gas-flame burns completely about 20 cubic feet of air per hour, and hence renders at least 100 cubic feet unfit for breathing. I wish to convey away this burnt air by suitable pipes from the rooms I usually occupy. Some years ago I thought of adopting ventilating globes, at that time extensively advertised as a patent, but the price was prohibitive. I, then, proposed to use an arrangement of sheet-iron pipes, which any blacksmith could construct; but my family objected that the thing would be intolerably ugly. What is wanted is something to work well, without a back draught; to be neat, and also cheap. It should not cost much more than a set of neatly-made stove pipes. If any of your correspondents can throw out some practical hints on the subject, he will do much to improve the conditions of health of your interrogator and many others who, in these long winter evenings have to breathe contaminated air in rooms absolutely without ventilation.—PI-SQUARED.

[49358.]—**Locomotive Boiler.**—To MR. T. CLARKE—The size of boiler I wish to have brazed together is 18in. long, 5½in. diam., made out of thick copper, to burn coal. Please say how the end of tubes in the inside of firebox end is brazed, there not being room enough to get the hand in. I shall be greatly obliged for a few hints for this kind of model boiler making. Also say if the inside of firebox should be flat on top or arched.—W. R.

[49359.]—**Bassoon.**—Will any experienced bassoon player kindly inform me whether the difficulty in making the upper notes has anything to do with the quality or nature of the reed, or is it bad management of the player's lips? These notes seem to come out more easily when the reed is comparatively dry; but after practising for a time they are only obtained by great pressure, and often will not come at all. Is this the player's or the reed's fault? Ought the reed to be further into or out of the mouth than usual for lower and middle notes, or ought it to be in the same position for the whole compass of the instrument? Ought new reeds to be rubbed down before use, or are they ready as sold? If rubbed down, what part particularly should be operated upon? Some reeds are broad, and some narrow; some long and some short—which are best? I also notice some have the corners cut off. What is the object of this? In what manner does the size of the small hole in the crook affect the tone?—STUDENT.

[49360.]—**Portable Tubes.**—Can any of our readers oblige one in a fix with a few hints on taking out old tubes of portable engine and replacing same with new tubes? What is the best method of securing tubes, both firebox and smoke-box end? I have had new tubes put in, but they do not hold, and appear split smoke-box end. Dugeon's tube-expander was used; both ends and steel rings turned and fitted tightly, and driven in firebox end.—Tube.

[49361.]—**Heating Boiler by Gas.**—I should be glad if any of your numerous readers could inform me whether it is practicable to use gas instead of coal for heating steam boilers, and what is the approximate consumption of gas for 12 hours, say for a 40 gallon boiler?—A Novice.

[49362.]—**Converting Flute into Flageolet.**—I have an excellent eight-keyed concert flute, and am anxious to know whether it can be converted into a flageolet, that is on the same principle as a whistle. Will some kind musical friend inform me whether this is practicable? This question was answered some months ago in the "E. M.": "That a mouthpiece might be inserted on the top"; but this was too vague to act upon.—Flageolet.

[49363.]—**Cement to Resist Moisture.**—Will some correspondent oblige by telling me of a glue or cement to resist moisture, such as coachbuilders use to fasten cloth on the frames of carriage windows?—It is for this purpose I require it.—H. F. L.

[49364.]—**Bamboo.**—I have made a canterbury and some more useful little things with bamboo cane. How could I give it the rich brown or bright yellow colour that Japanese goods have?—W. J. F.

[49365.]—**Blowing-up Vessel.**—Could any of your correspondents kindly give me the best method of blowing up, or rather blowing to pieces the sides and bottom of an old vessel lying in 8ft. water at low tide, and nearly flowed over at high water? If dynamite is recommended, where can it be procured, and what is the method of using?—R. L. C.

[49366.]—**Hydraulic Ram.**—In the construction of a hydraulic press, how is the cylinder for the ram made? Is it in two halves or in one? If in one, how is the leather packing put in between the piston and inside of cylinder? Is the leather specially prepared for the purpose, and how is it the piston does not tear it up in the working when they are so close jammed together?—A. B. C.

[49367.]—**Defective Rupture Trusses.**—I have for some time been suffering from hernia, and can only find relief by wearing a spring truss. I have tried all kinds of so-called strap-trusses, but find them useless. The defect in the spring truss I have had made or purchased is, that after using for a few weeks the spring gets so corroded with rust, in consequence of my perspiring so freely, that they so weaken as to be useless or break. Can Dr. Edmunds inform me of any truss without that defect?—A Poor Truss Wearer.

[49368.]—**Solvents for Dried Leaves of Plants.**—Will any of our chemical correspondents oblige by naming one or more thorough solvents for these that shall be innocuous to animal life, and not too expensive?—Mac.

[49369.]—**Fireproofing.**—Wanted a very cheap material for general purposes. Is phosphate of ammonia applicable to anything but wood, say for mixing with mortar, &c., and where and how is it sold?—Mac.

[49370.]—**Making Tuning-Fork.**—Full instructions on this subject will oblige—viz.: choice of steel, mode of working and tempering, equalising of elasticity of prongs, tuning, &c.?—Mac.

[49371.]—**Telescope and Microscope.**—Have these instruments ever been used in conjunction for observing the surface of the moon, say by reflection from the speculum to the microscope, or in any other such way?—Mac.

[49372.]—**Friendly Societies.**—To Mr. Wetherfield.—Will you kindly answer the following?—I belong to a branch of the Manchester Unity Friendly Society, which was registered in 1866. Did the Friendly Societies Act of 1875 cancel the former registration, and should it be registered?—R. J.

[49373.]—**Rain Forecasts.**—I should be much obliged to any correspondent who may have experimented with the spectroscope for rain forecasts, if he would publish the result.—N. Penrose.

[49374.]—**Boiler.**—What number and size of boilers (stationary) would be required to produce 16,000 pounds weight of steam at 90lb. pressure?—A.

[49375.]—**Saw Hammering.**—Can any reader give me a hint or two on saw hammering, or tell me whether there is a book on the same? I don't know whether it has been answered in the replies, as I gave up taking them for a few years, and missed the back numbers. I have hammered four, and three of them work very well; but the fourth I can't get straight. It is a little too slack in the centre, and straight one way; and when I put the straight edge crossways it is hollow: and when I get the latter straight the first way is hollow about ⅛in.—A Sawyer.

[49376.]—**Moulding Rings.**—Will any of our kind friends give me a little information about moulding rings, and how to make the mould?—A Young Mechanic.

[49377.]—**What Shall We Eat and Drink?**—T. R. Allinson says: "Allow me to feed a person and I will make him dull and stupid or clever and bright, always ailing or in uniform good health, and even long or short lived, and all by diet." Now if T. R. Allinson will inform me how this is done, he will confer on me the greatest favour, and one for which I will be grateful while I live, and, I doubt not, so will many other readers of the "E. M.," as I am dull and stupid about half, and ailing, more or less, about one third, of my time?—W. R.

[49378.]—**Boiler.**—I have a small oscillating engine, cylinder 1in. bore, and about 2in. stroke. Will you please tell me what size boiler it will require to drive it, and whether one made of block tin would be strong enough? Copper ones are so expensive. I should also like to have an arrangement to keep the boiler constantly supplied, so that I might leave it working for a lengthy time without attention, while at business. Can it be done? Would the ball-and-socket used in some household boilers do?—J. Dixen.

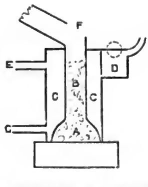
[49379.]—**Cylinder Cover.**—I have a horizontal engine, and am going to take the piston out to give it new rings; but I am at a loss to know how to take off the front cover, as it has not been off for six years (the back cover I have had off cleaning piston). I cannot take the piston out at the back—the condenser is in the way. Will any of our readers tell me how to proceed, as I have known them to have been broken in taking them off?—Anxious to Learn.

[49380.]—**Watchwork.**—To "Alfojor" or "Hamlet."—Will either of these gentlemen instruct how to rivet a pinion into a wheel, as I have great difficulty in getting them square? I hold the pinion in a pair of pliers, and get as near upright as possible, and then rivet, but this is very uncertain. Do I want more practice, or don't I go the right way about it?—J. S.

[49381.]—**Watch Turns.**—To "Hamlet."—Can I purchase the centres for turns illustrated on page 412, or are the two gunmetal centres supplied with turns for this purpose? What are the screws in the other centres for?—J. S.

[49382.]—**Tonic.**—Would one of our generous medical contributors kindly say what is the best tonic to give a boy nearly three years old to create an appetite? His food is plentiful and varied, but like an elder brother, he has lost his inclination to eat for about six months, necessitating one feeding him, or otherwise, coaxing or compelling to eat. We fear the defective nutrition will lead, as it did in his brother's case at the same age, to St. Vitus' dance. He has, of necessity, been much indoors, but lately has been three hours daily in the open air when weather permits, and his only medicine, tincture of orange?—J. S. M.

[49383.]—**Boiling Water.**—I want to get a supply of boiling water for washing purposes at the least cost of fuel. Can any of our readers recommend a good plan? I require about 70 gallons to start with in the morning, and in the course of the day about 200 gallons more. A friend of mine suggests the plan I have sketched. A is the furnace continued in the flue B. This would be made of ¼in. wrought-iron. C C is the boiler surrounding the furnace and flue, and made of ⅛in. galvanised iron. D is a supply cistern fed with a ball-tap, so as to keep the boiler continually full. E and G are pipes communicating with a second cistern on same level, from which the water would be drawn as required, the water circulating constantly between the boiler and cistern. The furnace A would have a door and an arrangement by which the supply of air could be totally cut off. The coke would be supplied through a door in the flue at F, and the furnace and flue, A and B, would generally be kept full of coke. When the water is not wanted immediately in a boiling state, the draught is to be shut off, by cutting off the supply of air from the bottom of the furnace, and the coke allowed to cool down. When the water is wanted to be again brought up to boiling-point, the draught is to be renewed, and if needful, an artificial draught can be introduced from a fan, to blow up the fire quickly. The affair is required to stand on a board floor in an upper story. I shall be very much obliged for any suggestions as to the construction of the apparatus, or as to preventing any risk of fire.—T. B. C.



[49384.]—**Photo Lens.**—Some time ago a correspondent, in answer to a question in the "E. M.," said that a doublet for landscape photography might be made in a portrait lens, by taking out the back combination altogether, and inserting in its place a plano-convex lens, similar to the front lens, each lens having its convex side away from the other. Can some reader say how such a combination would answer, whether it would be made rapid and give a sharper picture than by using the front plano-convex lens alone, and in what way such a combination would differ from a rapid symmetrical lens? What is the usual price to give for the front plano-convex (thick diameter) of a portrait lens? And what is the largest-size plate a combination of two such lenses would cover, using a ⅛in. stop? Any information on this subject will be valued by—T. W.

[49385.]—**Combustion.**—If I rightly comprehend the principles of the various "regenerative" gas-burners, both gas and air are strongly heated before combustion. Is this not opposed to the received axiom, that, to obtain the best results from gas, the supply should be kept as cool as possible, and the flame only be made as hot as can be? Again, is the whiteness of flame always a test of its temperature? Do not other causes modify this colour?—Xyto.

[49386.]—**Voss Induction Machine.**—Has any brother-reader succeeded in showing, with this apparatus, any of the ordinary phenomena of attraction, repulsion, and the reaction of points, and if so, how? I have practically failed with all these, and with regard to the spark itself, this seems to be different from the spark of a frictional machine, in that I can discover no heat in it; it will not inflame even spirit. As to the state of the atmosphere, Voss's machine appears to be peculiarly liable to the effects of moisture.—Xyto.

[49387.]—**Electro-Plating.**—How can I tell when my silver-bath requires the addition of fresh cyanide, as I suppose it does from time to time, and, should the silver ever require strengthening, if a good pure anode be always used? Has any correspondent ever succeeded in depositing a bright silver surface, by adding, as S. P. Thompson says, "a minute quantity of carbon di-sulphide to the solution"? I presume that the scratch-brush would be still necessary, to insure durability.—Xyto.

[49388.]—**Electric Bell.**—How can I reduce the loud noise occasioned by the vibrations of the armature between the magnet and contact screw? And also how to adjust the hammer so as to strike the bell harder? Any hints will oblige—Amateur Electrician.

[49389.]—**Grinding Cutlery, &c.**—Will some correspondent be kind enough to give me a few hints how to do this? I now send all the articles brought to my shop out to be done, but should like to be able to do them at home, and should be glad to know how many stones, polishing wheels, &c., I should require, and their sizes, and probable cost, and also of a few hints how to fix and use them? I may mention the articles I have to grind range from a carving- to a pocket-knife, including razors and scissors.—Ironmonger.

[49390.]—**Automatic Cut-off Motion.**—Will F. Walker, or any other engineering friend, say which is the best (for an engine of quick reversals, and a load of 50 horse-power instantly put on and as quickly took off)—a throttle valve or an automatic link attached to the back slide cut-off valve, which would be directly controlled by the governor? Also, I should like to know if the automatic cut-off motion acts well with a very changeable load as above? If preference is given to the throttle valve, please give size of bottom and top valves for a piston speed of 500ft. per minute, and 18in. diameter of cylinder.—J. Morrell.

[49391.]—**Alloy for Steam-Cocks.**—Will some one who has the experience, please give best mixture for steam-cocks and valves, as I find the steam soon cuts through some steam fittings, while others stand all right. No doubt, there is special alloy for this purpose, the result of experience?—H. Kent.

[49392.]—**Mill-Stones.**—Will any reader of this paper inform me the revolutions per minute of an ordinary flour-mill stones?—Turbine.

[49393.]—**Bending Press.**—I wish to make a press for a copper-shop, to bend pipes up to 18in. diameter. I have one, but it is on the old screw principle. I want this one to be worked by hydraulic and by hand. Also to work vertical, not having room to work horizontal. Will any of your correspondents oblige by a sketch?—T. Clarke.

[49394.]—**Poor Rates, &c.**—I shall be glad if Mr. Wetherfield, will state, whether in the case of a person entering upon possession of a new house at Xmas., 1882, (which was not even completed before November), he can be legally called upon in January 1883, to pay six months' poor rates, &c., for the full half-year, ending March 1883, less three weeks between December 8th, the day when the rate was actually made, and Xmas, when the house was first occupied?—or, on the other hand, whether he can only be compelled to pay three months' rates from Xmas, 1882, to March 1883.—J. A. G.

[49395.]—**To Mr. Lancaster.**—I have a Siemens H armature, 7in. by 3in., which I want to fit up into a small dynamo. Will you please to tell me what size of wire the field-magnets, also the armature, should be wound with, also what size the field-magnets should be?—W. Farrar.

[49396.]—**Regulating Atmospheric Burners.**—How can I so regulate an atmospheric burner that the flame shall be blue, and at the same time use the full pressure of gas, without forming soot? The burner is to heat a copper heating boiler, and I find the smell is unbearable, I have a chimney ending in a funnel to catch the fumes. I tried it with the chimney connected, but the down-draught put the gas out.—Perplexed.

[49397.]—**Induction Coil.**—To "Mr. Lancaster."—I propose constructing a coil on Ferguson's plan, dimensions as follows:—Core 9in. long, ¾in. diameter, No. 22 iron wire. Primary: Two layers of No. 16 silk-covered. Secondary: 2lb. of 36 silk-covered. The primary and secondary to be insulated by an ebonite tube ¼in. thick, and the dividing disc in the secondary to be ¼in. thick. Can the above quantities be improved on?—and what will be the respective weights of the "core" and "primary"? Any remarks kindly accepted.—Carbonitas.

[49398.]—**Lantern Slide.**—I shall be glad if Mr. Lancaster or some other gentleman will give me the information I need. Some years ago, I saw a very pretty experiment illustrating persistency of vision. A disc or discs, perforated, were thrown on the sheet, and by some motion the dots of light were thrown into lines of light of most intricate and beautiful pattern, straight lines and curves. It was a beautiful experiment, and I am anxious to reproduce it or something of the same kind in a lecture. What I want to know is number of discs employed, positions of holes, and what motions will produce the various patterns? Of course, if a disc were revolved on its axis holes arranged in regular lines would be changed into concentric circles. If moved up or down, or to right and left, there would be lines of light, but how those geometrical and convoluted patterns were produced is a mystery I fain would solve. I should be grateful for any experiment which could be performed with a lantern illustrative of "the eye as an optical instrument." I have no doubt some of our readers could suggest some which would be interesting and instructive, will some one or more oblige—Avidity.

[49399.]—**Steam-Engine.**—Is an engine 12-h.p. and 1in. stroke equal to or superior to one with one horse-power and 12in. stroke? Will steam at any pressure, say, 200lb. to square inch, do more work in a long narrow piston box, or in one of equal cubical contents, but of greater diameter, containing a piston of greater area for steam to act on, but with a shorter stroke?—Piston.

[49400.]—**To Fasten Glass Together.**—Will any readers kindly tell me best way of making plate-glass bath, about 18in. square? Is there any way of fusing the edges of the glass plates at the required angle without spoiling the plate farther than ½in. or so up, or must I have it made for me by a glass-blower? The plates I want to use are 18in. square and ¼in. thick. I want to put the five together (water tight) so as to make a bath? —R. M.

[49401.]—**Hexagonia.**—This game is somewhat similar to chess, but played on a board with six sides, the squares being all hexagonal. It has one piece less in number than chess, and consists of one general (or King), four cavalry (or knights), two artillery (or castles), and eight Infantry (or Pawns). It was brought out by Jaques and Son, with rules. Now as there are certain rules, or points in the rules wanting to make the game thoroughly enjoyable, I shall be glad to know if any reader can assist me in the following. Messrs. Jaques cannot, and they say, they received the game from the inventor, who resides in New Zealand. What I want to know is:—(1.) If the word *any* in the directions as to how the pieces are to be moved, means that they can be moved forward, backwards or forwards (right or left), on to the proper square allotted to each separate piece; if so, can the pieces of the enemy be taken in the backward as well as the other moves? (2.) What does the word *laterally*, referred to in the move of the Artillery, mean? Is it that the move can be made in any direction, so long as the hexagons run on side by side, like the squares in chess, and not over the corners in any way, like the second square of the Knight's move in chess?—i.e. it must move in any direction through the six hexagons that surround any hexagon one on the board, to any distance. (3.) The centre hexagon being the winning point, it is of a different colour to the others. Can a black Artillery piece, in commanding that point, prevent the white general from winning?—i.e., Would the general be in check if placed there? Again, can a Black Infantry be in a hexagon adjoining the winning one, and thereby prevent the game being won? It must be borne in mind that no instructions are given as to the power of the Infantry or Artillery to move into the centre hexagon; so it is desirable that some definite rule should be laid down to guide all who may have the game by them. Has any game properly played ever been published? Any suggestions will be thankfully received by—A Perplexed One.

[49402.]—**Rusty Nickel-Plated Tricycle.**—What is the best way of removing rust from a nickel-plated tricycle, which has become coated with rust in a damp house?—Tyro.

[49403.]—**Legal.**—To Mr. Wetherfield.—I am surviving executor under the will of a relative, and have an administration suit brought against me. I take nothing whatever under the will, and have already been put to much trouble and expense, and am told may be called upon to pay the costs of the suit, which would entirely break me down. I want to know if you will kindly inform me, whether I can secure to my wife what little property I have (consisting of personal and unrecovered debts) by deed of gift, or otherwise, so that she may have it in case of anything arising to me?—Exon.

[49404.]—**Barley-Sugar.**—Would some practical person oblige me with a recipe for the above; I require it for feeding bees? I have tried to make it myself, but it always granulates or crystallises on cooling. I used the best loaf-sugar, adding a little vinegar. Cream of tartar has been recommended—would it be of any use? Also, would it injure the bees? I suffer the same difficulty when feeding with syrup composed of sugar and water; it will sometime keep a few days, and then crystallise.—F. Search, Epsom.

[49405.]—**Thickness of Cylinder.**—What should be the thickness of a wrought-iron cylinder to safely withstand an internal pressure of 500lb. to square inch, cylinder, 3ft. by 1ft.? Also thickness to withstand pressure of 750lb. and 1,000lb.?—G. Smith.

[49406.]—**Velocity of Wind.**—Is it possible to calculate the velocity of the wind by observing the smoke issuing from a chimney? From what Mr. Charles A. Stevenson says in *Nature*, it appears this can be done; but no explanation of the method is given.—Vis Viva.

[49407.]—**Tension of Pianoforte Strings—Iron-Frame and Wooden-Frame Pianos.**—I should like some correspondents to explain the following:—The tension on the strings of a piano with an iron frame is much greater than on a piano with a wooden frame. This theory will be readily admitted to be practically correct. Now, as the tension on the strings of an iron-framed piano is greater than that of one with a wooden frame, is it to be supposed that the wires can be drawn tighter in the former case before the strings will break? In a wooden-frame piano, how is it that it will not resist the same tension as that of one with an iron frame? The iron frame is undoubtedly of great support to the tension of the strings; but, in either case, the strings will only bear a certain strain before they will break. The question is, In what part of the wooden frame is the deficiency?—G. Favas, Swansea.

[49408.]—**Cylinders.**—I have two cylinders 1¼in. bore for 3in. stroke. What amount of h.p. would they give with 10lb. of pressure, and what would the size of a single cylinder be to produce same amount?—Telegraphist.

[49409.]—**Froude on Resistance of Fluids.**—To "Shipwright."—Can you tell me any way in which I may find out the amount of h.p. that would be required to drive any body submerged at such a depth as to produce no surface disturbance, at, say, five miles per hour, and if by multiplying the h.p. would the speed be increased at same rate? Also please say what the per-centage of loss of speed would be by going to greater depths or rising to the surface? Your kind assistance will much oblige—Swindonia.

[49410.]—**Eyepiece for Gregorian Reflector.**—I have an eyepiece from which two of the lenses are lost, leaving only one—viz., a double-convex one, in the tube. Would any correspondent kindly advise me what lenses, with focus, I must provide to complete it? The tube is 4in. long, and 1¼in. diam.; 1 7-16in. from small eye-stop to screw for middle lenses (the lost ones), and 2¼in. from that to front one (the double-convex). The specula are 20in. apart in the tube.—A. J. W.

[49411.]—**Portrait Lens.**—To Mr. Lancaster.—I notice an opacity in my lens, which, I suppose, arises from the cement that joins the planes having perished. If this is so, how can I take the plane apart, polish, and put them together again?—Intelligent Amateur.

[49412.]—**Lump on Knee.**—If any reader could help me in the following case, I should be very thankful for any assistance:—My mother, who is 63 years of age, noticed a little pimple about the size of half a pea on her knee, just below the knee-cap. This was about 16 years ago. She did not feel any pain or think anything of it then; but about six years ago it had got larger, and pained her a little. So she went to the doctor; he said he could do nothing to it, and finished off by saying that it would get larger, and the pain would become unbearable, which, I am sorry to say, is now the case. I cannot think myself but what it can be cured, and if any reader can help me, I am quite willing to pay them.—C. Davies.

[49413.]—**Timber.**—Can anyone tell a circular sawyer which is the best place to go abroad? I have had 15 years' experience in the timber line, and have had charge of sawmill for a number of years, and a good knowledge of machinery. Any information regarding the above will oblige—Scotchman.

[49414.]—**To Dr. Edmunds.**—In consequence of an accident, I have for a long time been unable to take exercise, and although I live very plainly and take no suppers and no stimulant of any kind, except about half a glass of good old whisky about three or four times a week, there is a tendency to the formation of gouty matter: the blood gets poisoned with it, and the consequence is that I often suffer from dreadfully low spirits, depression and despondency. Could you kindly suggest a remedy suited to my peculiar circumstances? Any suggestion you may have the goodness to make as to food, I will also be grateful for. I have been recommended to use lemons; but they cause acidity in the stomach. Perhaps you would kindly say what is the best way to use them to prevent such an affect. This would be useful to many.—B. Thomas.

[49415.]—**New Ready Reckoner.**—Can any one inform me whether any new kind of ready reckoner of weekly wages has been brought under public notice since the year 1880, and if so, whether any have been patented or provisionally protected, or could any one inform me how to find out the same?—H.

[49416.]—**Harness.**—Will any of our mechanic readers oblige writer by giving lengths of double set of harness on last style?—A. J.

[49417.]—**Patent Knotting.**—Can any of our readers tell me how to make what is called patent knotting?—Petro.

[49418.]—**Growth.**—At what age does a man stop growing, and what is most conducive to promote the same?—Noakes.

[49419.]—**Tank.**—Can any of our readers explain: A tank 18ft. × 18ft. × 9ft. deep, full of sewage with two plunge pumps in it; at times when the pumps are going the sewage flows backwards and forwards? At times it will continue for a half-hour, at other times a few minutes. Is it when the pumps are in bad order or in good order, or something got into valves?—L. C. W.

[49420.]—**Positive Element, &c.**—Will Mr. Lancaster, "Sigma," or other practical reader of the "E.M.," kindly reply to the following?—(1) What is the effect of the zinc element of a battery, in the form of a cylinder, in the centre of which is placed a porous cell, and would this form give greater power, and be more constant than the ordinary arrangement of zinc rod and porous cell, as with the Leclanché battery? (2) What distance should the cylinder or rod of zinc stand from the porous cell, to obtain the best result? (3) Should the mixture of manganese and carbon be packed in the porous cell, loosely or firmly?—No Name.

[49421.]—**Portland Cement.**—Can any one give information as to manufacture of this artificial cement? Is it necessary that the clay employed should contain potash? Are there any good works published on the subject in English or French? Any information will oblige—Walter Dearden, Trinidad, Colo.

[49422.]—**Pleuro-Pneumonia.**—Can any of your readers kindly furnish me with a remedy for pleuro-pneumonia amongst horned cattle, or give me any information relative to the disease—its cause, cure, and prevention?—F. A. Muhlenbeck, Cape Colony.

[49423.]—**Ventilation.**—There are two airways, the first 8ft. square, and the other 10ft. × 4ft., and I want the same quantity of air to pass in each airway. The water-gauge stands at 2in. in the first airway. What will it indicate in the second case?—Non Valeo.

[49424.]—**Broken American Watch.**—I have one of the cheap American watches which are now being sold, and in winding it up one night the main spring slipped off the little pinhead-like which holds it on the spindle. Can you tell me how to fasten it on again? Must I bend the end of spring more over, or drill out pin and put new one in? Will you also please say how I am to take works out of case to put on long hand, which has flown off?—as the glass front will not open.—Amateur Watchmaker.

[49425.]—**Battery for Electric Light.**—Mr. Henry E. Hawkins or other reader of the "E. M." will greatly oblige by the following information respecting the "New Form of Cheap Battery" described in the "E. M." of April 22, 1882:—(1) What size porous cell should be used? (2) Proportions of iron borings and manganese, and should the latter be the powdered or "needle"? (3) Size Swan lamp referred to in particulars given?—No Name.

[49426.]—**Wimshurst's Influence Machine.**—To Mr. Lancaster.—A friend of mine is making one of these machines, as described in No. 929, and would be glad to have a little further information, if you will kindly oblige. How to obtain the exact size for the brass sectors? Will marine glue do to fasten them on, and what is the best transparent varnish to coat the plates, before putting on the brass sectors? What thickness should the brass rods carrying the brushes be, and of what and how are the brushes made? Working in metal is no difficulty to him, and he has plenty of material and means at hand, and wants everything done well. If this machine answers so well, would one be likely to be successful if made after the same model as "Wimhurst's Machine," described on p. 153, No. 917, with twelve pair of discs, each provided similar to the one described in No. 929. How are the discs fastened to the wooden boss they revolve with, and what size is the hole in disc—3in.?—Uranium.

[49427.]—**Legal.**—Will Mr. Wetherfield kindly advise in following case?—Three years ago I took at a yearly rental, and 99 years lease, half of a field, being a bank-side, to work out the clay. Having worked at the foot of the hill first, the bank is sliding down, and in danger of breaking the land above, beyond my boundary railings. I have offered either to rent, pay royalty, or come to any other reasonable agreement about it; but my landlord will do nothing. When his part of field breaks and moves downwards, what kind of damages can he claim from me?—Clay-Worker.

[49428.]—**To Dr. Edmunds.**—What is the best application for Psoriasis palmaria? I do not handle cold metal, and cannot account for the attack, my skin being usually very soft. Should I take acids or alkalies? Age 30.—Draper.

[49429.]—**Archimedean Screw-Pump.**—I saw a few days back a model Archimedean screw-pump, the screw being placed at an incline of one in three. It seemed to throw a considerable quantity of water with the expenditure of very little power. Can you tell me if such pumps are in use, if they answer well, can be counted on as certain to work day and night over a considerable period without much repair or attention? Are they suitable to throw a considerable quantity of water up a rise of 5 or 6ft., and at about what force are they most efficient?—One Who Values Your Advice.

[49430.]—**Water Engine.**—Will some one be kind enough to tell me whether a steam-cylinder could be made to work by the pressure of a good head of water, which is available? In what manner should the piston be packed? Any details (if the above is feasible) would be thankfully received. Would an oscillating and slide-valve cylinder do equally?—A. Sims.

[49431.]—**High-Pressure Heating Apparatus.**—I have got one of the above-named apparatus fitted up in an establishment of mine. I got printed rules along with the same how to work it. One sentence says: If kept regular at work, it must be refilled with water at least twice a week. Where does the water go to?—R. W. P.

[49432.]—**American Clocks.**—How can I regulate American lever clock?—it is gaining one hour daily. If I draw or slacken hair-spring through the stud, it pulls the pin on balance-wheel out of reach of the fork that works the lever?—H. Fay.

[49433.]—**American Clock.**—I put new pallet to American 30-hour cottage clock, but cannot regulate with the same pendulum. Although I have put longer pendulum rod, it gains over two hours a day; now the pendulum nearly touches the bottom of the case. I took old pallet for size of new one—how can it be altered?—H. Fay.

[49434.]—**To Mr. Wetherfield.**—A man is sentenced to five years' imprisonment. After having served one year, his father dies, leaving in his will £10 for his son, who is still in prison. Now he wants his wife to get the money left him for her personal benefit. Can she get it with his permission before the dead year is up? If so, which is the proper way to obtain it? Or will she have to wait until the dead year is up; if so, which is the proper way to obtain it then? Also, which is the best way to get to have a look at the will, and the cost, and the right time and place to go to?—A Fitter.

[49435.]—**Angle of Boring Collars.**—I should be glad to know the best angle for conical holes in boring collar. I propose making one for my lathe in the form of a simple standard with a large conical hole, into which fit a nest of conical rings. This form will, I think, be easier to fit up, and steadier in use than that with a rotating disc; but I should be glad to know if there are any objections to it?—Faber.

[49436.]—**Sizes of Nuts.**—Will any of ours oblige with a table of the standard sizes of nuts?—Faber.

[49437.]—**To "F.R.A.S." or Some Other Authority in Telescope Matters.**—I would be very much obliged for information on the following point:—Is a table such as that calculated by Dawes from his 4·56 aperture formula, and which is given in Mr. G. F. Chambers' "Descriptive Astronomy," a sufficient guide as to the probability of a *good* o.g. of a given aperture dividing a given double star? What I mean is this, May I confidently expect that, if my glass be a good one, and the distance of the components within its range, according to the table, I will split it; or do other circumstances come in to modify the result? Suppose a telescope split theoretically to 1·05″, could I feel sure of seeing a star measured at that?—Cepheus.

[49438.]—**L. & S.W.R. Engines.**—Can "Clyde," or any other reader, give me the following particulars?—Weight and coal and water capacity of 100, 190, 375, 140, and 355 classes? Also weight and principal dimensions of 394 and 412 classes? Also names and particulars of the following engines:—38, 45, 47, 55, 82, 90, 93, 106, 125, 129, 147, 150, 155, 158, 159, 167, 170, 174, 228, 246, 248, and numbers of 394 and 355 classes.—S.W.R. Loco.

[49439.]—**Ancient Astronomy.**—Where could I get full information concerning the "Zodiac of Denderah," and the Babylonian "Zodiacs," of which one is pictured by Prof Rawlinson?—Spica.

[49440.]—**Cod-Liver Oil.**—I am very delicate, and derive much benefit from cod-liver oil. I have, however, a difficulty, frequently, in taking it. This comes in part from its smell, but mostly from its oiliness. Can any reader suggest a ready means of overcoming this difficulty? I have often taken a little sugar along with it. Would any harm result if this practice were made constant, and the quantity of sugar rather large? What I want is some means of rendering this oil less disagreeable to take, and I have no doubt many other readers would like the same information.—Helicote.

[49441.]—**Mr. Lancaster's Lecture at Birmingham on Electricity.**—To Mr. Lancaster.—You say that the electro-magnet was invented by Arago in 1820. "Sabine's Telegraphy" says it was "discovered by Sturgeon, of London, in 1825"; which is correct?—R. Hansen.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

We receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 804, 807.
Bookbinding: Nos. 613, 627, 770.
Cements: Nos. 377, 729.
Coils, induction: Nos. 613, 620, 636, 640, 779, 797, 832, 885.
Coils, medical: Nos. 844, 808.
Copying processes: Nos. 750, 753, 761, 762.
Electric bells: Nos. 545, 558, 797.
Electric machines: Nos. 808, 380, 628, 750, 840, 816.
Electro-magnets: Nos. 736, 772, 783, 864, 872.
Electro-plating: No. 853.
Lacquers: Nos. 429, 475, 622, 806.
Magneto-electric machine: Nos. 376, 590, 783, 826.
Nickel-plating: No. 808, 811.
Silver-plating: Nos. 830, 808, 869, 870, 871, 874.
Varnishes: 321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 31, and unacknowledged elsewhere:—

G. Townend.—B. Baugh.—W. F. Stanley.—A. F. Fuller.—J. Calvert.—W. H. Nelis.—W. H. Sellens.—E. P. Alexander.—F. C. Farrow.—D. Simms.—P. W. D.—W. H. Stephens.—Timber Merchant.—Apprentice Watch Jobber.—High Speed.—Ego Alpha.—Mechanican.—C. E. A.—Rera.—Torment.—G. G. Blackwell.—Sic est Vita.—A New Reader.—Young Engine Tenter.—M. M. S.—London.—W. Howes.—Cabinet Maker's Apprentice.—G. Limer.—Experimenter.—Walter H. Ince.—Molo.—S. S.—G. T. B.—Time Will Show.—L'Epicier.—J. H.—T. K.—Wanting Steam.—J. Joby.—Cefer.—H. E.—Galbus.—Gut Bow.—Gas Engineer.—J. C. C.—G. C. P.—L. L. L.—S. M. B. G.—Prismatique.—W. J. Grey.

Peruano. (The method is illustrated in nearly all text-books of chemistry and electricity. Put a few drops of acid in the water; join the carbon of one cell to the zinc of the other; then take the wire from the carbon of the latter to the platinum electrode in one of the tubes of water, and the wire from the zinc of the other cell to the electrode in the other tube. Any handy size of wire will do.)—W. S. (See p. 520, No. 749, for a blacking varnish. 2. For utilising old tins and tinplate cuttings, there are several processes; some patented. See pp. 459, 602, last volume; p. 27, No. 858, and the indices generally. 3. First rub over with cinder-dust and water, then polish with bath-brick or whiting and a leather.)—H. Field. (The question has been answered. The remedy is to give any of the well-known purgatives, and to wash out the lower bowel, after they have acted, with an enema of salt water.)—J. E. A. (Rather too simple. Much more complete arrangements illustrated and described in back volumes.)—Glasgow. (Any of the electric lighting companies would be glad to give an estimate, and you can find advice in back numbers. You do not say whether it is a workshop or what, nor yet the price of gas.)—Adolescens. (You want a practical acquaintance with chemistry and dyeing, and you can only get that under some analytical chemist. 2. No, they don't pickle their hands in it.)—Tumbler. (Rather old. Not much doubt it is caused by thinking what it ought to do. Try it by suspending from a fixed support.)—A. B. C. (No.)—J. M. Jones. (See list of Back Numbers above.)—Housekeeper. (By adding a little white wax to the starch and using a polishing iron.)—E. H. Fay. (It is a matter for experiment; but apparently the mercury would run down until the pressure against it became equal to its weight.)—Mole-catcher. (Try the recipe on p. 191, No. 840. The chalk should be in powder. Why tan them? You can do that by wiping them over with strong decoction of oak-bark, thoroughly wetting and allowing to dry. Apply, say, six times, drying between each.)—E. H. H. (See pp. 112, 142, this volume. The climate is mild, and clothes are dear.)—G. W. (Carbolic acid is distilled from coal oil. Creosote is manufactured from wood-tar. Commercial carbolic acid is mixed with water for disinfecting purposes.)—Bric-a-Brac. (Logogriph is a sort of riddle in which the original word (whole) is to be discovered by guesses at other combinations of letters included in it. Thus, "plate" includes late, tale, pate, peat, &c. Literally, it means "word-riddle.")—H. O. N. (What is the apparatus you mention? There are several recipes in back volumes; but if you want fine ink, why not use Indian ink rather thick? Ordinary ink with more gum added might do.)—T. D. (The lime-water of the Pharmacopœia is made by taking half a pound of lime, slaking it by sprinkling with a portion of twelve pints of water, and then adding the remainder. Shake well together several times. Cover the vessel and set aside for three hours. When any is required for use, draw off from the clear portion, and add equal bulk of cold water, shaking as before.)—Avidity. (We do not think it would do. Why not place the cells one above the other and let the solution run over on to the next lowest, and so on. Some use siphons.)—Courier. (You do not say whether enamel paint or a vitreous enamel is meant. What is it used for?)—Ploughman. (If you cannot look through back volumes, you should send for one of the catalogues of those who make them.)—Tom. (Two illustrations of accordion stand in No. for August 26, 1870. Can be had for five halfpenny stamps.)—W. R. May. (We much regret that such a use should have been made of our advertising columns; but it is almost impossible to exclude such black sheep, owing to the facility with which they alter their advertisements and change their addresses. They also sail so near the wind in the production of their questionable specialities as to render the interference of the society mentioned not infrequently fruitless, and the insertion of your letter might subject us to an action for libel, and would do harm by attracting the attention of fresh and less unwilling dupes.)—J. Horner. (We should be glad to receive the proffered papers.)—J. D. (A drawing will be necessary, but your patent agent will prepare that. It is generally cheaper in the end and safer to employ a respectable agent, and any of those who advertise in these columns may safely be intrusted with your business. Write to either of them for a copy of their instructions to inventors, which will give you all the information you require.)—A. M. W. (The testament is of no great value. We do not recognise the mark; a dealer in old silver might.)—J. P. (Such recipes are to be found in most cookery books. See p. 600, last volume. To 4lb. of parsnip take 1 gal. of boiling water. To each gallon of liquor add ½oz. of cream of tartar and 3lb. sugar. Ferment and add 3 to 5 per cent. of brandy or plain spirit.)—J. H. A. (Suitable plant is advertised. The process is described in every cyclopædia.)—S. Moss. (Most likely it is Portland cement. Don't use any cement at all, but leave the filter so that you can easily clean the charcoal. Use fresh-burned animal charcoal, and clean it once a week, say. Such filters are really useless, as the sponge and the charcoal collect the dirt, and get into a fearful state.)—Enquirer. (10,000 cubic feet. See Dr. Siemens's address to the British Association, p. 566, last volume.)—R. E. S. (The punches are set out on barrels, which are divided by lines so that the exact position and size can be found. You can easily cut others, if you have a pattern, by means of a penknife. There are several patented machines for the purpose.)—Bouvardia. (Black sealing-wax dissolved in methylated spirit. Vegetable black ground up with copal; asphaltum, shoemaker's heel-ball, and many other things.)—S. S. (No: see the indices. By exposing phosphorus in a moist atmosphere; by passing electric charges through the air. See p. 188, last volume.)—Dandie Dinmont. (We cannot help you. Probably it is one of the new German products. Do you mean the letter inserted in this No.?)—Lill. (You should get booksellers' lists. Carpenter's is full, and Beale's is a good work. Perhaps Davis's "Practical Microscopy," Bogue, would suit.)—A 14 Years' Subscriber. (Half man-power. Very little trouble. Most require the flywheel to be turned round, but, practically, they all start by lighting the gas.)—Leo. (Only galvanising or painting.)—Brown. (As you have tried cold sponging, you had better consult a medical man. Perhaps, if you thought nothing about it, you would not be troubled. Dr. Edmunds replied at length on p. 441, No. 851.)—Nemo. (For painting bath, see p. 152, No. 708.)—J. N. (Marine glue, we suppose, or gelatine dissolved in acetic acid. Cannot you get an idea from the illustration? The size is not material. 2. The soap-bubbles are made of a solution of Castile soap, to which glycerine is added. See back volumes.)—J. Poulson. (See the indices. We believe benzoline is as useful as anything.)—Julian. (We have a letter in type; but you will find several methods in back volumes.)—Subscriber. (The temperature should be about 100—105° Fahr. Fowls, 21 days; ducks, 28; turkeys, 30; but the relative freshness of the eggs will make a difference of a day more or less.)—Self-Learner. (The "use" of the stop is to sell the instrument. Surely you can look inside and see how it is made to work. Most likely it does all it was intended to do.)—B. S. (No seal is required at all to a will.)—J. E. (Queensland is a fairly thriving colony—one of the best of the Australian colonies, but there are no special openings in the directions you indicate.)—The Amateur Mechanical Society. (Mr. J. H. Evans wishes us to state that his offer to the council included a *full set of screw tackle*, including stocks, dies, taps, wrenches, &c., and not screw tools only, as our report mentioned.)—J. Simpson. (Better have it examined by a surgeon. The tendons are probably strained, and will take time to get all right again.)—John Wilson. (Be contented, and do not attempt to stop it unless you want the rheumatism back again. Nature is doing her best to rid you of your enemy, and you must not hinder her. Drink as little as you can, take care to not catch cold, and the inconvenience complained of will soon disappear.)—Edw. Franklin. (The skin disease you mention seldom attacks the face. See a medical man—they are often puzzled by skin diseases, and ignorant persons who attempt to doctor themselves are sure to do mischief.)—F. W. G., L. Archbutt, Fiddler. (In type.)

M. M. S.—Architectus.—Sam.—Fenella.—R. Howard.—J. N. Dufty.—R. Hannen.—Castle Mona.—W. L.—T. H. A.—J. W. W.—J. W. S. L., and others have already replied to queries already similarly or adequately answered.

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CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

Game between Messrs. J. Pierce and W. T. Pierce in the English Mechanic Correspondence Tourney.

(Scotch Gambit.)

White (J. Pierce.)	*Black* (W. T. Pierce.)
1. P-K 4	1. P-K 4
2. Kt-K B 3	2. Kt-Q B 3
3. P-Q 4	3. P takes P
4. Kt takes P	4. B-B 4
5. B-K 3	5. Q-B 3
6. P-Q B 3	6. K Kt-K 2
7. Q-Q 2 (a)	7. P-Q 3 (b)
8. Kt-Kt 5	8. B takes B
9. Q takes B	9. K-Q sq
10. Kt-Q 2	10. R-K sq
11. B-K 2 (c)	11. Kt-B 4
12. Q-Q 3	12. Kt-K 4
13. Q-B 2	13. Kt-R 5 (d)
14. R-K Kt sq	14. Q-B 5
15. Castles (e)	15. Q takes B P
16. Kt-Q 4	16. P-Q B 4
17. Q R-K B sq	17. Q-K 6
18. Kt-K B 3	18. Q takes B
19. Kt takes K Kt	19. B-K 3
20. P-Q Kt 3	20. R-Q B sq (f)
21. P-B 4 (g)	21. R-B 3
22. K-Kt sq	22. R-Kt 3
23. R-K sq	23. Q-B 7
24. Q Kt-B 3 (h)	24. Q takes Q
25. K takes Q	25. Kt-B 3
26. K-B 3	26. P-Kt 3
27. P-K 5	27. P-Q 4 (i)
28. P takes P	28. B takes P
29. R-Q sq	29. Kt-K 2
30. Kt-Kt 5 (k)	30. K-B sq
31. Kt takes R P (l)	31. R-R sq
32. Kt-B 6	32. K R takes Kt (m)
33. Kt takes B	33. R-K 3
34. Kt takes Kt	34. R takes Kt
35. R-Q 5	35. P-Kt 3
36. R-K sq (n)	36. R takes R P
37. R-K 2	37. R-R 4
38. P-Q Kt 4	38. P takes P (ch)
39. K takes P	39. R-R 5 (ch)
40. K-Kt 3	40. R-Q 2 (o)
41. R-Q 6	41. K-Q sq (p)
42. K R-Q 2	42. R takes R
43. R takes R (ch)	43. K-K 2
44. R-Q B 6	44. R-K Kt 5
45. R-B 7 (ch)	45. K-K 3
46. R takes R P	46. R takes P
47. R-R 6	47. P-Kt 4
48. R takes P (ch)	48. K takes P
49. P-R 4	49. R-Q 7
50. R-Kt 8	50. R-Q 8
51. K-B 4	51. R-Q R 8
52. R-Q R 8	52. P-Kt 5
53. K-Kt 5	53. P-Kt 6
54. Resigns (q)	

NOTES.

It is right to mention that the greater part of this game was played not by correspondence, but over the board.

(a) Mr. Blackburne's new move.

(b) The only move to avoid a certain loss of position is P-Q R 3, but this gives White too much time. It may, perhaps, be doubted whether Black does not obtain an equivalent or a quicker development by the move in the text than White, although he is forced to move his King.

(c) Perhaps castling at once is better.

(d) Black has already wrested the attack from his opponent.

(e) This, in a measure, relieves White, although at the cost of a Pawn. 15 P-K Kt 3 would be answered by K Kt-B 6 (ch) and after the exchanges, White's King's Pawn must fall.

(f) Q-R 3 is stronger.

(g) Well played.

(h) Forcing the exchange and paralysing the attack.

(i) This looks risky, but it was much better than taking the Pawn which is isolated and ought to fall.

(k) The position at this point is very interesting and critical for both sides.

(l) Tempting, but unsound, as thereby Black again recovers the attack: R to K B sq is better.

(m) Here we think Black misses an opportunity, 32. B takes Q-Kt, P recovers the Pawn with a good game, for if in reply White play 33 P takes B, then 33 K-R takes Kt, and if then, 34 R-Q 7, 34 R takes Kt, 35 R takes Kt, 35 R-K 3, 36 R takes B P, 36 R takes K P, and Black ought to win.

(n) An error, 36 P-K R 3 is the right move; if then 36 R-K 5, 37 R-K B sq and Black cannot take the Pawn without losing his own.

(o) To get the King round so as to attack the Kt with it.

(p) R-Q 5 is also a good move.

(q) For if 54 R-K Kt 8, 54 K-B 5, 55 P-R 5, 55 P-B 4 (best) 56 P-R 6, 56 K-B 6, 57 K-Kt 6, 57 P-Kt 7, 58 P-R 7, 58 R takes P, 59 K takes R, 59 P-B 5, &c.

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The English Mechanic
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FRIDAY, FEBRUARY 9, 1883.

THE SPORTSMAN'S EXHIBITION.

THE Sportsman's Exhibition, which, for the second year in succession, is open this week at the Agricultural Hall, Islington, is one of the most popular exhibitions now held annually at the great building in the Liverpool-road. Last year, we understand, about 80,000 persons paid for admission—a sufficient indication of the interest which is taken in all matters of sport. It must not, however, be supposed that the visitors were all sportsmen, for very many, no doubt, went to "take stock" of the exhibits, to observe what progress had been made in construction, and what new ideas had been introduced. It is mainly on those grounds that we propose to give a general summary of the exhibits, which, with the exception of the bicycles and tricycles, were, with commendable punctuality, ready for inspection on the opening day. Entering at either door, the most prominent objects are boats and carriages, the latter of all shapes and sizes; but the boats restricted almost entirely to those used for pleasure purposes—racing craft being noticeable by their absence. Viewing the exhibits of the boat-builder's art as here shown, it is impossible to deny that it has reached a high degree of perfection, both as regards model, construction, and finish. Searle and Sons, Stangate, S.E., show their water velocipede for one passenger and one driver. It consists of two light-decked skiffs firmly braced together, with paddle-wheels extending beyond the combined breadth, which are driven by an ordinary pedal crank in the centre. The driver of necessity sits rather high, but as great stability is obtained by the use of the two "holds," there is no fear of the vessel turning over. The paddles are connected by the same shaft, and the two rudders are also linked together. On still water, a speed of about five miles an hour can be reached; but we suspect it is rather hard work if continued for any time. Pair-oared gigs and skiffs, fitted up for the conveyance of pleasure parties are notable for their number; but the more interesting exhibits in the boat line are the canoes. Mr. Tagg, Molesey, shows a large North-American style canoe, called the "Niagara," which is especially adapted for work on rapid streams. It has Clasper's swivel rowlocks, and a shifting centre keel to keep it steady while shooting rapids. Rowland Ward and Co., Piccadilly, show native-built Canadian canoes, which can be compared with those constructed on the same type by Messrs. Burgoine, of Kingston. The former (amongst other curiosities) show a Welsh coracle, which will interest many boating men, while the latter exhibit the Thames gig "Violet," lent for the purpose by its owner, as arranged for camping-out purposes. Just here we may direct attention to the double-roof boating tent, shown by B. Edgington, Duke-street, S.E., constructed of the "Willesden" water repellent and rot-proof canvas. The tent is erected and shown with its outfit of utensils, &c., for camping out, or for use by travellers and explorers. Amongst the exhibits of Mr. H. Woodhouse, of Maidenhead, we note a beautifully finished punt for fishing and pleasure purposes, constructed of mahogany, with white pine fittings, and nicely-marked teak lids to the lockers and other prominent parts. This builder also shows a double skin ribless skiff, in which the planking is arranged diagonally from keel to gunwale, the outer skin of one side being at the same pitch as the inner skin of the opposite side. This method of construction not only makes a very strong boat, quite proof against blows which would make a hole in boats built in the ordinary manner, but also especially adapted to prevent warping and leakage in hot countries—the "planks" in breadths of about 4in. crossing each other and holding the whole together very firmly. The Bertbon boat has been described several times in our columns, but those who see it for the first time are rather surprised to find that a 7ft. fishing-boat, which is 3ft. 6in. beam, shuts up into a width of 5in. Boats on the Berthon principle are now constructed of all sizes, from the smallest canoe to a troop boat capable of carrying 100 hands. They are exhibited by the Berthon Boat Co., of Aldersgate-street, E.C. H. F. Speed, Esq., lends models—one of the single-handed cruising canoe *Viper*, 20ft. long, 5ft. 5in. beam, with a draught of 3ft. 2in. The *Viper* has made three voyages between Erith and Lymington. At same stand, C. Penrose, Esq., exhibits his model tent for canoes and small half-decked boats, which works on the principle of a carriage hood, can be fitted in a couple of minutes, and raised or lowered in 30 seconds. The Loan Exhibition also contains a number of racing yachts registered in the Model Yacht Sailing Association.

Carriages and carts of all sorts and sizes occupy by far the largest space of any kind of exhibit. Mr. H. Whitlock, Holland-gate, W., strikes a new line by showing a four-in-hand drag finished on one side only; so that the workmanship and the quality of the materials can be inspected before they are covered up by the painter. Mr. Carpenter, Staines, shows a drag which is hung very low, and is stated to weigh about 18cwt. only. Of specially light vehicles, however, we may note a few "buggies" of the American type—scarcely likely, we think, to find much favour in this country, although some of our best makers have lavished all their skill on them. Some of the dog-carts are fitted with brakes (patented); others have appliances for shifting the weight on going down- or up-hill. Cook and Casson, of Malvern, exhibit a cart and working model of the latter's patent brake for two-wheeled vehicles, which, while it retards the wheels, takes all weight off the horse. The shafts in this case are hung outside the body, and the driver, by means of a lever working on their ends, throws the weight off the horse's back, and brings the wheels against a fixed brake. Atkinson and Philipson, of Newcastle-on-Tyne, amongst other exhibits, show a Cape dog-cart, fitted with adjustable pole and shafts, for one or two horses, and the Mortimer patent brake; Thorn, of Norwich, exhibits a Norfolk shooting-cart, and a car fitted with patent adjusting shafts; while Mulliner and Co., of Leamington, show a Whitechapel, in which the driver can "exactly regulate the balance" by turning a small crank immediately in front of the seat without interfering with the hanging of the shafts. There is, however, no brake in this instance. A novelty in this department is the device shown by Aves and Moss, of Barbican, for reducing the vibration imparted to the wheels. In this invention, the wheel proper is really encircled by the rim of another, which is made to bear upon and clasp it by means of sheet-steel springs, free to move at one end, and riveted to the outer tire at the other. Wheels made on this plan are also said to prevent the humming noise heard in closed vehicles, and to be as useful as rubber tires at one-fourth of the cost. The invention is also shown (in the gallery) applied to a bicycle wheel. Of saddles, harness, and other accessories, there is little to be said, except to note that Alexander and Co., of Westminster Bridge-road, show a varied collection of Thomas and Bezer's slip links—a humane device by which a fallen horse can be released instantly by touching a spring, instead of being half-strangled by the collar. These links are now extensively used by all the large carriers, and by many firms doing their own cartage. We must also direct attention to the patent saddle-bars intended to prevent the dragging of the rider in the event of falling or being thrown from a horse. These devices are ingenious, but are scarcely perfect, for although it is claimed that the stirrup and the leather are instantly freed in whatever position the rider may fall, it is obvious that if the pressure is brought on the stirrup in the perpendicular line it will not be released, or it would be useless as a stirrup.

Most of the well-known gunmakers are represented with improvements chiefly in the form of hammerless guns, with cartridge-extractors and safety-actions. In this branch of sporting exhibits there is great competition, and while several of the makers show ingenious arrangements for ejecting the cartridge as soon as the gun is opened, Messrs. Kynoch and Co., of Witton, near Birmingham, exhibit an improvement in another direction—viz., a "perfect" reloading metallic cartridge. Sportsmen have thus a choice of using a gun that ejects the cartridge, or one that does not eject, but preserves the cartridge for future use. The only real novelty in this department is the "Gye" gun, exhibited by Messrs. Gye and Moncrieff, of St. James's-street, S.W. The gun was not in the building at the time of our visit; but judging from the description we obtained, the improvement consists in the loading arrangements. The inventors compare it to a locomotive by pointing out that in the latter a small door is opened and the fuel inserted. In an ordinary breech-loading shot gun the barrels are allowed to drop in order to insert the cartridge, which is analogous to moving the whole engine and leaving its door standing. The barrel, then, in the new gun is rigid, the improvement consisting in the breech mechanism, which dispenses with levers and grips, and admits of the gun being reloaded without altering the position in any way. In connection with the shooting department is the Ligowsky "clay pigeon" and trap. The trap consists of a tripod and pedestal, the latter being capable of movement in all directions. At the top of the pedestal is a coil spring which, by means of a notched sector and trigger, can be set to four different tensions. Attached to the sector is the sling arm which throws the "pigeon,"—a saucer-shaped piece of hard-baked clay, with the rim rounded in in such a way that the air is compressed, as it were, within the hollow part by the rotary motion. The "clay pigeon," after its first rapid flight, which is in the direction to which the sling-arm is pointed, sails or skims in the air, and unless hit and broken, settles gently to the ground. It is thus an economical device, as well as commendable on humanitarian grounds.

In the gallery, which, owing to the machines being mostly at the Albert Hall, was only partly tenanted last week, will be found, besides the bicycles and tricycles we noticed recently, a decided novelty in the shape of the "Remicycle," the invention, we believe, of Mr. F. Woodhams, Larkin Hall, Frindsbury, Kent. The machine is a true rowing tricycle, the levers by which it is propelled resembling in their shape and action as nearly as possible the handles of a pair of sculls. Loose on the axle at each side is a grooved pulley, which gears into the driving mechanism when it is turned round for forward propulsion, the motion being imparted by a "band," which also passes around a wooden pulley attached to the oar or scull. The fulcrum end of the latter slides in guides, so that a long stroke is gained, and the cord band being so arranged that the motion of pulling the levers towards the breast revolves the driving-pulley, the rider advances face foremost. The steering is effected by means of levers within reach of the heels; but, as a matter of fact, the practised rider will steer with the sculls, just as if in a boat; for each scull is independent of the other, and, consequently, the wheels also. The brake is applied by means of a lever within reach of the toes of either boot. The loss of power in friction is no doubt considerable; but the machine has many features to recommend it to those who require such exercise as rowing affords without going upon the water. The Leicester Tricycle Company exhibit Kirby's patent safety tricycles in the folding and rigid forms. This machine is a front steerer, with a frame of peculiar construction. From the axle at each side rises a bar in an oblique direction, and extending to a horizontal or safety-bar, on which the hands of the rider rest while he grasps the steering-lever with his thumbs. From the centre of the horizontal bar depends a vertical bar which forks to pass the backbone and to form bearings for the crank and spur-wheel, the rider sitting right over the pedals and a little in advance of the axle. The double driving is effected by differential gear, and the action is the same both backwards and forwards. The machine is mounted from behind, a safety-leg being provided to prevent a capsize in that direction. The mounting requires a little practice, as both feet must be placed on the axle and the knees bent until the saddle is reached, when the legs are passed down in front of the axle to the pedals. Dismounting is very easy, and is practically safe at any speed. The folding machine can be taken to pieces in about half a minute, and reduced to a width of 15in. The brake, a powerful one applied to the tires, is put on by a motion of the left wrist without moving the hand from the safety-bar. Mr. W. Scantlebury, of Lea Bridge-road, exhibits his patent safety bicycle, or rather safety appliance, as it can be added to any two-wheeled machine. It consists of a little rubber wheel held in a cage at the top of the fork, just in front of the head. This contrivance, while permitting the driving-wheel to run freely through the fork, will not allow the latter to turn over in front of the wheel, the little rubber ball jamming it tightly. Thus if the rider comes across a brick, the back wheel is not thrown over his head; but if he is going at high speed we are afraid this device will not save him from being thrown over the handles. Aves and Moss, Barbican, exhibit a tricycle in which motion is imparted to the axle, through chain gearing speeded up, by means of levers driving the shaft by a clutch action. The levers are returned by spiral springs. Both feet can be worked at once, if desired, or one only, while the stroke can be long or short. The South London Machinists' Co. exhibit their new machine the "Challenger," in which the connection between the cranks and axles is made by means of four universal joints and an upright shaft. The arrangement is ingenious, and is patented.

OBJECT-GLASS WORKING.—IV.

By "PRISMATIQUE."

THE two forms of o.g.'s given in a former paper, are so arranged, by curvature, as to combine as near as practicable the C and G lines of the spectra. The outstanding colours cannot be combined to correction in any form, by the glasses yet made. For a fuller account I must refer our readers to some very excellent articles from the pen of "Orderic Vital" printed in the ENGLISH MECHANIC a few months since. On the "Irrationality of Equal-Length Spectra." We have, then, to consider the effect of these outstanding colours, the flint lens effecting a greater dispersion of the violet end of the spectrum than the crown, the latter an *almost* proportionate greater dispersion of the red end. This fact gives us an approximate rule or guide to balance our combination, testing, as before described, on the mercury-filled bulb. In trade parlance the colours are called "red" and "blue." I shall use these terms to avoid complexity. Taking for granted that the centre of the ray is achromatised as near as can be by our calculation, we must in practice correct, until the blue and red edges of the pencil emerge as nearly parallel with each other as can be, to insure the most colourless image. We must now consider the action of two lines when parallelism is obtained. The red edges of the ray will be visible just inside the visual focus, and the blue edges just outside. Fig. 1 explains this. R, red edge; B, blue; the line F, the visual focus. The appearance, end on, will be, that the luminous point expands into red rings inside the focus with a blue fringe; outside the focus the positions are reversed, as a moment's consideration will prove when we look at the diagram. If blue is present at the visual focus, the prismaticity of the flint lens must be increased by lessening the radius of the flatter curve of the flint lens in the first form I give, and by increasing the radius of both convex outer curves in the second form, in equal proportion. The final corrections for colour are extremely minute, to obtain a very near approach to perfect achromaticity. The consideration of a number of diagrams, in which the red and blue rays are drawn out of parallelism, will assist much in testing, and also give an idea of the extreme delicacy of the alterations necessary. These alterations have always been, and I think must always be, experimental, but conducted with judgment. Figs. 2 and 3 show two conditions of error: Fig. 2 when the blue rays are too near the focus, Fig. 3 when the red rays are too near; yet both proofs of undercorrection of greater and lesser degree, needing similar treatment—viz., greater prismaticity of the flint lens. It will be seen that the conditions can vary immensely with every degree of nearness, and much difference of opinion exists, even amongst opticians as well as astronomers, as to the best appearance on test to show a naturally coloured stellar body. I am of opinion that the best correction is when the outside fringes are equal in width, with the forms I give; thus proving, as nearly as practicable, absolute parallelism.

FIG. 1.

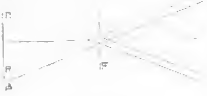


FIG. 2.

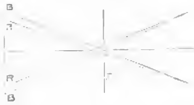
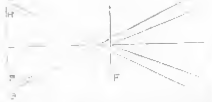


FIG. 3.



(*To be continued.*)

CALIPERS AND CALIPERING.*

By JOSHUA ROSE.

A POINT of great importance in a pair of machinists' calipers is stiffness—not stiffness in the joint particularly, but stiffness of shape or form. Nobody complains of the weight of the caliper gauge that is used for fine standard measuring, and yet ninety-nine out of a hundred pairs of calipers are light, flimsy things that will spring readily, even with the small amount of contact pressure that the average machinist gives in the set of his calipers. It is the amount that calipers will spring under a certain contact pressure which necessitates that men must become used to a pair of calipers before they are enabled to make correct measurements with them; and it is remarkable how correctly some machinists will measure, notwithstanding that they set the calipers with much more forcible contact than is really proper, because, although they may transfer measurements from one piece to another and make them a good fit, yet from the spring of the legs the measurement to which the calipers are set will be found, if tried on a Brown and Sharpe steel rule, to be sensibly affected by the spring.

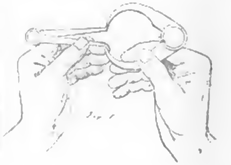


Fig 1

Take a piece of work, for example, of say 4in. diameter, and let the calipers be set so as to have sensible pressure on the work, and take the measurement on the hundredth divisions of the measuring rule. Then reset them so that contact is barely perceptible, and on again applying them to the rule the difference will be clearly noted if an ordinary eyeglass is used. There will be a certain amount of spring in any pair of calipers if the joint is stiff enough to permit the calipers to be handled freely without fear of the set altering; but if the legs are broad enough and the washers and pin are sufficiently large, and at the same time a good fit, calipers may be closed upon the work by the hand, as in Fig. 3, and set to the required size at once without requiring any further adjustment, all that is necessary being to close them upon the work with a proper degree of force, which is soon learned by practice.

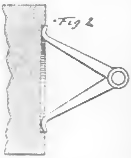


Fig 2

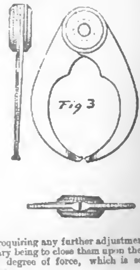


Fig 3

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* From *Mechanics.*

A good form for outside calipers is shown in Fig. 3, the pin and washers being much larger than is usual. The holes should be slightly taper, and the pin fit made by forcing it in by hand while rotating back and forth, applying oil to keep it from cutting. The pin should fit so well as to make the joint very nearly tight enough, independent of the washers. Calipers thus made will last many years without getting loose-jointed. The pin, however, will get loose in time, and in the larger calipers it is a good plan to drill a hole through the pin, so that a punch may be drawn through to tighten the joint when necessary. The legs of the calipers in Fig. 3, as will be noticed, are much wider than usual, which is done to prevent sprung.

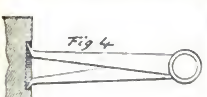
Fig 4

In applying calipers to work of 2in. or 3in. diameter, the little finger should project beneath the piece, as in Fig. 6, so that the lower caliper leg can be rested against it to steady it and enable the upper leg to be very finely adjusted. A lighter contact is thus attained. This is a much better plan than trusting to the calipers to adjust themselves, as will be the case if they are applied as in the figure. The calipers should be held lightly, because the hand is more sensitive to the contact then than it would be if they were held with a firm grip. The points should, for ordinary work, be slightly rounded, as in the end view in Fig. 3, so that the calipers may be moved sideways to try the set, on work of from 3in. to 6in. in diameter, the difficulty of accurate measurement increasing with the size of the work, especially in cylindrical work. The ends should be tempered to a purple and bevelled off from the outside, as shown, and not from the inside, because in that case it is difficult, when they are opened out very wide, to know just where to locate the point of contact for the inside calipers.

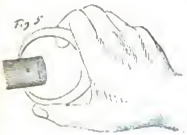
Fig 5

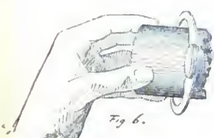
Fig 6.

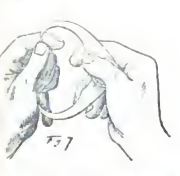
Fig 7

In trying outside with inside calipers, the sizes being between 2in. to 4in., the calipers may be held as in Fig. 1, the point of the "insides" resting on the fingers in such position that the point of the "outsides" may be rested there also, and both will be steadied. The forefinger supports one leg of the outsides, and the middle finger supports the other. The insides may be held vertically or horizontally, the latter position being preferable, as the light will be better. For larger sizes the set should be tested in the position shown in Fig. 7, the insides and outsides resting on the forefinger of the left hand and both legs of the "outsides" being supported as shown.

A good form for inside calipers is shown in Fig. 4, the points being at an angle and not rounded, as in Fig. 2, the difference being that the extreme points of the angle will measure clear to the back of a hole, which the curve of rounded points prevents. The Pratt and Whitney Company have found that a machinist can with a good pair of calipers measure within the twenty-thousandth of an inch—a degree of accuracy sufficient for nearly all purposes.

NURSING THE SICK.

DR. J. HALLIDAY CROOM recently lectured at Edinburgh on "Nursing the Sick." Dr. Croom began by pointing out that the three great factors of life were air, heat, and nourishment, which were almost entirely in the hands of the nurse who was constantly with the sick person. He then gave some hints as to the choice of a sick-room, the regulation of temperature, the cleanliness of the room, and the *personnel* of the nurse. Among other advices to the nurse, he remarked that none could be more important to her than the avoidance of all forms of alcoholic stimulants while she was engaged in nursing. There could be no question that long physical fatigue and anxious watching were better maintained on tea, coffee, or cocoa than by the use of any form of alcoholic or malt liquor whatever. The nurse must, for the time being at least, become a total abstainer from alcoholic drinks. The patient's bed, he insisted, should be made at least once a day, however ill the patient might be, unless the doctor absolutely forbade it. If possible, the patient should not have a feather bed, a hair or straw bed being far more comfortable for him. He described the best way of making a bed so as to give the least possible disturbance to the sick person; and, in order to prevent bed sores, laid down these rules:—(1) Keep the sheet below the patient perfectly smooth; (2) wash the parts where the bone is prominent daily with soap and warm water, dry them well, rub them over with a little spirits of wine or whisky to harden the skin; (3) change the patient's position frequently; (4) never let him lie on a blanket; a freshly-made bed, a good sponge over with vinegar and water, would often, after a restless, sleepless night, have the good effect of making the patient fall into a sound sleep. He gave directions as to making linseed, mustard, and other poultices, and also fomentations. Nourishment was the third great factor of life, and food played a most important part in the treatment of all illnesses, more especially fevers. The nurse must devote much of her attention to the subject of diet, observing carefully the patient's appetite, and attending carefully to the quantity of food and the effects of it. Milk was the most valuable article of diet in the sick-room. About half a pint of milk was equal to about a quarter-pound of beef in nutritive value. Beef-tea was not of so much intrinsic value as milk, but was useful as a stimulant as well. In giving sick people medicine he laid down three points which ought carefully to be remembered—namely, regularity, punctuality, and exactitude. To those intrusted with the administration of medicine to sick persons, he offered the hint to always read the label of the bottle before administering the medicine. By doing so they might probably save themselves a lifelong reproach. Addressing a few words on the nursing of children, he remarked that this was a much more difficult task than to nurse a grown-up person, who could tell exactly how he felt, and where his pains and aches were. Frequently the only indication of a child being ill was its fretfulness. If the child was usually happy and good-tempered, and suddenly became cross and fretful, then they might be quite sure he was ill, and instead of scolding him, as was unfortunately too frequently the case, they ought to set themselves to try and find out what was the matter. Children suffered from the same causes as grown-up people, but much more quickly and seriously; nothing did them more harm than bad air. This was specially so at night; nothing could be worse than putting them to sleep in a close, shut-up room. The disease which they all knew as "rickets," and which was unfortunately very common amongst the poorer classes of our large cities, was mainly brought about by a want of pure air and light, as well as, no doubt, by insufficient food. Now, the two first of these requisites cost nothing, perhaps only some trouble and thought; and because these were not attended to our hospitals and dispensaries were crowded with children stunted in growth, with deformed chests, crooked backs and legs, and altogether in a miserable condition. In the case of infectious diseases, he gave directions as to treatment, and particularly the measures that ought to be taken to prevent the spread of infection. Infection in scarlet fever was conveyed by the flakes of skin shed when desquamating; these might be carried long distances, and be conveyed from one person to another by means of letters, books, clothes, &c. When desquamating, if they rubbed the patient all over twice daily with camphorated oil it would help greatly to prevent infection spreading. In measles, while draughts should be carefully guarded against, the diet should be very light—plenty of good milk, beef tea, &c., until quite convalescent, then a little fish was always a good thing to begin with. When typhoid fever broke out, one should suspect something wrong with the drainage, water, milk, or it might be the dirty, badly-ventilated state of the whole house. Typhus was a preventible disease, and was caused by overcrowding, bad ventilation, and a dirty condition of houses, clothes, and people. No one should ever go near a fever-patient fasting

PRELIMINARY NOTE ON A THEORY OF MAGNETISM BASED UPON NEW EXPERIMENTAL RESEARCHES.[*]

By Prof. D. E. Hughes, F.R.S.

IN the year 1879[†] I communicated to the Royal Society a paper "On an Induction Currents Balance and Experimental Researches made therewith." I continued my researches into the molecular construction of metallic bodies, and communicated the results then obtained in three separate papers[‡] bearing upon molecular magnetism.

To investigate the molecular construction of magnets required again special forms of apparatus, and I have since been engaged upon these, and the researches which they have enabled me to follow.

From numerous researches I have gradually formed a theory of magnetism entirely based upon experimental results, and these have led me to the following conclusions:—

1. That each molecule of a piece of iron, steel, or other magnetic metal is a separate and independent magnet, having its two poles and distribution of magnetic polarity exactly the same as its total evident magnetism when noticed upon a steel bar-magnet.

2. That each molecule, or its polarity, can be rotated in either direction upon its axis by torsion, stress, or by physical forces such as magnetism and electricity.

3. That the inherent polarity or magnetism of each molecule is a constant quantity like gravity; that it can neither be augmented nor destroyed.

4. That when we have external neutrality, or no apparent magnetism, the molecules, or their polarities, arrange themselves so as to satisfy their mutual attraction by the shortest path, and thus form a complete closed circuit of attraction.

5. That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically in a given direction, producing a north pole if rotated in this direction as regards the piece of steel, or a south pole if rotated in the opposite direction. Also, that in evident magnetism, we have still a symmetrical arrangement, but one whose circles of attraction are not completed except through an external armature joining both poles.

The experimental evidences of the above theory are extremely numerous, and appear so conclusive, that I have ventured upon formulating the results in the above theory.

I hope in a few weeks to bring before the Royal Society the experimenta evidence which has led me to the conclusions I have named; conclusions which have not been arrived at ha tily, but from a long series of research upon the m lecular construction of magnetism now extending ov r several years.

ON THE USE OF INCANDE CENCE LAMPS AS ACCESSORIE TO THE MICROSCOPE.[§]

By C. H. Stearn, F.R.M.S. (Swan United Electric Lighting Co., Limited).

WHEN, in 1871, I first commenced the study of the physics of high vacua, it was with the object of investigating the law governing the arrangement of the lines in the spectra of rarefied gases; but after my meeting with Mr. J. W.

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[*] Communicated to the Royal Society, January 25, 1883.

[†] Proc. Roy. Soc. Vol. XXIX., p. 56, 1879.

[‡] Proc. Roy. Soc. Vol. XXXI., p. 525; Vol. XXXII., pp. 25, 213, 1881.

[§] From the February number of the *Journal* of the Royal Microscopical Society.

Swan, in 1877, I entered with him upon an investigation, having for its object the discovery of the conditions under which thin carbon conductors could be rendered permanent when made incandescent by an electric current in the most perfect attainable vacuum. With what success that investigation was attended, my colleague has already described in his lectures and pamphlets. I hope to show that microscopists need not wait for the realisation of the hopes of the shareholders in electric companies, and the fears of those interested in gas companies, but may at once discard their troublesome oil or gas lamps, with many of their accessories, and proceed at once to avail themselves of the advantages of electric illumination. I am aware that Dr. Van Heurck, of Antwerp, has anticipated me in the application of our lamps to the microscope; but, as those employed by him were of comparatively large size,* the battery power necessary to render them incandescent would, till electricity is supplied from a central station, constitute a bar to their general use.

There can be no advantage in using a large light at a distance from the object, when a small one near to it will give as good, or better, results, and will at the same time require the expenditure of so little electrical energy, that the trouble attendant on the use of the battery is almost inappreciable; and in this way the lamp can be made a permanent attachment to the microscope itself.

The lamps I have constructed for the purpose are shown full size in Figs. 1 and 2, and *in situ* on the microscope in Fig. 3 at A, B, and C. The length of the incandescent filament is $\frac{1}{10}$in., its diameter $\frac{1}{100}$in., and its superficial area about $\frac{1}{300}$th of a square inch. Two Bunsen or four Leclanché cells are sufficient to render them fully incandescent; but for general purposes it will be best to use an additional cell, regulating the intensity of the light by means of the adjustable resistance coil D interposed in the battery circuit, and attached to the base of the microscope.

FIG. 1.

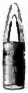
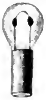


FIG. 2.



As the duration of the lamps is in an inverse ratio to the temperature at which they are maintained, it is desirable that the most intense light that the lamp will give should only be employed for a very short time when a special effect is required; such, for instance, as for purposes of micro-photography. If the lamp is at other times used no brighter than is necessary to obtain a white light, and the current turned off when observation is not going on, the lamps will last a very long time, as experience has shown that a life of more than 2,000 hours of continuous and brilliant incandescence is frequently exceeded by Swan lamps. It is possible to obtain a light of 2½ candles from the tiny surface just mentioned, with an electromotive force of 3½ volts, and a current of 1½ ampère. It would, however, at a safe temperature, give a light equal to one candle.

It will be found the most convenient plan to keep more than one, say three, of these lamps on the instrument, so that by merely turning a switch the position of the light may be varied.

(1.) For the illumination of opaque objects the lamp A (Fig. 3) is attached by a jointed arm E, to an insulated collar *a*, which screws on above the objective. The source of light can then be rotated around the object while under examination, so that delicate surface markings can be readily brought out.

(2.) On moving the switch *b* from the central position to the right, contact is made with another stud, and the current passes to a second lamp B, mounted on a platform fitting into the substage, and capable of rotation and lateral adjustment, so that direct or oblique illumination at any angle may be obtained.

As the source of light is almost a point, and the lamp can be brought very nearly into contact with the slide, a greater degree of obliquity of the illuminating rays can thus be obtained than by almost any other method, and hence blackground illumination is shown with great beauty, and many of the diatoms display diffraction colours with unusual splendour. The resolution of test objects becomes very much simplified, as most of them can be resolved by the lamp alone, without any accessory apparatus.

FIG. 3.

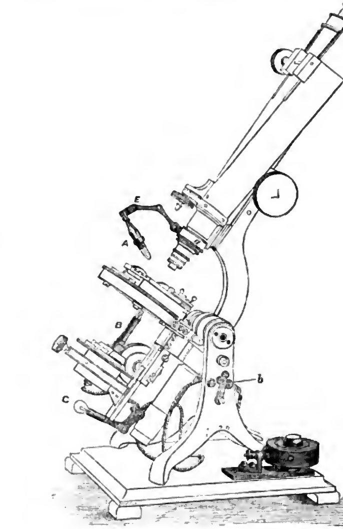


FIG. 4.

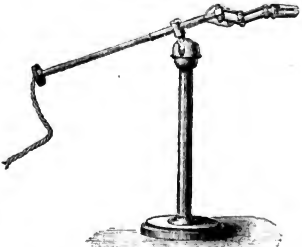
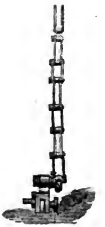


FIG. 6.



(3.) For use with the polariscope, a third lamp C, of slightly larger size, is placed in the position of the usual mirror; it is put in action by moving the switch to the left, so as to make contact with the third stud. This lamp requires an additional cell so as to develop a light of about four candles.

As the sockets of the lamps are all made to a standard size, it is easy if more light be required than is given by the smaller lamp to transpose the larger one to either of the other positions and use the full strength of the battery. If it is found desirable with the lower powers to give parallelism or convergence to the rays, a very small lens can be mounted in front of the lamp.

If a more simple mounting is desired, the forms shown in Figs. 4, 5, and 6 may be adopted; and the lamp can be thus placed in any position above or below the stage.

If it is required to maintain the lamps for several hours at full incandescence, the most satisfactory battery to use would undoubtedly be a Bunsen or Grove. If, however, the switch is turned off whenever an observation is completed, a recent modification of the Leclanché answers admirably; for if exhausted through polarisation it recovers itself when left for a short time, and will, when once filled, keep in good order for several months. It is best to use five of these modified Leclanché cells, controlling the strength of the current by means of the resistance, and diminishing it as the potential of the battery falls. For all ordinary work these Leclanché cells will be found to meet all the requirements of the microscopist. The Swan-Sellon, or Faure accumulator, will also be found convenient, but these are at present rather expensive luxuries; and though they last for a considerable time when charged, the trouble of charging at intervals would probably counterbalance the advantages gained in other ways.

I have been able to light the lamps satisfactorily with a small dynamo, about five inches in length; and if it be possible to obtain a spring which can be wound up by hand, and will drive it for half an hour without occupying too great a space, this may probably be a very convenient method of obtaining the current when required. When, however, we consider that to obtain the amount of electrical energy represented by the product of 3½ volts and 1½ ampere, we should have to expend about 4 or 5ft.-lb. of mechanical energy per second, the probability seems rather remote; and, both for convenience and economy, the modified Leclanché cells carry off the palm at present, so far as microscopical illumination is concerned.

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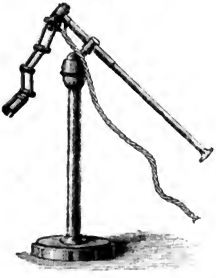
* Since the above was written, Dr. Van Heurck has informed me that he has used lamps requiring an electromotive force of not more than 7 volts.

Fig. 5.



DYNAMO-ELECTRIC MACHINERY.—VI.*

By Prof. S. P. Thompson, B.A., D.Sc.

(*Continued from p.* 494.)

The Brush Dynamo.

BEFORE passing on to the dynamos of the second class, I have some remarks to make on that much mis-understood and mis-described machine, the Brush dynamo. Its armature—a ring in form, not entirely overwound with coils, but having projecting teeth between the coils like the Pacinotti ring—is unique. Though it thus resembles Pacinotti's ring, it differs more from the Pacinotti armature than that armature differs from those of Siemens, Gramme, Edison, Bürgin, &c.; for in all those the successive sections are united in series all the way round, and constitute, in one sense, one continuous bobbin. But in the Brush armature there is no such continuity. The coils are connected in pairs, each to that diametrically opposite it, and carefully isolated from those adjacent to them. For each pair of coils there is a separate commutator, so that, for the ordinary ring of eight coils, there are four distinct commutators side by side upon the axis—one for each pair of coils. The brushes are arranged so as to touch at the same time the commutators of two pairs of coils, but never of two adjacent pairs; the adjacent commutators being always connected to two pairs of coils that lie at right angles to one another in the ring. The arrangement is best studied graphically from the diagram given in Fig. 26. In this figure, the eight coils are numbered as four pairs, and each pair has its own commutator, to which pass the outer ends of the wire of each coil, the inner ends of the two coils being united across to each other (not shown in the diagram). In the actual machine, each pair of coils, as it passes through the position of least action (i.e., when its plane is at right angles to the direction of the lines of force in the field, and when the number of lines of force passing through it is a *maximum*, and the rate of change of these lines of force a *minimum*) is cut out of connection. This is accomplished by causing the two halves of the commutator to be separated from one another by about one-eighth of the circumference at each side. In the figure it will be seen that the coils marked 1, 1, are "cut out." Neither of the two halves of the commutator touches the brushes. In this position, however, the coils 3, 3, at right angles to 1, 1, are in the position of best action, and the current powerfully induced in them flows out of the brush marked A, (which is, therefore, the negative brush) into that marked A'. This brush is connected across to the brush marked B, where the current re-enters the armature. Now, the coils 2, 2, have just left the position of best action, and the coils, 4, 4, are beginning to approach that position. Through both these pairs of coils, therefore, there will be a partial induction going on. Accordingly it is arranged that the current, on passing into B, splits, part going through coils 2, 2, and part through 4, 4, and re-uniting at the brush B', whence the current flows round the coils of the field-magnets to excite them, and then round the external circuit, and back to the brush A. (In some machines it is arranged that the current shall go round the field-magnets after leaving brush A', and before entering brush B; in which case the action of the machine is sometimes, though not correctly, described as causing its coils, as they rotate, to feed the field-magnets and the external circuit alternately.) The rotation of the armature will then bring coil 2, 2, into the position of least action, when they will be cut out, and the same action is renewed with only a slight change in the order of operation. The following table summarises the successive order of connections during a half-revolution:—

FIG. 26.

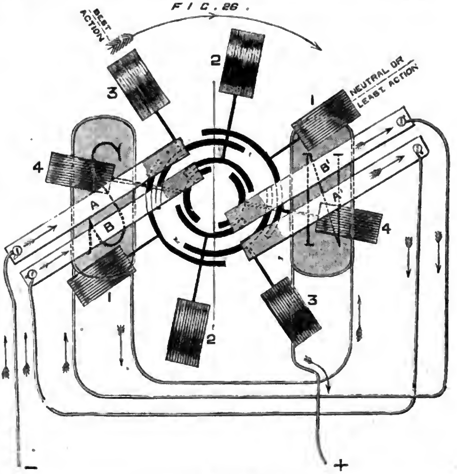


Diagram of the Brush Dynamo.

First position. (Coils 1 cut out.)

$$\mathrm{A} - 3 - \mathrm{A};\ \mathrm{B} < \substack{4\\2} > \mathrm{B};\ \text{Field-magnets} - \text{External circuit} - \mathrm{A}.$$

Second position. (Coils 2 cut out.)

$$\mathrm{A} < \substack{1\\3} > \mathrm{A};\ \mathrm{B} - 4 - \mathrm{B};\ \text{Field-magnets} - \text{External circuit} - \mathrm{A}.$$

Third position. (Coils 3 cut out.)

$$\mathrm{A} - 1 - \mathrm{A};\ \mathrm{B} < \substack{2\\4} > \mathrm{B};\ \text{Field-magnets} - \text{External circuit} - \mathrm{A}.$$

Fourth position. (Coils 4 cut out.)

$$\mathrm{A} < \substack{3\\1} > \mathrm{A};\ \mathrm{B} - 2 - \mathrm{B};\ \text{Field-magnets} - \text{External circuits} - \mathrm{A}.$$

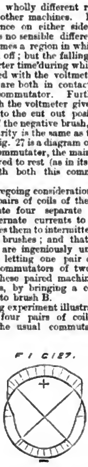
From this it will be seen that whichever pair of coils is in the position of best action, is delivering its current direct into the circuit; whilst the two pairs of coils which occupy the secondary positions are always joined in parallel, the same pair of brushes touching the respective commutators of both.

One consequence of the peculiar arrangement thus adopted is, that measuring the potentials round one of the commutators with a voltmeter gives a wholly different result from that obtained with other machines. For one-eighth of the circumference on either side of the positive brush, there is no sensible difference of potential. There then comes a region in which the potential appears to fall off; but the falling off is here partly due to the shorter time during which the adjustable brush connected with the voltmeter and the fixed positive brush are both in contact with the same part of the commutator. Further on there is a region in which the voltmeter gives no indications corresponding to the cut out position; and again on each side of the negative brush, there is a region where the polarity is the same as that of the negative brush. Fig. 27 is a diagram of a 6-light Brush taken at one commutater, the main + brush being, however, allowed to rest (as in its usual position), in contact with both this commutator and the adjacent one.

From the foregoing considerations, it will be clear that the four pairs of coils of the Brush machine really constitute four separate machines, each delivering alternate currents to a commutator, which commutes them to intermitten uni-directional currents in the brushes; and that these independent machines are ingeniously united in pairs by the device of letting one pair of brushes press against the commutators of two pairs of coils. Further, that these paired machines are then connected in series, by bringing a connection round from brush A' to brush B.

The following experiment illustrates the independence of the four pairs of coils in the Brush dynamo.* The usual commutators of a small Brush dynamo were removed and replaced by eight brass collars, to each of which was united one end of one of the four pairs of coils. Against these rings pressed eight separate brushes, and the circuit

FIG. 27.



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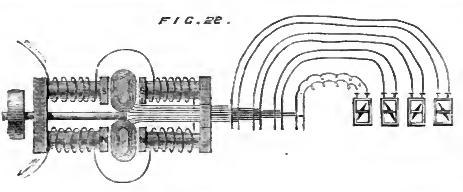
*Extracted from the Cantor Lectures, delivered before the Society of Arts.

* This beautiful experiment was first shown me by Mr. P. Allen, who kindly fitted up the little Brush dynamo with the eight collars for this occasion.

FIG. 28.



of each of the four pairs of coils was completed, as shown in Fig. 28, through an ordinary detector galvanometer. On rotating the armature by hand, at a moderate speed, the needles of all four detectors are set vibrating to and fro by the alternate currents, not synchronously, but one after the other. If any one of the four circuits is broken, the others go on as before.

Dynamos of the Second Class.

I now pass on to dynamos of the second class, in which coils are carried round to different parts of a magnetic field, whose intensity differs in different regions, or one, in different parts of which the lines of force run in opposite directions. In the early machine of Pixii a single pair of coils was mounted so as to pass in this fashion through parts of the field where the magnetic induction was oppositely directed. Such a machine, therefore, gives alternate currents, unless a commutator be affixed to the rotating axis. Niaudet's dynamo, which may be regarded as a compound Pixii machine, having the separate armature coils united as those of Gramme and Siemens into one continuous circuit, is furnished with the radial collector mentioned above. In the Wallace-Farmer dynamo, there are a pair of poles at the top arranged so that the north faces the south pole, and another pair at the bottom where the south faces the north pole. The coils are carried round, their axis being always parallel to the axis of rotation, upon a disc; there being two sets of coils on opposite faces of two discs of iron set back to back. They are united precisely as in Niaudet's dynamo, and each disc has its own collector. Each bar of the collector is, moreover, connected, as in the dynamos of Pacinotti, Gramme, Siemens, &c., with the end of one coil, and the beginning of the next. In fact, the Wallace-Farmer machine is merely a double Niaudet dynamo with cylindrical collectors. There is a serious objection to the employment of solid iron discs such as these. In a very short time they grow hot from the eddying Foucault currents engendered in them as they rotate. This waste reduces the efficiency of the dynamo. In the dynamo of Hopkinson and Muirhead, the disc-armature takes a more reasonable shape. Instead of a solid disc of iron to support the coils, there is a disc built up of a thin iron strip wound spirally round a wooden centre. The coils, of approximately quadrangular shape and flat form, are wound upon the sides of this compound disc. The dynamo of Ball (the so-called "Arago-disc" machine) is similar in many respects, but has no iron cores to the armature coils.

(*To be continued.*)

THE MODERN LATHE: ITS MANUFACTURE AND USES.*

By J. H. EVANS.

IT should be known that the size of the lathe is named after the radius of the cylinder that can be turned upon it—i.e., the distance from the axis of the mandrel to the top of the lathe-bed; thus, when the distance is 3in., the lathe is called a 3in. lathe, if 8in. or 10in., it is called an 8in. or 10in. lathe. For all ordinary amateur and ornamental turning, a 5in. lathe is to be recommended.

The lathe-heads and bearers of a 5in. back-centre lathe are made of cast-iron. The bearers or bed should be 3ft. 6in. long, solid enough to be perfectly rigid when finished and planed up at the top and bottom, and squared at the ends. The top surface of the bed should be finished off and surfaced truly; the slot between the bed should also be carefully finished and left parallel to its sides, and square to the surfaces, and the outside edges of the bearers are also planed true. The bed should be supported on cast-iron standards, firmly bolted at the ends.

The shape of the mandrel and poppet-heads is shown by the examples upon the table; the mandrel-head should be 9in. long at the base, and the poppet-head 4in., both having a solid tenon of such size as to true up to fit into the interval between the bearers. The mandrel-head must then be carefully set out, its base and tenon planed true and accurately fitted to the bed, and its face planed up at a right angle to the lathe-axis. The poppet-head is then bored out with a hole $\frac{5}{8}$in. in diameter, and accurately ground out to receive the sliding cylinder; this hole is then used to carry what is termed the centring-bar, a long cylinder with a point at each end, which is used for the purpose of setting the poppit-head perfectly true, both vertically and horizontally. It must then be planed up correctly, and carefully fitted to the lathe-bed, and in fitting its base and tenon it is necessary that great perfection is obtained, as the ultimate truth and accuracy of the lathe depend upon this point.

Having the poppet-head thus fitted to the lathe-bed, and centred to the axis, and the mandrel-head also accurately fitted, the heads are firmly bolted down upon their own lathe-bed. In this condition the heads—still firmly bolted to their own bed—are set up truly between the centres of another powerful and accurate lathe. A long drill, with its shaft accurately fitting the cylinder-hole of the poppet-head, but actuated by a square hole chuck upon the large lathe mandrel, is passed through the front of the mandrel-head. The poppet-head, kept facing the same wey, is then lifted over to the other side of its mandrel-head, and again bolted down upon its own bed; then the long drill, having been reversed, is passed through the back of the mandrel-head.

We now have the three holes of the same size, with their axes approximately in the same line, and in a plane parallel to their own lathe-bed. For the long drill, a boring-bar is now substituted; this boring-bar is a cylindrical shaft, which accurately fits the hole in the poppet-head; but it is mortised through, so as to carry flat steel cutters of various shapes and sizes, for the purpose of shaping out the aperture in the front of the head to receive the steel collar in which the mandrel is to permanently run. Other cutters are also used to face up the mandrel-head at the back, so as to finish all the faces or bearing-parts true and square to the lathe axis.

The finished hole in the front of the mandrel-head, to receive the steel collar, is tapered about $\frac{1}{16}$in. in its length, which is about 1in., and the back part is shaped out to a curve to leave the right length of collar bearing. Finally, a vertical hole has to be drilled through from the top as a passage for the access of oil to the mandrel. The back-centre cylinder is left carefully true by the drill.

In making the steel collar, a suitable ring of cast steel having been forged and properly annealed, is chucked and turned out true, the inside being slightly tapered from behind forward, and the hind part turned out to receive an obtuse cone of 45° from the axis; the collar is then fixed upon a true steel arbor and turned outside to fit the tapered hole in the mandrel-head; it should be of such size as to fit into the hole to within $\frac{1}{32}$in. of its intended position. The front edge of the collar is then rounded off, and a hole is drilled through it to correspond with the hole drilled through the mandrel-head, and a slight groove for the passage of oil is filed parallel to its axis.

The collar is then hardened, by being made hot in a clear fire, and dipped into clean cold water. In order to fix the collar in its place, the mandrel-head is placed upon a hot-plate or stove, until the face becomes too hot to touch. It will then be found that the cold collar can be easily driven up to the desired position, and the head, on being cooled, will retain the collar in its place. The collar must, of course, be inserted so that the hole which has been drilled in it is in a line with the oil-hole in the mandrel-head.

The inside of the collar, having been turned with both its cones fitting a steel gauge plate, to which counter-gauge plates have been made, we use those gauges for turning up the corresponding cones on the mandrel.

In proceeding to make the mandrel, which is made of the very best Lowmoor iron to be procured, it has a ring of shear steel welded on the neck where it runs in the collar, and at the end another piece of shear steel for the back centre.

Having carefully centred it, it is turned up all over, and the nose partially screwed. The neck is then fitted to the collar, but leaving sufficient to allow for the contingencies of hardening and final fitting. Now the mandrel neck or bearing must be hardened, also in clear cold water, and if the result be successful—though failure at this point at times occurs—the back centre is corrected, and countersunk to 55°, and finished, being hardened in the same way. The mandrel will generally have been distorted and rendered uneven in the process of hardening. This has now to be corrected by the process of grinding up by an emery-wheel, which is used quite dry and free from grease, and revolving at a very high speed. The emery-wheel should revolve in a frame held in the slide-rest, the mandrel also being revolved between dead centres, by a small temporary pulley, in a direction opposite to that in which the emery-wheel is revolving. In this way the neck of the mandrel is ground perfectly true upon its back centre, and so as to enter the collar almost completely. This done, the back centre cylinder should next be taken: this is composed of cast steel, forged to the desired shape; it is turned all over, and the cylinder accurately ground into the hole in the back of the mandrel-head. The point is then turned up to correspond with the centre in the mandrel, 55°, by means of the boring collar, and is then hardened. The cylinder slides truly in the hole at the back of the mandrel-head, and is brought forward by means of a circular nut, working against the front face of the casting, which has been trued by the cutter, as before mentioned. Now, the final adjustment of the mandrel in its collar has to be effected by grinding in, which is done with oilstone powder, or, in some cases, with very fine emery. In doing this, the mandrel is kept up to its collar by means of its own back-centre cylinder sliding truly in the back part of the mandrel-head. Great care must be exercised in this process, the mandrel being worked backwards and forwards by the hand until its obtuse cone is brought up into its seat. Lastly, the face of the mandrel and the thread upon its nose is finished off.

A steady-pin now has to be fitted to the body of the mandrel for holding the pulley, which is fixed by a nut and washer from behind; the pulley may be of wood, brass, or iron; but for general purposes I prefer iron. The face should be broad enough to show clearly the necessary number of dividing circles.

The poppet-head must then have its cylinder finally fitted in. This having been done, the cylinder is bored out to within an inch of its rear end, and coned out in front to take its centres; the rear end is then bored and tapped with a thread of ten to the inch. Its leading-screw is then fitted. This has a circular flange at its rear end to bear against the face of the casting, and also against the inside of the metal cap which is screwed on to the casting; the end projects for the purpose of receiving a winch-handle, wheel, or drop-lever. By graduating the circumference of the flange to hundredths of the circle, the traverse of the back-centre will be shown to thousandths of an inch, which, as Dr. Edmunds has remarked, is of great value for accurate boring and other scientific purposes.

Having thus briefly described some of the most important points making a lathe of this character, we will consider for a few moments a few of the simple tools adopted in metal-turning—that is, iron, steel, &c. The lathe will, of course, be the same as used for wood-turning, although for heavy work a back-geared lathe is to be preferred; but this must be according to circumstances. As for hand-tools, a graver, chisel, round nose, triangle tools, and parting tool, will be sufficient for practical purposes. The graver is made of square steel, and ground to a diagonal or diamond shape. Now as to the correct angle at which such a tool should be ground. This is, and always has been, the subject of great comment; but my experience as a practical turner is that after a very little practice, a workman will grind up the tools to such an angle as will suit his purpose, and cut clean and sharp without paying any attention to the many theories laid down by various authors.

In centring a piece of iron or steel, it is important that it should be drilled up and counter-sunk. This is done with a small drill in the first place, and a half-round counter-sink to follow. The object of it is to prevent the point of the centre working against the bottom of the hole. The next process will be to face the ends up true. This is done with a triangle tool, which is a tool easily made from a worn-out saw-file; I say a saw-file, because these, for the purpose for which they are used, are left harder than other files of the same shape, and, consequently, only require grinding. I have brought a few here to illustrate what I mean. Two sides are ground up sharp, and the end diagonally. This tool can be used for either the right or left side of the work.

The object of facing the ends of the material is to prevent its running out of truth, which it will soon do from the unequal pressure upon the poppet-head centre, caused by an unequal surface. The best way to hold this tool will be thus:—The handle grasped firmly in the right hand, with the knuckles upwards, and the tool itself passed between the third and fourth fingers of the left hand; the lower edge of the tool is then brought firmly on to the rest, and by inclining the cutting edge towards the work, it is brought into contact, and those parts that are uneven are soon reduced to flat surface.

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* Paper read before the Society of Arts on Wednesday, Feb. 7, 1883.

To turn a cylindrical piece of steel or iron, the graver is necessary; this tool it held in a similar way, only brought to a different position; the right hand must be more to the front, and the T-rest so arranged that the point of the graver can be brought to the centre of the work. The character of this tool, like many others, will greatly assist the operator in finding the position of the rest that is most suitable to the diameter of the work being turned. With these few remarks upon turning iron and steel, and holding the tools, I will take another branch of metal-work—that is, drilling and boring.

In this branch of turning, which is a very important matter, there are various ways and means adopted; work that is held in a chuck must have a centre formed with a triangle tool, and the drill is made to pass through it by means of the poppet-head; if the drill is used between the centres, it is held either by a carrier or a wrench, and sufficient pressure maintained by the poppet-head to keep the drill always cutting. In using a drill thus, it will be necessary to be careful to keep the pressure against the centre when withdrawing it; if it is allowed to get free, the revolution of the lathe will cause it to catch and break the drill, and probably damage the operator's hand.

When a long cylinder is required to be bored, the boring-collar must be brought into use; this is a circular plate, with a series of holes coned out from the back. The work is rounded on the front edge, and runs between the plate and the running centre. The centre must be formed in similar manner, and the drill passed up in the same way; after which, a half-round bit must be used. The mouth of the hole is turned out to fit the bit, which is held in the same way as the drill; for steel and iron a lubricant of some kind is necessary; either oil or soap-suds will answer.

I have great pleasure in saying that, as for the various chucks for holding drills and small work, our American cousins have made such rapid strides, that they need no comment from me; suffice it to say, that they are a most useful adjunct to any lathe, and as Mr. Churchill is, I am glad to see, in full force and so able a representative of the American trade, I will leave this matter in his hands, and proceed to give a few details on screw-cutting.

Screw Cutting.

I think a word or two on striking and chasing screws will be of interest to many, especially those not far advanced in the art of turning. This, then, forms a very important part in general turnery; screws cut upon ivory or hard wood, for such purposes as boxes, can be cut with a screw-tool or chaser, without the assistance of any special apparatus; but to do this of course requires considerable practice, and is what is termed striking a thread.

It will be policy, in the first place, to practise upon inexpensive material; and for wood-screws, boxwood will be the best material, having the wood chucked in a cup-chuck. A plain cylinder, without a shoulder or obstruction of any kind, will be the best to begin with, about 2in. long and 1in. in diameter, and the chaser should have about 20 threads to the inch. The tool will require to be held somewhat differently to the graver and chisel: the handle is held by the right hand, with the knuckles underneath; the left hand is passed round the body of the rest, and the thumb placed on the top of the screw-tool. The rest is placed parallel to the work, and not quite close to it, the height being so adjusted that it will allow the cutting face of the tools to be held at a slight angle. When central to the diameter of the material, when about to start the thread, the tool should scarcely touch the flat of the rest, but must be guided by the first finger of the right hand and the thumb of the left hand. When thus supported, it is moved in a curved line, in the opposite direction to the rounded edge of the end of the iron, which must be rounded off. Now, this action, it will be readily seen, necessitates the movement of both wrists, the right going forward for the purpose of advancing the tool, while the thumb of the left hand regulates the speed at which the tool traverses, which rate will also mainly depend upon the pitch of the screw that is being struck.

It will be seen at once that the tool being moved in the opposite direction to the rounded edge of the work, that the cut only takes place in the centre of the width of the tool, so that the greatest depth of cut is obviously there. Supposing that, what is termed a true lead, is obtained, the same action must be repeated several times, to gradually lead the thread on to the cylindrical part of the work, where it is of course required. When practising striking screws it will form an important feature of the work, that the hand and foot work, so to speak, simultaneously; by this I mean, that the speed of one should coincide with the others. By way of further illustration: it would be impossible to cut a screw of, say, twenty threads to the inch, with the lathe running at a high speed.

I need scarcely add that the practice of striking threads is productive of some very curious results, such as double where single threads are wanted, treble, and what is commonly known as a drunken thread: this latter is, I may say, the most prominent result; and although the term is, I am aware, extremely inelegant, I will ask you to pardon it, as it so forcibly expresses the meaning, and I venture to say that as long as the practice of striking screws by hand is continued, it will be heard far and wide. I will ask the tyro not to be disheartened if his first trials prove fruitless, but to make a determination to overcome the difficulties of what will prove to him a most useful branch of the art of turning, and to bear in mind, at the same time, that if there were no difficulties to contend with, there would be no merit in endeavouring to become efficient.

I will now proceed to describe the traversing mandrel, which offers a means of cutting such screws mechanically. This is largely needed by amateur turners, as striking screws with certainty requires continual practice. It will be found to overcome all difficulties, and to be extremely handy.

In the traversing mandrel the lathe-head casting is about the substance of the ordinary back-centre lathe, but both ends are more nearly alike. The mandrel, however, is made sufficiently long to project at the rear. It is made of the very best cast-steel, and should always be bored throughout; its bearings are cylindrical, and its cylinder is hardened at those parts which run in the collars. The front of the mandrel has a cone left on it of 45° fitting to a corresponding cone in its collar, and which stands in the reverse direction to the obtuse cone of the back-centre lathe. When being used for plain turning it is kept in its place by a steel cap, fitting over the back end of the mandrel, and bearing against that face of the collar. This cap is prevented from turning round by a steady-pin in the end of the mandrel passing through a corresponding hole in the mandrel, and is retained there by a screw which fits into the end of the mandrel. On the end of the mandrel, steel screw-guides may be substituted for the cap, and secured by the same screw. Six of these generally accompany a high-class lathe of this kind, and are found to be sufficient for all practical purposes. The conductor is made of either brass or gunmetal, and consists of a ring cut into segments, and severally screwed to correspond with the steel guides; the ring is then fitted on to an eccentric mounted on a stud under the centre of the mandrel at the back of the head. The metal guide works freely on the eccentric, but to fix the guide selected for use in contact with the steel screw-guides, it will need the use of a lever. By means of this guide the mandrel is quite under control of the conductor, and, with the guide on the mandrel, is compelled to work backwards and forwards, according to the pitch of the guide and the direction in which it is turned. I have now abolished the obsolete fractional pitches, and screw these guides with six convenient aliquot threads, each guide being branded with a figure giving the number of threads to the inch which it cuts.

The pulley, which is also made of brass or gunmetal, should receive careful attention in its construction. It is made hollow to avoid weight, but is turned all over inside, so that it is equally balanced when put together. The best way to put such a pulley together is to shrink the face in. Some makers solder them, but the former way is preferable. The inside having been carefully turned all over, the front is then turned out $\frac{3}{16}$ths deep, and under-cut. The face is then turned to a corresponding angle, and left one $\frac{1}{16}$th larger than the recess. The body of the pulley is then placed on a heating-stove until it expands sufficiently to admit the front, which is pushed in, and then allowed to cool, when it will be as solid as if it were one piece. The centre hole is then turned out taper, and the mandrel fitted accurately to it. As only a small face can be left on the mandrel, it is necessary to fit to it a steady-pin and, the pulley being cut out to fit it, a nut and washer behind fix it securely to its place.

On the face of the pulley eight circles of divisions are drilled—viz., 360, 192, 144, 120, 112, 96, 60, 12, an adjusting index is also an indispensable addition. I may mention that I put the division of 12 for dividing square and hexagon, as it saves the wear of those that are required for ornamental turning. Such lathes are usually mounted on a strong double frame of mahogany, which checks vibration and deadens sound.

(*To be continued.*)

SPIRIT of turpentine is now made from sawdust and refuse of the saw-mill. It is extracted by a sweating process, and yields 14 gallons of spirits, 3 to 4 gallons of resin, and a quantity of tar per cord.

SCIENTIFIC NEWS.

THE great comet was observed by Mr. Common on the 27th ult. with the 3ft. reflector, and under a high power the condensation was found to contain five distinct nuclei in a straight line, each about equal to a star of the eleventh mag. Mr. Common thinks the comet may be visible with a moderately-large telescope during the dark nights now prevailing. Herr Stechert has calculated an ephemeris from the elements of Dr. Kreutz; but one position will probably suffice—Feb. 10, R.A. 6h. 0m. 17sec.; N.P.D., 109° 35′, Berlin midnight. The comet is thus in the constellation Lepus, near the south-west horizon. "A History of the Discovery and Appearance of the Great Comet of 1882," by the Rev. T. E. Espin, B.A., forms No. 1 of the *Transactions* of the Liverpool Astronomical Society, published by Adam Holden, Liverpool.

D'Arrest's comet is expected to return about June 12, and M. Leveau is preparing an ephemeris for April 23 to November 25; but other calculations place the next perihelion on Jan. 13, 1884.

The new comet, which we mentioned last week as having been observed from Puebla, Mexico, has not been picked up, and is probably a myth or a nebula.

A telegram has been received from Prof. Lemström, chief of the Finnish Meteorological Observatory at Sodankyla, in which he states that he placed a galvanic battery with conductors covering an area of 900 square metres on a hill, and found the cone to be surrounded by a halo which faintly but perfectly yielded the spectrum of the aurora. He regards this, and some subsequent results, as direct proof of the electrical nature of the aurora.

A valuable memoir on the observations of Denning's Comet (V. 1881) has been published in *Copernicus* by Mr. W. E. Plummer, of the Oxford University Observatory. The author's opening remarks are very interesting. He says:—"Of the several periodic comets with which we are acquainted, that whose orbit is discussed in the following pages, and for whose discovery we are indebted to Mr. Denning, will probably prove to be not the least interesting if continued observation at successive returns be practicable. Accepting, for the present, the elements of Dr. Hartwig, published in the *Astronomische Nachrichten*, No. 2405, which are very approximate, we have the following data:—

T = 1881, Sept. 13, ·4263. Berlin M. T.

$$\begin{array}{rcrrr} & & {}^{\circ} & {}' & {}'' \\ \pi - \Omega & = & 312 & 39 & 36{\cdot}2 \\ \Omega & = & 65 & 54 & 14{\cdot}8 \\ \iota & = & 6 & 50 & 43{\cdot}4 \\ \phi & = & 56 & 7 & 4{\cdot}4 \\ \log. a & = & \multicolumn{3}{l}{0{\cdot}630750} \\ \text{Period} & = & \multicolumn{3}{l}{8{\cdot}8335 \text{ years.}} \end{array}$$

These elements present some striking peculiarities; for, in the case of the comets of short period hitherto observed, the aphelia have grouped themselves at a distance from the sun, but slightly removed from the orbit of Jupiter, or, as in the case of Tuttle's Comet, near the orbit of Saturn; but this division, hitherto marked with tolerable distinctness, is, to some extent, removed by the discovery of a comet whose mean distance corresponds to a period of nearly nine years, and which considerably bridges the gap hitherto noticed in the aphelion distances. The period exceeds more than a year that of Faye's Comet, the most distant of the short-period group (properly so-called), and falls about midway between that of Encke and Tuttle, indicating a mean motion differing considerably from that of any comet yet observed. The inclination of the orbit to the Ecliptic is so small that the comet's distance from that plane is never very great; and, consequently, its approach to each of the planets can be within very narrow limits. If, therefore, the comet has been a member of our system for any considerable time (and considering its faintness at the last apparition this is not improbable), the orbit must have suffered considerable perturbation from any or all of these planets: a fact which, while it may account for the unusual mean distance that the comet now has, renders any attempt to inquire into its past history, with precision, a matter of great difficulty and uncertainty." Mr. Plummer then proceeds to an able and rigorous discussion of 36 observations of this comet obtained during the seven weeks it remained visible, and gives the period of revolution as 3,235 days, after applying certain corrections.

The members of the Greely Colony Relief party have been selected, and will sail from St. John's about June 15 next. The Greely Colony was not relieved last year, and it is important that they should receive fresh provisions this year, as it is desired to continue the observations until the autumn of 1884. The expedition will endeavour to reach Discovery Bay; but failing, will seek a suitable shelter, and endeavour to communicate with Lieut. Greely by sledges.

At the last meeting of the Physical Society, Prof. G. C. Foster read a paper "On the Determination of the Ohm," in which he described a method he proposed in 1874, which consists in balancing the E.M.F. set up in a coil of wire, by spinning it in the earth's magnetic field against the E.M.F. of a battery in a wire the resistance of which is to be determined. The general results are so satisfactory that the experiments are to be continued. Mr. Glazebrook stated that the Cavendish Laboratory at Cambridge would soon be in a position to test and certify any resistance coils sent there.

According to Herr Stefan, a magnet placed in a hollow sphere of iron magnetised by external force is screened from the action of other magnets, but not from the influence of the earth.

A catalogue of the Library of the Royal Geological Society of Cornwall has been compiled by Mr. W. A. Taylor, the assistant curator and librarian. The books, papers, &c., are entered under the authors' names.

At a recent meeting of the Institution of Civil Engineers, Mr. John Fernie, member, read a paper on mild steel fireboxes in American locomotives, in which he stated that the use of mild steel was now general, although the outer shells were made of iron in many cases for economy. The actual cost of steel fireboxes is about one-fifth that of copper, but the workmanship costs a little more.

M. G. Tissandier has lately been studying, with his brother, the application of dynamo-electric motors to aerial navigation, and in a paper read to the Paris Academy, he describes a system designed to drive along, in free air, an elongated balloon of 900 to 1,000 cubic metres. It comprises (1) a screw-propeller with two vanes, made of steel wire and varnished silk; (2) a small Siemens dynamo (minimum weight), which makes 1,200 revolutions for 120 of the propeller; (3) a bichromate battery, of 24 elements, mounted in tension, and divided into four series. An element consists of a vulcanite case, holding ten zinc and eleven carbon plates alternating. The liquid, a very concentrated acid solution, is supplied through tubing from a vessel that can be raised or lowered at will. A commutator and two instruments for electric measurements are added. With a total weight equal to that of three men, the system is capable of furnishing regularly, during three consecutive hours, the work of 12 to 15 men.

According to the *Eisen Zeitung*, the horse-power costs per hour (1) in the case of small steam-engines, about 31·6 pfennige (10 pf. = about 1d.); (2) hot-air engines, 28·5 pf.; (3) Otto's new gas-motor, 25 pf.; (4) water-motors, with artificial high-pressure supply, 95·5 pf.; (5) horse work, per time and work unit, 45 pf.; (6) wheel turners (8 men calculated per horse-power), 200 pf.; (7) large better class steam-engines, of at least 50 h.p., consuming 5lb. coal for the time and work unit here considered, 8·5pf. Thus the large steam-engines are peculiarly economical; and if electric transmissions become available for small industries, the large steam-engine will always be cheaper than the cheapest small motor, as in such transmissions half the mechanical power is still lost; the horse-power per hour may be put at 17pf. to 20pf. Possibly in the future steam-engines may be surpassed by gas-engines in some cases. From the Deutz gas-motor works a sugar-factory has recently been supplied with two 50 horse-power gas-engines and special gas-works; and this system has shown a coal-consumption of 0·8kg. (say 2lb.) per h.p. per hour.

At Erlangen, in Bavaria, a committee has been formed, with the burgomaster as president, to consider the feasibility of making an electric railway between Erlangen and Graefeuburg, a few miles to the east.

A competition has been recently opened (till 3rd April) by the Roumanian Government, for the construction of two metallic bridges on the railway line from Bucharest to Kustendje; one over the Danube, about 2,600ft., opposite Czernavoda; the other, 900ft. over the Borsea. Three prizes, of 40,000f., 30,000f., and 20,000f. are offered.

A committee has been formed in France to organise an international exhibition of apparatus designed to insure the safety of travellers on railways. The objects exhibited will be in three classes—(1) various systems of couplings; (2) signals; (3) brakes.

Paris decided to try wood-paving last year, and a part of the Boulevard Montmartre was so paved. The system has since been introduced in the Champs Elysées, between the Place de le Concorde and the Rond Pont (surface about 27,000 metres). The English Company employed undertakes to maintain the paving in good condition during the 18 years of the contract, for 4fr. 85c. per superficial metre and per year.

The direct photography of sound-vibrations has recently been effected by Prof. Boltzmann, as follows:—A small, thin platinum plate was attached perpendicularly to the centre of a thin iron plate, which, as in the telephone or phonograph, was fixed on a wall-piece and vibrated to sound. With a solar microscope an image of the platinum-plate was focussed on a screen. Then a prepared photographic-plate was quickly moved across, in the plane of the screen, by a strong spring, while the mouthpiece was spoken to. A bounding line between light and shadow was so obtained on the prepared plate, forming a curve which closely corresponded to the sonorous vibrations. To the vowels pretty simple curves correspond, often approximately curves of sines, often interference curves of two or three curves of sines. The consonants give very multifarious curves.

A Franco-Italian Exhibition is to be held at Nice next winter.

The adoption of the repeating rifle (Mauser system), has almost been decided upon in Russia. It is estimated that the required modifications in the existing armament will not involve serious expense.

The Japan telegraph lines have, roughly, an extent of 4,475 English miles, with a wire length of 10,551 miles. In the last working year there were sent 1,935,320 telegrams, of which 1,888,438 were in the Japanese tongue. The telegraph staff numbers 1,802 officials.

The Dervaux *epurateur-bourbeur* (so-called) has for its object the automatic extraction of deposits which form in steam-boilers. The apparatus consists essentially of a plate-metal reservoir communicating on the one hand with the feedwater, and on the other with the boiler; in the latter case by two vertical tubes, one of which penetrates to the bottom of the boiler, while the other terminates a little below the mean water-level. This arrangement results in a circulation of the boiler-water, which rises to the upper part of the receiver, where, finding a sudden increase of section, the sedimentary matters fall to the lower part of the decanting reservoir; then the purified water returns to the boiler by the second pipe The system is said to work admirably. Details are promised by *Annales Industrielles* in an early number.

The observation has been recently made by Herr Noack, that zinc-powder heated to 400° C. abundantly reduces carbonic acid to carbonic oxide. The reducing action of highly heated zinc on CO_2 has long been known; but zinc-powder does not appear to have been tried in this way. Herr Noack considers the method, on account of its cheapness and the great purity of the carbonic oxide gas produced, to be vastly superior to other methods of obtaining the gas. The mode of operation is described in a recent paper to the Berlin Chemical Society.

Last year, according to the *Industrie Zeitung*, 1,790 shipwrecks occurred, in all seas, as against 2,039 in 1881, 1,680 in 1880, 1,688 in 1879, and 1,594 in 1878. These wrecks, 576 of which were on the British coasts, involved the loss of 4,129 men's lives. During the last five years no fewer than 21,763 men have perished by sea.

The Prussian Society for Encouragement of Industry has offered a prize of £300 for the best account and estimation of the methods of working coal mines, also of modes of ventilation, and precautions taken to insure the safety of miners. The Society for the Protection of Animals in Copenhagen offers two prizes of about £75 and £38 for the two best memoirs on the possibility, with the view of physiological investigation, of substituting for vivisection the section of animals newly killed.

It is generally recognised that rain-water takes up ammonia from the atmosphere, which probably contains the substance in the state of saline matter; but there is discrepancy as to the proportion of ammonia present. M. Houzeau (who recently received rain-water from Algeria containing not a trace of ammonia), says the time that has elapsed between obtaining the water and analysing it is an important factor. Another important consideration is the amount of monthly rainfall. M. Houzeau's tables show that the less it rains, the richer in ammonia is rain-water.

An instructive series of articles on "Turbines," by M. Richard, is now appearing in *La Lumière Electrique*. The same journal (20th Jan.) has an account of a control apparatus for measuring the velocity of trains on large railway bridges. It is the invention of M. Waldorp, a Dutch engineer; and a few months' trial of it on the South-Eastern Railway of Holland, at a bridge over the Mouse at Karestein, has proved its efficiency. In Holland, the limit of speed for trains passing over bridges is 30 kilometres (say 19 miles) an hour. The apparatus referred to acts automatically; gives the record of a series of trains during 24 hours without requiring alteration; and the curves it gives indicate the velocity of the train at different parts of the bridge separately.

With its harbours considerably enlarged, its vast docks, its hundreds of ships from all parts of the globe, Hamburg is a striking picture of maritime activity. In front of the principal part of the town, along the opposite bank of the Elbe, extends the island Steiuwerder, which is occupied with numerous docks. Steamers ply regularly between it and Hamburg. It is now proposed to make a tunnel under the Elbe connecting the two banks. The length will be about 2,666ft., and the cost about £900,000.

The Exciting Properties of Oats.—Experiments have been recently made by M. Sanson with a view to settling the question whether oats have or have not the excitant property that has been attributed to them. The nervous and muscular excitability of horses was carefully observed with the aid of graduated electrical apparatus before and after they had eaten a given quantity of oats, or received a little of a certain principle which M. Sanson succeeded in isolating from oats. The chief results of the inquiry are as follows:—The pericarp of the fruit of oats contains a substance soluble in alcohol and capable of exciting the motor cells of the nervous system. This substance is not (as some have thought) vanilline or the odorous principle of vanilla, nor at all like it. It is a nitrogenised matter which seems to belong to the group of alkaloids; is uncrystallisable, finely granular, and brown in mass. The author calls it "avenine." All varieties of cultivated oats seem to elaborate it, but they do so in very different degrees. The elaborated substance is the same in all varieties. The differences in quantity depend not only on the variety of the plant but also on the place of cultivation. Oats of the white variety have much less than those of the dark, but for some of the former, in Sweden, the difference is small; while for others, in Russia, it is considerable. Less than 0·9 of the excitant principle per cent. of air-dried oats, the dose is insufficient to certainly affect the excitability of horses, but above this proportion the excitant action is certain. While some light-coloured oats certainly have considerable excitant power, some dark oats have little. Determination of the amount of the principle present is the only sure basis of appreciation, though (as already stated) white oats are likely to be less exciting than dark. Crushing or grinding the grain weakens considerably the excitant property, probably by altering the substance to which it is due; the excitant action is more prompt, but much less strong and durable. The action, which is immediate and more intense with the isolated principle, does not appear for some minutes after the eating of oats; in both cases it increases to a certain point, then diminishes and disappears. The total duration of the effect is stated to be an hour per kilogramme of oats ingested.

According to a German contemporary, a brass capable of being forged hot, may be made with 60 parts copper, 38½ zinc, and 1½ iron.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

◆

ASTRONOMICAL—CORRIGENDA FOR "CELESTIAL OBJECTS."

[21031.]—HAVING been requested by a friend, who had failed with a smaller instrument, to examine the star θ Aurigæ, I attacked it on Jan. 30 with my beautiful 9⅓in. "With" mirror. The night was not sufficiently favourable for the purpose, there being much of what I believe Sir J. Herschel called "brandishing" about the object. A fine power of about 210 showed me nothing; but with 450 there was a sufficient indication, which better air would have converted into a certainty, of a minute companion, the position-angle of which I guessed at 5° or 10°. Subsequent reference to O Σ's work gave a mean of 5·55°, so that there could be no doubt as to the object. But it certainly appeared much too small for his assigned magnitude of 7·5 (7·8 on one occasion), corresponding with a little less than 8 of Smyth's scale. Will some observer, provided with superior means, examine it? I have reason to suppose that in the immediate proximity of a brilliant star, I am apt to under-rate the magnitude of a smaller companion. If not, there may be a probability of variable light.

Notwithstanding the general state of the weather, there have been a few fine intervals this winter, and I have repeatedly glimpsed Encke's division on the outer ring of Saturn; on one occasion (Dec. 9) it was held so firmly that I could see that it formed an unequal division of the ring. The variable S Orionis is extremely small at the present time.

I have noticed, with regret, an omission of some importance in my "Celestial Objects." It should have been stated, on p. 7, that Dawes's value for separating power was intended to apply to 6-magnitude stars.

The "pretty pair" mentioned on p. 228, under PXIX. 144 is, I am informed, Σ 2531, and that on the next page, under PXIX. 241 is Σ 2544.

Hardwick Vicarage, Feb. 3. **T. W. Webb.**

THE GREAT SOUTHERN COMET OF 1882.

[21032.]—THIS magnificent and interesting object, which, long ere this must have disappeared from your Northern sky, is still a conspicuous ornament to our Southern heavens. Having given a considerable amount of attention and study to the subject, and, as there is not a scientific journal in our colony, I beg leave to submit, through your columns, my theory of the period and previous appearance of the comet.

The fact of the orbits of the three great Southern comets of 1843, 1880, and 1882 being similar, affords reasonable grounds for a suspicion of their identity; and this suspicion is confirmed by the fact that the period between the perihelion passages of the comets of 1880 and 1882, measures the period between the perihelion passages of 1843 and 1880; it will not, however, satisfy the appearance of the comet of 1668, the orbit of which comet is found to be similar. A third of this period, however, will measure all four of these comets, and, moreover, account for others that have appeared. In Webb's "Celestial Objects" is a record and carefully-executed drawings of the transit of a comet across the sun, observed on 26th June, 1819; and I find that the period above-mentioned measures the interval between that observed transit and the perihelion passage of the present comet; the earth was also so situated that a transit of the comet across the Sun would occur at perihelion.

The period of 321 days also satisfies the observed transit of a dark body across the sun on June 6th, 1761. The comets recorded to have appeared in the Southern heavens in the years 1132, 1618, and 1689 satisfy the same conditions, and I have little doubt that when the list of observed comets is more critically examined, others will be found as claimants to identity with the great Southern comet of 1882.

Considering the extreme difficulty of computing the eccentricity of an ellipse so elongated, we may have to depend upon such a method as the foregoing for the period.

Stanmore, N. S. Wales. **G. Butterfield.**

THE GREAT COMET, 1882—NEW COMET, 1883 (?).

[21033.]—IT was stated some time ago that the great comet of 1882 would not likely be seen during the latter part of January, except in the most powerful telescopes. The nights of the 30th and 31st being very clear, I turned the 4·3in. Wray equatoreal, armed with a power of 55, on the place indicated in the ephemeris (Dr. Oppenheim's) given in the Dun Echt Circular, No. 67, and instantly found the comet in the centre of the field. It was certainly not very bright nor well defined, especially in the *n. f.* side, which faded away in the direction of position-angle 50°, the *s. p.* side being better defined and more condensed, but no nucleus could be detected. It would be difficult to measure the extent of the "nebulous" mass, but it was estimated at 5′ to 6′ long, by 3′ to 4′ broad, with my optical means.

As it may likely yet be seen with 4in. telescopes before the next moonlight, I give an extract from the ephemeris for the last three nights of next week, viz.:—

HOUR.		H. M. S.		° ′
Feb. 8, 11	R.A.	6 2 40	D −	20 4·2.
Feb. 9, 11	,,	6 1 48	D −	19 48·6.
Feb. 10, 11	,,	6 1 0	D −	19 33·1.

These places, with regard to neighbouring stars, can readily be found from Proctor's Star Atlas, in case the observer has not an equatorial mounting.

A correspondent of the *Globe* newspaper writes this week that he had (with a 6¼in. telescope) seen the new comet reported to have been discovered at the Puebla Observatory, Mexico, about 1½° south-east from Jupiter. During a short interval between breaks in clouds this evening, I examined this region, and the only object I could find resembling a comet was the well-known "Crab Nebula" (M.1), which has more than once led tyro observers astray in supposing they had discovered a new comet. The sky becoming entirely overcast, prevented me looking in other directions around Jupiter.

Belfast, Feb. 3rd. **Isaac W. Ward.**

[21034.]—HAVE any of your readers succeeded in picking up the comet described at the Puebla Observatory, Mexico, on about Jan. 23, and said to be situated near Jupiter? The only "comet" (?) I can find in the neighbourhood of this planet is the celebrated "crab" Nebula (= Messier 1 and No. 1157 of Sir John Herschel's general catalogue, 1864). An English observer is also said to have seen the comet on Jan. 27, about 1½° S.E. of Jupiter. It was then somewhat faint, and about 4′ diameter. This corresponds to the nebula referred to, and I should have considered the whole matter as one of mistaken identity, were it not that the original telegram emanated from an observatory, where, most assuredly, some means would be adopted to avoid the chances of such an error. The nebula referred to is such a well-known object, and the means of identifying it so easy from its position, about 1° *n.p.* Zeta Tauri, that it is difficult to understand how it can have been mistaken for a comet. Moreover, the means of distinguishing a comet from a nebula are so well known, that one can hardly believe them to have been entirely overlooked on this occasion. Still, there is an ominous silence from Dun Echt, which gives strength to the inference that a mistake has been made in regard to this alleged comet by the Mexican observers. Perhaps, however, one of your readers is in a position to explain the matter?

Bristol, February 5. **W. F. Denning.**

[21035.]—IT may interest our readers to hear that the comet was seen here to-night, at about 9h. with the 10in. dialyte. It was brighter than I expected to find it, lying between two 10 mag. stars, and appeared as an elongated streak of nebulous light surrounded by a faint coma, which streamed away in a north following direction, and lost itself about 5′. Power 110.

Herbert Ingall.

Champion-hill, S.E., Feb. 3.

FEATHERY MIST ON MOON.

[21036.]—PLEASE indulge me in a brief response to the polite letter (20462) of "M. A." in your issue of Sept. 8, 1882. The reason it has been so long deferred is that I had allowed my subscription to your valuable journal to expire, and did not see the letter for some time. I have since renewed the subscription in my son's name, and will probably soon order another copy in my own; since I find it inconvenient not to have its weekly visits.

"M. M. S." says, "I cannot understand how Mr. Jackson can be sure that what he thought was a feathery mist" on the moon "was not really a long hill or high ground of some kind faintly illuminated," and he "only asks for information as to [my] reasons for judging it to be mist."

I freely admit that it is difficult to be certain of anything touching the matter, and only say that it was called a mist or cloud because it looked so exceedingly like one.

That there is a ridge or roll of high lands in the bottom of the Mare Crisium parallel with the Promontorium Agaram, and nearly corresponding in position to the mist we saw in May last, appears to be true, and since reading that "startling work" of Mattieu Williams "The Fuel of the Sun," and his chapter on "Meteorology of the Moon, &c.," I am inclining to the view that the appearance seen, instead of being of volcanic origin, was caused by a frost mist arising from a dense deposit of hoar frost on this roll of land just struck by the rising sun.

The great southern declination of the moon and its low-lying position during the summer and autumn last part, prevented good observations being repeated at the proper time; and now that she is again assuming her more northerly declination at the time of new moon, it is to be hoped that all observers will keep a watchful eye about two days after conjunction, that they may catch the "terminator" near the westerly side of the "Mare," and assist in determining what causes the appearance in question.

"M. A." remarks, "the light is very misty and transparent (?) sometimes when it is just beginning to rest on the top of some high object." Will not the presumed deposit of hoar frost during the lunar night, just struck by the sun's rays, account for these misty appearances also?

Whether the greater depth of the Mare Crisium, and hence heavier deposit of frost, naturally produces the marked appearance I twice witnessed, remains to be determined.

We had a glorious time in our country watching the Transit of Venus, since it came right in midday, and we saw all the contacts. My observations with an imperfect amateur outfit were:

First external contact, Dec. 6 ..	8h. 56m. 21s.
First internal ,, ,, ..	9h. 15m. 23s.
Second internal (approximation)	2h. 41m. 51s.
Second external.................	2h. 59m. 53s.

Washington time obtained by telegraph.

At the first internal contact we saw the line of light entirely surrounding the disc of Venus before she fully entered upon the sun, and noted the contact by the seeming coincidence of that light line with the edge of the sun, and not by the severance of the black drop. An idea occurred to me that the most accurate method of taking such contacts would be to provide a proper automatic arrangement connected with a time-noting pendulum, whereby an instantaneous photograph of the sun could be taken every second of time, about the period of each contact. Let the different observers be provided with the same apparatus so that the images would be similar in size. If such an arrangement could be perfected, by trial on transits of Mercury, and ready for our great-grandchildren in A.D. 2004, methinks the comparison of times at different stations might be much perfected.

J. G. Jackson.

Hockessin, Del., U.S.A., January 16th.

SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[21037.]—IN reply to letters from 21006 to 21009, of course I am wrong, for Mr. Calver says I am; and who would fail to be silenced, if not satisfied, by such a dictum, from such an authority? But I will ask him to inform me how it is that my mirror will give me an image of sun or moon when all but the extreme margin is cut off by a stop, if my flat *is* too small? And as most seem to allow that all parallel rays are reflected by it, and as my telescope tube has an opening in front only as large as the mirror—and most others are made like mine in that respect—I ask, How any but parallel rays can get into it from any object at which it is pointed? I believe also that my error is *that* of all the old makers. I have a 10in. reflector of Herschel's, of 10ft. focus, and the flat of that is only 1in. in minor axis; also another of 6½in. aperture, and 6ft. focus, by an old maker, with a flat of only ¾in.; so that it is very evident that those old makers did not understand what they were about, for I believe Mr. Calver will be puzzled to find any old telescope of 12in. aperture with a flat of 2¼in. in minor axis. And until I am shown how the converging rays from sun or moon, or any other object, can get to my mirror, I shall be contented with a flat that reflects all the parallel rays into the eyepiece.

Philip Vallance.

[21038.]—IN the Fig. in my last (21006), the line near the centre is placed there in mistake.

I only take exception in Mr. Bell's letter (21007) to his expression, that the centre of the mirror is where you can best afford to lose light, and to his drawing his conclusions apparently from theory. I should say that the centre is the most valuable and critical part of the mirror, and I believe that makers will bear me out in this. Who would think of putting in a disc, which a flat virtually is, instead of a stop, to improve his definition? What charming discs also you get with a large mirror and an eccentric stop—in which case the central rays are all there and perfect. My remarks on the subject have simply resulted from my own experience.

My mirror is 122 sq. inches area, 2½in. flat, 4·908 sq. in., and 1¾ flat, 2·405, or rather less than half. The loss of 2½in. of light seems very little on 122; but the result with the 1¾, as I have before said, is unquestionably superior on all points—light, definition, colour, and discs.

My 2½ flat is A1, and is the right size to take all the rays from cone 32' angular object. My 1¾ takes all the rays from 19'; but there should always be a margin, and I should not consider that I get the *very best* from my mirror on more than 12' to 16'. This gives very ample field, 12' being 16 times the diam. of Jupiter. If I wanted more I should use the 2½in. flat.

Fordingbridge. **T. Westlake.**

SIZE OF FLATS IN NEWTONIAN REFLECTORS—EYEPIECE LENSES FOR GREGORIAN.

[21039.]—As the view I took of the principle on which the size of the flat should be determined is so abundantly confirmed by Mr. Calver and others, I need say but little more on the subject. I wish, however, to refer very briefly to certain remarks of Mr. Westlake and Mr. P. Vallance in your issue of February 2nd.

Of course, if Mr. Westlake likes to have two or more flats, and to go to the trouble of changing them, he can use a small one for the stars, and a larger one for the sun or moon; but I quite agree with Mr. John Bell that the gain of light before reflection must be infinitesimal in substituting the lesser obstruction, while, as regards the loss of light *after* reflection, the amount is, as I have shown, very considerable.

On what authority Mr. Vallance states that the stops in a refractor are fixed without any reference to the size of the focal image, I know not. If they *are* so fixed, then they are *wrongly* fixed. Certainly, "if" a flat will reflect all the parallel rays which fall on the large mirror, it is large enough *for that mirror*; but if you use it for a larger mirror of the same focus, it is *not* large enough.

Again, if you have a longer focus as well as a larger mirror, you may, perhaps, find the same flat sufficiently large for the stars, but *not* for the sun or moon. In fact, the size of flat depends on three conditions, which may vary considerably in different telescopes. Firstly, on focal length of large mirror, which determines the size of the image; secondly, on the diameter of the mirror, which, in conjunction with the size of focal image, determines the *form* of the frustum of the cone of rays; and thirdly, on the distance to which the image is to be projected outside the tube, which determines at what part of the cone the flat has to be placed.

If "A. J. W." (query 49410) finds by trial at what distance from his lens (when removed from the telescope) he gets the smallest image of the sun, he will know its focal length, and the other lens ought to be three times such focal length.

A. S. L.

[21040.]—If Mr. Brashear will collect about 1oz. from 1lb. of best rouge of good purple colour, he will find it will not scratch. A pad once rubbed with rouge and shaken out lasts for many months, and will polish beautifully. Of course, always use a pad without rouge to finish; but it is merely a form, for it doesn't appear to require it. If the bath acts well, a couple of minutes suffice to do the whole polishing—it often hardly needs touching at all.

I get best results with 25 grains of potash to 50 of silver. I have often given a mirror two baths.

I see Mr. Bell and Mr. Westlake have fully and clearly dealt with Mr. Vallance's flat question, and I need only remind him that he is quite wrong in stating that no provision is made for the image of the moon in the diaphragm of a refractor—that provision *is* made by those who know how to mount them. I shall be interested to see Mr. Vallance accept Mr. Bell's challenge.

G. Calver.

OBJECT-GLASS—COLOUR-TESTING—FLATS.

[21041.]—The figures on the glass of M. Feil are rather a mystery to me—I mean by "brand" in the case of Messrs. Chance's glass, the red and blue chalk-marks L.F., H.F., &c., and the gum labels on M. Feil's glass. I have some 3·64 density numbered 1307, and some very light crown, 1404. The only thing to go by is the paper label, and I should say M. Feil could say what the glass is if the numbers were sent to him—he is very obliging. The querist, "J. C. L.," is not doing so badly with his flats; when he gets a flat, and not before, the appearances of that sized plate will be a succession of *straight* rainbow-coloured bands, with a space quite colourless between each; there seems a difference to me inexplicable in the intensity of the colours, as well as the shades. I should hold the plates vertically, and place them together without slipping, and let them stand a bit. Use no pressure at all; but very carefully clean and brush the surfaces before attempting to try them. Mr. Brashear, I have no doubt, will give us more information when he writes. **Prismatique.**

WHAT SHALL WE EAT AND DRINK?

[21042.]—Dr. Allinson will probably not need any aid in maintaining his ground against all comers, "A London Medical Student" included; but the question now raised is really of such extreme importance, that I trust you will find space for my small contribution.

The question I refer to is:—May we, as a community, place ourselves, our wives, and our children unreservedly in the hands of the medical profession in regard to what we shall eat and drink?

The question, so stated, seems to infer that it is the general custom to seek professional advice specially upon this point, which is not, of course, quite the case; but it cannot be gainsaid that the family doctor does wield an immense influence in this respect. Few families pass twelve months without some member requiring surgical or medical aid, and then the doctor's influence comes into active operation, and, in most families, the doctor's word is law.

The importance, therefore, of each member of the medical profession being possessed of the highest obtainable knowledge of the science of life in all its branches is obvious—*but are they?*

And, further, no one, either in or out of the profession, will, I imagine, deny that it is not only incumbent on the doctor to cure, or do his best to cure, the malady for which he is called in or consulted; but that it is also his duty to advise his patient how best, by a proper and scientific mode of living, to avert evil consequences in the future—*but, as a body, do they?*

I should like to put two test questions to "A London Medical Student" on these two heads.

First, is it not now an acknowledged fact amongst all *authorities* on the subject of nutrition, that ordinary beef-tea "is nearly, if not quite, useless" (to quote the words of a recently published medical publication), and can our student give us an estimate of the number of cases (many of which must necessarily be critical) in which it is probable that during the past week the family practitioners throughout the country have ordered, counselled, or permitted an exclusive, or nearly exclusive, diet of this useless decoction?

And, secondly, is it not within the knowledge of every qualified practitioner (for I believe they are, or have been, so far instructed) that bread made from fine flour is not only defective in most important nutritive elements, but is, in many cases, positively deleterious; whereas bread made from wheat-meal possesses every constituent necessary to the building up and sustaining of the human frame. But do they tell us this? Do they, when attending a family of children, point out and impress upon the parents what an infinitely greater chance they would have of rearing their children if they adopted this very simple change of diet? A glance at the bakers' shop windows, remembering the influence and force of a doctor's dictum, will answer this question.

I believe that this question of the amount of reliance that may be placed upon the dicta of the medical profession of the present day, in regard to diet, is of paramount importance, and I trust you will think it sufficiently so to find space for my letter.

The unnecessary application of the word "absurd," applied to the theories that Dr. Allinson champions, tempts me to suggest that our young demonstrator may have, in the course of the long life before him, to *unlearn* a few of the theories he is now in the habit of expounding, and abandon them on the ground of real absurdity. Time will show. **Libertus.**

[21043.]—Dr. Allinson (21026, p. 502) wants to study a good many things in a broader spirit than he appears yet to have done. Logic is the first which occurs to me. He says: "I think it is proved beyond dispute that alcohol is not a food." Now, how can he think it beyond dispute when he knows it is disputed? For my part, I believe that, if questioned, the majority of those who have any right to have an opinion on the matter (and no one has such a right except on the ground of some knowledge of the matter, not mere hearsay acceptance of some one else's dogma) would hold that alcohol is a food as truly as starch or sugar. My own knowledge of chemistry tells me that it is so; that when not presented in quantity beyond the power of assimilation, being an easily oxidisable substance, it is used up as a heat and work-producer.

Then, again: "Alcohol is a chemical substance; and if we sanction its use, we may sanction the use of ether or any other product." Will our friend tell us what compound body is *not* a chemical substance, or what out-of-the-way meaning he attaches to the term? We are told it is not found in nature, and is a product of decomposition. Both statements are scientifically untrue: it is found in nature, because it is produced by a natural agency wherever saccharine juices are exposed in solution; and it is not a product of decomposition, but as truly the result of a vital vegetable growth as sugar is. Considering, also, that what is commonly called alcohol is only one form of a vast series of intimately-connected bodies abundantly formed in nature, it would be a bold man (so bold that his courage would probably be due to ignorance) who would venture the assertion that alcohol does not form a step in many important operations in the chemistry of nature. It would have to be some one who knew little of the relations between cellulose, starch, sugar, and the various fats; or, possibly, some one who, like Dr. Allinson, finds the assertion of some notion he has taken up more simple than a deliberate argument based on tested evidence. It is a very nice-sounding argument to say: Come with me to the poor, police-courts, &c. That is legitimate in dealing with the moral and social aspects of the abuse of alcoholic drinks. But it is beneath contempt when dealing with the question of the physiological effects of a moderate use of them. I doubt even if it is a sound *argument* in any case: it is a mere appeal to emotion, and may on examination prove fallacious. Civilisation is a very complex matter, and has its drawbacks; but with all the drawbacks of suffering and disease, poverty and crime, which seem to be its inevitable accompaniments, civilisation is infinitely superior to savagery. I doubt if it would be fair to contrast some back-slum of a great city with a South Sea island, and condemn civilisation. With all its evils it enables thousands to enjoy existence where the "noble savage" would dwell alone. Now, I should like to ask, *who are the men* who make the world? On whose energies is civilisation based? Is the answer doubtful? Are not the English, the Norse and German races, with their off-shoots, the ruling races of mankind? And what are these but races bred on *Beef and Beer?* Oh! Doctor, Doctor, out of thine own mouth will I condemn thee! Did you not say, "Allow me to feed a person and I will make him dull and stupid, or clever and bright—we are what we eat?" Mind, I do not think you could do what you say; but accepting your own ground, what pretence have you for condemning the beef and beer which, on your own dictum, have made the English race the leading race of man? The statement itself is simply preposterous as regards an individual person, just as is the Doctor's assertion that he will not be ill or die under 70. The man's own food is only a small factor in producing good health and long life, though it may be a very important factor in destroying them; the health and life capacity of Dr. Allinson, as of each of us, is primarily conditioned by antecedent facts; by the process of his evolution through his ancestors and the conditions of his childhood. It is a pity the Doctor does not discriminate between his own somewhat rash conceptions and external facts, and the words of other people. *I did not say* "That I had got into such a state that I am uncomfortable without my whisky"; that is simply a perversion of his own; and when he tells me I am a slave to the habit, he makes me laugh at his want of judgment.

For some 17 years I have taken eggs for breakfast, and have supped on a basin of oatmeal-porridge probably 300 times out of the year; or, in fact, nearly always when at home. I took up those habits on the advice of a very intelligent medical man; I like the diet, and object to be deprived of it; I also take a slice or two of meat in the middle of the day, and if I am kept out of it I certainly do feel uncomfortable. So I suppose I am to be told I am a slave to the habit, and, dear me, how sad! A slave to oatmeal-porridge. Well, honestly speaking, I see no difference between that and my modicum of whisky; I took to that also on medical advice some six years ago, so I am much less a slave to it. I took it because I was suffering from rheumatism, and I manage (in part, I believe, through its aid), to keep that annoyance in pretty fair subjection; better, at all events, than some vegetarian teetotalers of my acquaintance can. If I thought I should be better without it I should stop it to-night. I have no doubt that in the course of a few years I shall drink enough to drown myself in, as the Doctor remarks; but then, I fancy, he would feel uncomfortable himself if all the loaves of bread he has eaten in the course of a few years were suddenly piled on the top of him, and I fail to see any distinction between the two imaginations.

I think "F. R. C. S." put the matter very simply.

It is absurd to deal with diet as if we were mere animals, to be brought into condition with the least possible outlay. Man cannot live by bread alone; enjoyment is an essential element of nutrition. and if a cup of tea, or a glass of wine, or even of whisky, causes a sense of rest and satisfaction, we need not examine too closely to find out in what way it affects the intricate mechanism of life. I have always seen that the people who trouble themselves as to what to eat, drink, and avoid, were less healthy than those who took moderately of whatever came in their way, and that those who find everything wrong and unwholesome are, to say the least, not exceptionally healthy or happy.

Sigma.

[21044.]—ALCOHOL.—I have known two children pulled through fever by being fed with teaspoonfuls of brandy for thirty-six hours. In this case, was it a food or a stimulant, or did they recover in spite of the treatment?

Habitual drunkards (so called) in H.M. service in Bermuda, at the time of the yellow fever, did not take the fever. Tobacco-smoking saved me from marsh-fever, when shooting in North Africa (Morocco), and in Canada the North American Indians mix it with willow-bark. It then affects me like quinine.

The lumberers in Canada use nothing else but tea when in the woods. In my experience, it is by far the best drink to work upon. **R. O. H.**

[21045.]—ON reading the conflicting statements of Drs. Edmunds (21017) and Allinson (21026) concerning the action of the tannin contained in tea and coffee on the gelatine of meat, I tried a series of experiments on the subject with the following results:—On adding infusions of tea and coffee, separately, to a strong solution of gelatine (Nelson's), I obtained no precipitates; but in the case of the tea, the solution was rendered *very slightly* turbid. The coffee mixture, however, remained quite bright. I also added the infusions, separately, to some pepsin wine, but failed to get any precipitate with the coffee, and only a slight one with the tea, which was, however, readily soluble in a few drops of hydrochloric acid assisted by a little heat.

With regard to the poisonous (?) quality of caffein, I quote the following from "Cooley's Receipts," 4th edition, page 378:—

"Mr. Cooley took 20 grains of pure caffein daily, for over a month, without experiencing any other effect than a *very slight* elevation of spirits after each dose, similar to that produced by a small quantity of sal-volatile." According to "Cooley," a pound of coffee contains, on the average, 24 grains of caffein, and hyson tea from 2·5 to 3·4 per cent. of the same; so that, if this testimony be accepted, I think the idea that caffein (in the minute dose which a cup of tea or coffee contains) is even "mildly poisonous," may be set aside as a fallacy.

Dr. Allinson says: "Tea is worse than coffee, since it contains thein, a *stronger* (!) alkaloid than caffein." I always have been of the opinion that thein and caffein are one and the same alkaloid; but may be mistaken.

Plymouth. **E. G. T.**

[21046.]—IN his reply on p. 456 to my remarks on p. 437, Dr. Edmunds says that I avoid "answering the question which he put as a virtual answer to mine." When he penned this, did not Dr. Edmunds think that "the kettle was objecting to the pot its sordid superficies"? He finds fault with me for not replying to a question which has no real bearing on the matter at issue, and passes by all the pertinent queries which I addressed to him. He has not dealt with the three queries I put regarding Dr. Allinson's statement regarding the tannin of tea and the gelatine of meat; not shown how it comes about that so large a proportion of his professional brethren are so "wofully far behind the advance of science"; not explained why it is that if the action of alcohol be *simply narcotic*, and in *no degree curative*, its action should be immediate and final; not told the unwise world how its inhabitants are to "avoid indigestion." As to the latter matter, I queried if "anyone sought it." Does anyone?

As to the question Dr. Edmunds put to me, "Why did our medical grandfathers and fathers bleed, starve, and mercuralise every one who had the misfortune to be ill"?—it is not pertinent. That medical men in the infancy of their science, and in the infancy of chemistry, made a monstrous mistake, is no reason why they should now, when their science has widened to its present dimensions and their stores of fact have accumulated to their present proportions, make another no less monstrous. But neither Dr. Edmunds nor Dr. Allinson makes allowance for individual constitution. The former quotes, "Fix upon that course of life which is best; habit will render it most delightful." But, does "best" here refer to some universal and ideal perfection, or to that which is best for each individual? And what is to be the test of "that which is best"? Is it to be the individual? Apparently, Dr. Edmunds and Dr. Allinson consider that they and their confrères are to be the judges of what is, and has been, and will be, "the best" for all the members of the human family—dead, alive, and to be born. But I have heard that "One man's meat 's another man's poison," and I suspect that the experiences of ages summed up in pregnant proverbs have in them more of truth, as applicable to universal human nature — whether mental, moral, or, as in this case, physical—than have the novel and intolerant utterances of any theorists, however able, and of any instructors, however full of precepts or prodigal of remonstrances. The MECHANIC is a strange place, but one of its very best features is that every opinion is fully and fairly represented. And, strangely enough, on p. 463 of the number which contained Dr. Edmunds' reply and Dr. Allinson's diatribe appeared some hints upon "Diet for Night-Workers," which ran directly counter to their precepts and remonstrances. Will these knights-errant of total abstinence tilt against this windmill? Dr. Edmunds practically declines further controversy, and while elaborately replying to "Dandie Dinmont's" excellent letter, neglects to mention its most important allegation. But the point raised is of far too great importance to be allowed to sleep, and I hope that others of your able correspondents, besides those who have already written, will take it up. By the way, the experience of hard workers and keen thinkers, such as "Nun. Dor.," "Anglo-Dane," and "Sigma," three names which I am sure every reader of the "E. M." agrees with myself in holding in respect, certainly does *not* countenance the theories nor support the inferences underlying or flowing from the jeremiads of Drs. Allinson and Edmunds.

Of "Dandie Dinmont" I would ask one question. On p. 437, No. 929, he says, "The healthy person does not require them, therefore I think it his duty to abstain." *Pourquoi?* If you like a thing, and it can do you no harm, is there any reason—of the heavens, the earth, or the nameless regions beneath—why you should not indulge your fancy? If this principle were extended, we might at once shut up concert-rooms, theatres, and picture-galleries, and destroy all else not, to the maintenance of simple comfort, essential. Luckily, the English nation has no "lucidity."

But what shall be said of Dr. Allinson? That gentleman of light and leading has (*vide* letter 20973, second column, lines 10 to 15) solved the unsolvable, and learned how to avoid death. But it is a pity that he did not inform himself (*vide* the letter of a "London Medical Student," in this week's "E.M.," and the calendar or syllabus of any one of our medical colleges or schools) of the methods and curricula of *modern* medical training. Universal condemnation is never wise, however convenient, for it is always tedious to dissect contradictory statements and weigh doubtful evidence; and I think that most people would hesitate to believe that the soldiers in that great Army whose conflicts with disease and with death are never over, are trimmers and time-servers, unfit to use their weapons, and unable to appreciate the principles upon which they are constructed. Dr. Allinson's statements concerning the effects of food, remind me of the story concerning Dr. Tanner and his wife, which went the round of the papers. Dr. Allinson says "the last part of 'Housekeeper's' is soon answered"—and then proceeds to talk of brandy-and-water. I did not speak of *it*, but of alcohol, using the word whisky, or of whisky made up as "toddy." But will Dr. Allinson or Dr. Edmunds say why, if these things be merely diluted, it is that *so small a quantity* will produce so considerable an effect? and why, if they be merely narcotics, the effect should be permanent? Surely, the narcotic action of alcohol must be very powerful if so small a quantity as will entirely relieve intense pain can "paralyse the nerve filaments of the stomach" for a period long enough to allow of the digestion of the unassimilated food. But if alcohol *does* act by "causing stored-up force to be used at once," its use cannot, surely, be *altogether* baneful. Is not this in itself a benefit, and just what people often require? Is Dr. Allinson right in saying that the alcohol in wine varies from "10 to 20 per cent"? If my memory does not deceive me, Prof. Roscoe says that the amount of alcohol in light wine is 7 to 8 per cent. As "Anglo-Dane" remarks, the questions involved are, in great measure, questions of figures. What is the *amount* of theine in tea, of caffeine in coffee, of alcohol in wine, of nicotine in tobacco? And are these effects, when diffused through the cup, the glass, or the cigar, identical, in kind and in degree, with their effects when they are concentrated? I have heard that a single drop of *pure* prussic-acid will kill; but will a single almond do so? I do not suppose that Dr. Allinson would decline to prescribe quinine in ordinary doses, because a *very* large dose might fever?

By the bye, *how* does the carter's saying, "Get along, Dobbin," act as a *stimulant?* Does it "*give* force" to Dobbin's "system"?

In letter 20996, Dr. Edmunds raises an important question. I would like to ask him if the air suspended in fresh water goes for nothing?

In conclusion, I would like to ask Mr. Allinson how, if vegetism was only adopted by him some 18 months ago (as appeared from his letter of Sept. 22, 1882), he has, in so short a time, fully tried its effects, and convinced himself of its efficacy to defeat disease and discomfit Death? Has his examination of the improvement in himself, of which he speaks, been so thorough as to eliminate *all* other causes of improvement? **Housekeeper.**

[21047.]—I DARE say that this dispute will lead to good results in the long-run, but it will not be by using arguments such as a few of those in the opening paragraph of letter (21026). Dr. Allinson says that alcohol is the product of a decomposition, a chemical substance, and as a consequence it ought not to be taken. I fail to see the logic of this. If alcohol is deleterious, it is certainly not *because* it is a chemical product, but because its peculiar, I may say individual, properties exercise a damaging influence on the tissues, the nervine and digestive system, which these cannot resist in the long-run. What in the whole creation is *not* the product of a decomposition and a chemical substance. That alcohol is not a food, I fully believe; but even if it was, it is sufficient to condemn it if it is also a poison.

I cannot see, either, the strength of the argument, that if all the drink we consume in a few years was collected (a mere arithmetic calculation will drown nobody), it would be sufficient to drown us in. Agreed. I need not tax my imagination on that point. If I invest 6d. in a glass of sherry anywhere where they sell wines from the wood, I can see so much wine as will drown me and all my relations, but I am not a bit the worse for that. I can see the force of Dr. Edmunds' advice about the hot water. Could I shake the strength of his argument by reminding the public, that if all the hot water Dr. Edmunds could consume in ten years was collected in one tub, what a washing might be done in it?

If alcohol is taken, its effects are either near or remote. Just so; and it is these remote effects of coffee and tea I want to know something about. Whatever a medical man may say, any thinking individual may form an opinion of the actions of certain articles of food on his system, when such opinion is founded on careful and prolonged observation. Now, in my case, I am rather fond of coffee, my average consumption being 4 breakfast cupfuls a day; tea, about 1½ cupful. I never take beer or spirits at meals, and rarely water; but I like my cup of coffee after dinner. I am a moderate eater, rather inclined to frugality, plenty of exercise, and I have never felt any of all those complaints "Bartholow" mentions. I have never suffered from any illness worse than an eight days' cold, contracted by open-air exercises; have never taken castor-oil in all my life, and only once Epsom salts. I do not see a pimple on my skin once in a twelvemonth, and am sure nobody can enjoy better bodily health than I do. And as regards mental faculties, memory, &c., I am thankful that it has fallen into my lot to live in times so mentally agitated, that no one can enjoy better than I the full freedom which reigns in the world of the mind, that in my humble way I rejoice at belonging to those who daily go in search of knowledge and never get disappointed. Where, then, I ask, are the effects of coffee on me?

If nervous diseases have increased since the introduction of tea, what part of that increase is to be put down to the account of railways, impure air in large towns, gas, and high-pressure living?

I think Dr. Allinson deals very imperfectly with the tannin. I cannot alter one iota in what I wrote previously about it, and beg for fuller reply. I was always informed that in making an infusion of either coffee or tea, a minimum of tannic acid went into solution, that it required *boiling* to extract it; but boiled coffee or tea is not the thing I consume. Coffee contains further an empyreumatic oil, and tea an essential one, whose actions many medical men consider highly important.

I see that Dr. Allinson repeats that there is a distinction between thein and caffein. Is that really so? Would Mr. Allen inform me? And what about theobromin? Is that a poison or a food?

Anglo-Dane.

DIETETIC REMARKS.

[21048.]—EDWIN HOLMES (21024) and "W. R." (49377) are desirous of knowing how I am going to make people "dull and stupid, clever and bright, always ill, or in uniform good health." I answer at once, By the food they take. To be "dull and stupid," eat plentifully of animal food; the more they eat the more heavy and dull will they be. At the same time do not take much exercise, and I will promise, to soon make them unfit for mental work. After a meat dinner I defy anyone to do hard mental work; the only mental work he is then fit for, is a light newspaper article or a light novel. To be "clever and bright," live on two or at the most three meals a day, and those must consist of fruits, roots, or grains, and no animal food must be used: even such things as eggs, butter, milk, and cheese tend to clog the brain. Take also a regular amount of exercise, to make the blood course more swiftly through the blood-vessels. To be "always ill," eat plentifully of animal food, take four or five meals a day, add to these a moderate supply of alcoholic drinks, and smoke freely. Keep much indoors, in hot close rooms, carefully exclude every draught of fresh air; the less exercise you have, or the less baths you take the sooner will you develop disease, either of the digestion or breathing organs. The above is a sure receipt for making oneself ill—the attack of ill-health coming on about five days from the beginning of the experiments.

To be "uniformly well," live moderately on three regular meals; if meat or fish is taken, it must be only once a day, and then sparing in quantity. Avoid alcoholic drinks, also too strong tea or coffee; do not smoke tobacco. Take daily, regular exercise, be in the fresh air as much as possible. Keep the skin open by daily friction, and occasional baths. If these rules are followed, you will rarely be ill, and life will be worth living.

Mr. Holmes wishes I had the dieting of the House of Commons, of children, and others if my theory is true. I also wish I had the dieting of children. I would make our children a very lively, jolly, and sprightly set. Many of them are so now, but I would have them more full of fun and jollity. I am leaving my authorities and my old-age articles for another week, as too much knowledge might satiate not only Edwin Holmes and "W. R.," but also many others. I wonder how many have any idea how a heavy meal makes a difference in a person? How is it that at charity dinners that the collections are always left until the dinner is over? Has anyone been in a law-court, and noticed the sentences before and after lunch? A hungry judge is not to be trifled with, any more than any other hungry person. The same in the House of Commons and elsewhere. What is the best time for writing an article for a publication? In the early morn, when the stomach is empty and plenty of blood can be sent to the brain. The tone of a newspaper article often explains to me the time it was penned. This article is written about five hours after a vegetarian dinner. I have had no tea-meal in order to write it, but have left my usual meal for an early supper. How are ferocious animals tamed? By the hunger method. The old English spleen is not so common amongst us since we have introduced lighter meals and less drink. I must now stop, for it is time that I took my evening constitutional. Since I am going to live until seventy I must look after myself, and follow the rules of health.

During my walk I recollected that I have now been a vegetarian for a year. I did not like the idea of giving up my meat, not because I thought it necessary for life, but because I liked it. But the change is greatly in my favour; I have not had a bilious attack since changing my food, and I have had only one headache, which was due to being at two parties on consecutive nights, and being in hot gaslighted rooms for many hours. I do a good deal of writing of different kinds, and a good deal of hard reading. I am in an almost constant flow of good spirits, and can take a great deal of exercise without much fatigue. Speaking from the experience of a mixed diet, and of a vegetarian one, I at once vote for the vegetarian, without the slightest hesitation. If two stamps are sent to Mr. Doremus, 30, Rochester-road, N.W., he will send pamphlets showing how to begin.

"Dandie Dinmont" (20125), writes me a very sensible critique, and I am pleased to meet a good opponent. I know the experiments of Wanklyn, &c.; but it does not follow that, since they cannot trace all the alcohol, that it must necessarily be used for food. It may be destroyed by the system; but that is no proof of its use. Take citrate of potash, and we can recover it from the urine as the carbonate; but we do not recommend the use of this salt, even in small doses, to give force to the system. A pint of beer daily is as much as the system can use up; but using up is not necessarily force-making. Teetotalism is a thorough medical question, since the use of alcohol gives rise to innumerable deaths, diseases, and accidents. The moral and religious aspects are secondary, since it is the duty of every one to have a healthy body first, and then we consider religion and morality; but health is first.

T. R. Allinson, L.R.C.P., &c.

February 3.

CUTTING STEEL WITH A WET IRON DISC.

[21049.]—HAVING seen the letters upon the above subject in the ENGLISH MECHANIC, allow me to contribute my quota of information.

About ten years ago I commenced the manufacture of an article which required a great number of slits about 1¾in. deep; it occurred to me that by using a plain steel disc I should accomplish that object much more rapidly than by using an ordinary toothed saw. My theory was: that a plain disc running at a sufficiently high speed, would, upon coming in contact with the metal to be cut, instantly bring it to a red heat, and in that state it would easily be removed by the pressure of the disc. The result of the trial fully verified the theory; by using a periphery speed of about seventeen thousand feet per minute, I was able to cut slits in a steel plate $\frac{3}{32}$in. thick 1¾in. deep in about two seconds. I had 4 discs on one shaft; they were 2ft. diameter, and about $\frac{1}{16}$in. thick, and did not require to be kept cool with water, as, owing to their large diameter, the increase of heat was only slight.

The great advantage of this system of cutting, in addition to its rapidity, is that no sharpening of tools is required, and the wear only slight compared to the work done. **High Speed.**

MANDREL-NOSES AND CONICAL FITTINGS.

[21050.]—I WROTE to Dr. Edmunds recently upon the subject of his model mandrel, suggesting a plan for securing the small chucks in the conical hole. He is interested in the plan, and at his request I send a description of it, hoping that some of your readers will give us their opinion upon it.

First, however, a word about conical fittings *versus* screws. Our best lathe-makers tell us that the plan of making the head of a drilling spindle to screw off to take instead the head of the eccentric cutter, is not satisfactory, as it leads to both becoming slightly untrue. I understand that if the threads securing any chuck upon the mandrel wear, so as to allow the chuck to turn a little further round, it will no longer run absolutely true. This, I think, explains why the eccentric cutter and driller-head become untrue. The screw-threads securing them are small, frequent removals wear them, and the parts screw up a little further round than at first. If this be true, the same effect must occur with chucks screwed upon the mandrel, though perhaps to an imperceptible degree, and would go to show, if that is not universally admitted, the superiority of cone fittings over screwed. One maker fits the head of the eccentric cutter into the drilling spindle by means of a cone, and says it keeps perfectly true; and I have a small set of brass chucks, bought in France, all screwing into a brass receptacle chuck against a conical shoulder, the plan being intended to secure absolute truth.

I submit, therefore, that all the smaller chucks should be made with conical fittings to go into the hole in the mandrel-nose, and should be secured by a screw-ferrule or holding chuck.

Fig. 1 shows the parts together, and Fig. 2 the front of the screw-ferrule. The small chuck is seen from behind at Fig. 3, and both it and the ferrule have a flange, of which the alternate quarters are removed; this allows the small chucks to be put through from the front without removing the ferrule, when a turn of the latter draws the cones together and fixes them. Turning the ferrule backwards loosens the chuck, when it can be taken out. Thus the cones secure permanent truth; the chucks are changed without taking off the ferrule, and without a tommy or mallet.

FIG. 1.

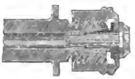


FIG. 2.

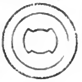


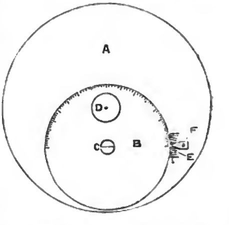
FIG. 3.

The small chuck shown in position does not make the slots necessary, as the ferrule might be made to pass over it; but with other chucks this could not be, and by so constructing the ferrule it would not disengage the cones, and would also require to be taken off to change the chucks. The little chuck shown was intended to illustrate how the mandrel-nose might form a kind of "Essex" chuck, and here Dr. Edmunds tells me he had anticipated me: it is simply a piece of brass with a groove in it, turned to fit the cone, and sawn across. I propose to have a small set of these, rising by about $\frac{1}{16}$in. up to ¼in.; they would be very simple to make, and would hold wire and small drills with perfect truth.

Feb. 3. **F. A. M.**

ECCENTRIC CHUCK.

[21051.]—IN No. 916 there is the description of an eccentric chuck. From the form of this it is impossible to get very much eccentricity, because the arm will strike against the bed. I inclose a sketch of what I think is a considerable improvement. A face plate A is as large as the size of the lathe will admit, on this is screwed a plate B capable of revolving around a screw C, which allows it to revolve freely but without shake. Round the edge of B divisions are marked to be used with a pointer F.

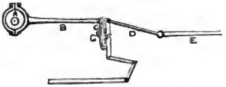


A screw E gears with the edge of B, so that when E is turned by a winch the plate B revolves. On B is a nose, D, to carry the chucks. In cutting the divisions one division should be cut when the work is ⅛ out of truth, another when it is ¼, another when it is ⅜, and so on. Of course, instead of eighths, it can be divided into any sized division. I must add that I have never tried this chuck.

Hartwell. **E. Thomas.**

ECCENTRICS IN REVERSING GEAR.

[21052.]—SOMEBODY asked some time ago whether it was absolutely necessary to use two eccentrics in reversing gear. The accompanying sketch will, I think, help him. I have not tried it myself, so cannot speak from experience. A, the eccentric; B, eccentric rod; C, the link which is pivoted at G. E, valve rod and valve connecting rod connected to link of the arrangemet for raising or lowering, and the same arrangement being used as for raising the link in the ordinary method.



Hartwell. **E. Thomas.**

PLANING IN THE LATHE.

[21053.]—PERMIT me a little friendly criticism on the device of "Mechanicus" for above, letter 20991. "Mechanicus" is, I presume, a practical engineer, and not an amateur like myself, and having made the lathe shown in engraving, must have had access to and used a regular planing machine; he is therefore not very likely to have had practical experience of the working of the device he describes with such minuteness of detail. Now I, having devised and fitted a planer to my own lathe, which I have already described in your paper, and which I have now used practically for many years, can at once see the weak points in this apparatus. In the first place, in any planer it is of the first importance to have a true and rigid bed to support the work against the pressure of the tool. Now in this apparatus there is no bed at all, and there is nothing to resist the pressure of the cutting tool but the strength of the work itself. The example "Mechanicus" gives of part of a slide-rest is probably as favourable a piece of work as to rigidity as he could have selected, and if he has only tried the machine on it, it may have worked fairly well; though if I were to undertake the job I would have improvised some more secure means of holding the work, than trusting to the grip of a scroll chuck on a round tenon, as the distance of the top and bottom edges of work from the line of lathe-centres would give considerable leverage to tend to twist it in the jaws of chuck. But supposing the work to be planed were the V-strips or slide of an ellipse or eccentric chuck of the ordinary dimensions—which would be a very likely job for an amateur to undertake—I do not think they would be sufficiently rigid to withstand the cut without yielding, and I have often had to plane up much thinner articles, which "Mechanicus" could not possibly do with his machine in the form he describes without their having some support at the back. Another defect I would point out is the limit as to width in the article to be planed; on measuring the figure he gives, which I presume is in proper proportion, allowing for height of saddle, &c., it appears as if it could only plane work about 3in. wide, which is far too small for even the requirements of an amateur. I must say "Mechanicus" has worked out the details of the self-acting mechanism very neatly. In the end of his letter he mentions having seen a lathe-planer of the overhanging arm type, the tool of which used to dig in. Now, as my planer is of this pattern, and is a specially heavy and strong one, I will give my experience in the matter. The first job I tried my planer on I used an ordinary slide-rest tool of the pattern Fig. 1, where the point was on a level or higher than the top of shank, and I found that with anything of a heavy cut on, it dug in most abominably. However, I at once saw where the fault lay, and made a set of tools of the pattern Fig. 2. I cranked the ends so that the cutting-point was on a level with the bottom of shank, and found them to work beautifully, as the tendency was to spring out instead of into the work; but by making them of ⅜ square steel, they were strong enough to work perfectly. Many a man can plan a machine, and more especially a combination one, such as a lathe-planer, apparently perfect in every detail, and it is not till he has had practical experience of its working that he finds out its weak points, and has to exert his ingenuity still further to overcome them; and I often see different mechanical devices recommended in your pages to amateurs, which I am convinced their authors never thoroughly tested themselves. **F. W. G.**

STANDARD WIRE-GAUGE.

[21054.]—Kindly allow me to thank Mr. S. for his letter (21002, p. 481). I believe the first wire-gauges were made to fractional parts of the inch, No. 4 being ¼in., No. 11 ⅛in., and No. 16 $\frac{1}{16}$in., the intermediate sizes in 64ths of the inch.

The numbers I last sent you were suggested by me in 1880, and if we add to them the numbers to correspond with the ¼ and ¾ parts of the sizes, we can see how near they correspond to the numbers suggested by others.

I may say that the ¼ and ¾ parts of a size present no difficulty to the wiredrawer, as No. 6¼ is only No. 6 easy, and No. 6¾ is No. 7 full, and is a matter of everyday work.

Decimal numbers approximating to the old B.W.G.

No. 5 0.	¼	½	¾	4 0.	¼	½	¾
·500	·490	·480	·470	·460	·450	·440	·430
No. 3 0.	¼	½	¾	2 0.	¼	½	¾
·420	·410	·400	·390	·380	·370	·360	·350
No. 1 0.	¼	½	¾	1.	¼	½	¾
·340	·330	·320	·310	·300	·295	·290	·285
No. 2.	¼	½	¾	3.	¼	½	¾
·280	·275	·270	·265	·260	·255	·250	·245
No. 4.	¼	½	¾	5.	¼	½	¾
·240	·235	·230	·225	·220	·215	·210	·205
No. 6.	¼	½	¾	7.	¼	½	¾
·200	·195	·190	·185	·180	·175	·170	·165
No. 8.	¼	½	¾	9.	¼	½	¾
·160	·155	·150	·145	·140	·1375	·135	·1325
No. 10.	¼	½	¾	11.	¼	½	¾
·130	·1275	·125	·1225	·120	·1175	·115	·1125
No. 12.	¼	½	¾	13.	¼	½	¾
·110	·1075	·105	·1025	·100	·0975	·095	·0925
No. 14.	¼	½	¾	15.	¼	½	¾
·090	·0875	·085	·0825	·080	·0775	·075	·0725
No. 16.	¼	½	¾	17.	¼	½	¾
·070	·0675	·065	·0625	·060	·0575	·055	·0525
No. 18.	¼	½	¾	19.			
·050	·0475	·045	·0425	·040			

Anyone using the old Birmingham wire-gauge would have very little difficulty in adopting the above scale; but the Sheffield and Lancashire wire manufacturers would differ very widely from it in some numbers, and in some numbers they also would differ from each other. This shows the hopelessness of a general agreement to the old numbers.

Anyone ordering from the decimal numbers only would obtain the same size wire from any number of manufacturers (with the slight variation of one or two per cent. above and below the number named that is allowed the workman), as the Board of Trade has made Sir Joseph Whitworth's decimal gauge the standard gauge, and all those numbers must, of course, correspond to that gauge. This I believe, truly, to be the only way possible to insure anything like uniformity in size in wire-gauges during this present generation. **Lestar.**

SUN-DIALS.

[21055.]—A correspondent recently asked for particulars of construction of a sun-dial, which were partially given by "F.R.A.S."; but as I have come across the whole of the angles ready worked out, including the quarters as well as the hours (thus saving much time and trouble), I send a copy of them.

It is assumed that the plane of the dial is tilted up 5¾°, which serves to throw off rain-water. The inclination will then be right for his latitude. The mode of determining the angle of the gnomon is too clearly shown in "F.R.A.S.'s" letter to need repetition.

ANGLES FORMED BY THE HOUR-LINES.

With the XII. o'clock line.		°	′	″	With the VI. o'clock line.		°	′	″
11¾	12¼	2	49	30	8¼	3¾	41	35	26
11½	12½	5	39	37	8	4	37	29	4
11¼	12¾	8	31	0	7¾	4¼	33	13	36
11	1	11	24	18	7½	4½	28	49	11
10¾	1¼	14	20	6	7¼	4¾	24	16	14
10½	1½	17	19	10	7	5	19	35	30
10¼	1¾	20	22	4	6¾	5¼	14	48	1
10	2	23	29	32	6½	5½	9	55	9
9¾	2¼	26	42	14	6¼	5¾	4	58	33
9½	2½	30	0	50	These last angles to be drawn on both sides of the VI. o'clock line to give the hours before VI. a.m. and after VI. p.m.				
9¼	2¾	33	26	1					
9	3	36	58	26					
8¾	3¼	40	38	40					
8½	3½	44	27	14					

The angles are given to seconds as worked out; but unless used in calculation it is not, of course, necessary to consider them. With a large vernier protractor the *minutes* can be utilised, but in ordinary protractors ¼° is about as near as the lines can be drawn to. **L. L. L.**

SHOWING ELECTRICAL RESISTANCES OF WIRE.

[21056.]—The account appearing in the "Scientific News" columns, in No. 930, of Herr Obach's device for showing to an audience the different electrical resistances of wires, recalled to my mind a contrivance for accomplishing the same end, which I made about a year ago and exhibited before the Experimental Science Association of the Dublin University.

Four wires, of the same diameter and length, are stretched on a sounding-box; they are attached to pegs, and so can be tuned to unison. The box may be of the size and form of an Æolian harp.

Binding-screws enable three of the wires to be put separately, or in series, into circuit with a battery. To this end the bridges are topped with straps of brass in connection with the binding-screws. One of the wires is of iron, another of copper, and a third of platinum; the fourth is placed at some distance on the board from the others, and before commencing an experiment, is carefully brought into unison with the other three.

On a current being passed through the wires, either singly or in series, and each wire being successively caused to vibrate by striking or plucking it, the difference of the resistances of the wires is shown by the marked degrees of lessened pitch as compared with that of the standard string.

This effect is, of course, due to the slackening of the wires on expanding under the heating effects of the current. Thus the number of vibrations per second is directly as the square root of the tension of the string; the tension varies inversely as the temperature, and the temperature directly as the resistance for a given current. Finally, therefore, the number of vibrations, or pitch of note, varies inversely as square root of the resistance. Practically, there are disturbing causes which render this connection approximate only.

An attempt was made to measure the strength of the current by a sliding bridge arranged to move beneath the standard wire, and so bring the standard wire to unison with the wire traversed by the current to be measured, the path of the bridge along the surface of the box beneath the wire being graduated empirically by using currents of known strength.

This acoustic method of showing the presence of a current proved very sensitive when fine platinum or iron wire was used.

Trinity College, Dublin. **J. Joly.**

AUTOMATIC REGULATOR FOR GAS.

[21057.]—With reference to Gartrell's regulator, I went to Cotterill's to see and purchase one which could be used without steam pressure, and as I clearly understood Mr. Cotterill, the pressure was necessary, and they were made only in one form. It appears that one of us was mistaken, and that I have unwittingly done Mr. Gartrell an injustice, which I certainly had no desire to do. It is quite certain that I did not get the regulator, and I wanted it at the time. The want of an adjustable and simple regulator has led me to experiment with several forms, and I find that the one known as Kemp's can be made adjustable, to work at any temperature, by placing a small tap on the air-chamber and closing it when the desired temperature is reached. No further attention or adjustment is necessary, as, once set at any specified temperature, it works at the same so long as the tap is not interfered with.

Mr. Gartrell is right in saying, I expect a regulator to cost about 2s. 6d. A high price is, unless for some special work, totally prohibitive, and the form of Kemp's certainly can be made cheaply. For a large proportion of the work in which a regulator would be used, it is a question of saving gas rather than exact temperatures, and with this object it becomes a point to be considered, whether it is not cheaper to do entirely without the regulator. **Thos. Fletcher.**

Museum-street, Warrington.

CURVE — LOCOMOTIVE ENGINES — VELOCITY OF ELECTRICITY.

[21058.]—A line drawn representing graphically the attraction of a small charge of electricity for another small charge of opposite sign at various distances will form a curve whose equation is obviously $yx^2 = K$. Where x is abscissa, y is ordinate, and K is some constant quantity. This curve continually approaches the two axes without ever actually meeting them; it thus somewhat resembles a hyperbola, but is a different curve, and I would be glad of any information concerning it. At present it does not seem to have got any special name, though it is at least as interesting (representing generally the law of inverse squares) as many named curves.

Some months ago I sent a query to the "E. M.," asking for particulars as to the H.P. of various classes of locomotive engines, and the weight of different kinds of trains; and, seeing how much is written on similar subjects in the paper, I have been very considerably surprised at the query being unanswered. Surely the railway writers who have sent all kinds of details about engines (except their H.P.) can give some information on the point.

Noticing a query about the velocity of electricity, it may be well to explain that in all probability electricity is some kind of a wave-motion in the luminiferous ether, and that it probably, in free ether, would travel as fast as light, but of course in metals its rate is much slower, just as light travels more slowly in glass than in air. The ratio between the dimensions of the electrostatic and electromagnetic units is always mixed up with the dimensions of velocity. Take, for example, quantity: in the electrostatic system, it is $M^{\frac{1}{2}}\ L^{\frac{3}{2}}\ T^{-1}$ in the electromagnetic system, it is $M^{\frac{1}{2}}\ L^{\frac{1}{2}}$, and the ratio between these is obviously $L\ T^{-1}$, which represents a velocity. This ratio has been measured in various ways, and is so close to the velocity of light as to leave no doubt of their identity.

Wm. John Grey.

Quayside, Newcastle-upon-Tyne.

SPONTANEOUS COMBUSTION OF OILS—WATER ANALYSIS—LIME BRICKS—LUBRICATING OILS—SIPHON—BIOXIDE OF BARIUM—BICHROMATE BATTERY.

[21059.]—I am afraid A. E. B. Smith (p. 482) very wide of the mark in his reply to query 49078. He apears to have confused liability to spontaneous combustion with ready inflammability. The mineral oils are not at all liable to spontaneous combustion, though the lighter of them are very readily inflammable. The only experiments that I know of on the subject are described in a paper by J. J. Coleman, in the *Chemical News*, Vol. XXIV., and were made by saturating handfuls of cotton waste with various oils, and noting the time required for spontaneous ignition. The waste was placed loosely in a paper box, and kept in an air-bath maintained at about 65° C. The results obtained were as follows:—

Oil	h.	m.
Boiled linseed	1	15
Seal	1	40
Raw linseed	4	0
Lard oil	4	0
Gallipoli olive	5	0
Refined rape (about)	9	0

The effect of mineral oil was very marked. Thus equal parts of seal and mineral oil refused to ignite, and even 20 per cent. of mineral oil materially delayed the ignition. One of the great advantages derived from the use of the heavier mineral oils as lubricants is their safety in this respect. (See also Mr. Allen's "Commercial Organic Analysis," Vol. II., p. 146.)

Lime (query 49214) can be weighed very accurately as CaO if cooled in a desiccator, and weighed as soon as cold. But a very high temperature is required in ignition, which would necessitate the use of a blowpipe. The querist had, therefore, better weigh his lime as carbonate or as sulphate.

In reply to query 49284 (p. 486), I quote the following from the latest edition of Bloxam's "Metals." The material of which the bricks are made is magnesium limestone. "By grinding it, and mixing it with pitch, as patented by Mr. Riley, bricks can be formed which, after burning, are very refractory. In lining the converter it was impossible to cement the bricks satisfactorily together; they generally get a good deal curved in baking, and fit badly together, and the cementing material is easily washed out by the molten metal. The converters are now lined by placing a hollow tapered iron core in the centre, at the bottom of which a coke fire is lighted; a liquid mixture, or "slurry," of tar and previously well-burnt limestone being run into the space between the core and the shell of the converter, which has had a layer of bricks placed flatwise against it. The lining consolidates with the beat, so to speak, into one solid brick."

It is very probable (query 49286, p. 486) that for lubricating heavy machinery, such as that of a locomotive, mineral oil alone would not be suitable unless of considerable viscosity. Possibly, therefore, the engine-driver you spoke to had not used a suitable oil; but there is a good deal of prejudice in these matters. Pure lard-oil is undoubtedly one of the best lubricators; but it is very expensive. For agricultural machinery you want an oil of tolerable viscosity, not liable to gum, and having a low freezing-point. If you can get it really pure, rape or colza oil would answer your purpose; but pure rape oil is rare in England. You can get it from several houses in Glasgow, where it comes direct from Stettin, but the oil expressed and refined in this country is often largely adulterated. Better, perhaps, than rape, but more expensive, would be Gallipoli olive-oil. It has a less tendency to gum than rape, and in order to prevent it congealing in winter you might mix with it about 10 or 20 per cent. of "Ragosine Oil." The objection to olive-oil is its acidity, which causes it to act considerably on the metal of bearings and become thick. Perhaps the Ragosine oil alone would suit your purpose, and you could at any rate try it. It is a mineral oil which you cannot freeze, under ordinary conditions, and which would not gum or corrode. If I can give you any further information I shall be glad to do so. Mr. Allen will pardon my having answered your query, which I see was addressed to him.

The highest point of a siphon (query 49308, p. 487) used for transferring water, must not be more than, say, 30ft. above the surface of the water. You might go up to nearly 34ft., but your siphon would only work while the barometer stood very high.

"Bi-oxide of Barium" (query 49335, p. 487) is a combination of oxygen with the metal barium, and having the formula BaO_2. It can be obtained in several ways, and is produced on a large scale by passing air at a high temperature over the monoxide BaO. If "S." has had any practice in chemistry I will tell him how to prepare it on a small scale, if he wishes to do so; but from the query I presume he has not, and in that case it would not be advisable for him to try.

The purplish crystals that form at the bottom of bichromate battery jars (query 49336, p. 487) are *chrome alum*, a double sulphate of chromium and potassium having the formula $K_2Cr_2(SO_4)_4 . 24H_2O$.

Derby, Jan. 27th. **L. Archbutt.**

HOW TO EXHIBIT SPECTRA WITH THE LANTERN.

[21060.]—If we wish to project spectra upon a screen for exhibition, the expense and trouble of the necessary electrical apparatus is a consideration for many of us. To obviate these difficulties, I devised a simple plan for exhibiting spectra with a lantern which may possibly be of some assistance to others.

The defects of slides painted by hand to represent spectra are, first, a want of the smooth uniform shading of the tints so characteristic of the spectrum; and secondly, a lack of purity and brilliancy in the colours. These defects may be overcome by the use of a thick slide carrying two glasses, one in front, and the other at the back, separated by a certain distance, the right amount of which must be found by trial; for the Sciopticon I use, the distance is about 1¼in. Upon the glass nearest the condenser are ruled the Fraunhofer lines, &c.; these are focussed upon the screen; upon the other glass are cemented by their ends strips of thin coloured gelatine film, tinted to match the various portions of the spectrum, and, of course, suitably varied in width.

These strips must be cut out with a straight-edge and fixed close together. When in position in the lantern these strips will be considerably out of focus, and the various tints will blend upon the screen, producing, if properly managed, a spectrum which, to the eye, will be indistinguishable from a prismatic spectrum. It is only necessary to prepare one front glass to exhibit all kinds of spectra; the different spectra are produced by changing the second glass.

To show the solar spectrum the second glass may be coated with a thin solution of gum-dammar in benzol, and upon this are ruled the fine Fraunhofer lines with a sharp-pointed lead pencil: two or three leads of different degrees of hardness should be used.

To insure the lines falling in their proper places in the spectrum, a glass slide should have a scale of equal divisions ruled upon it, and being placed in the lantern the proper positions for the principal lines should be noted; the lines should then be planned upon paper to serve as a guide when new spectra are required. Care must be taken that all the glasses fit in the slide without play. The rest of the glass not occupied with the solar lines will, of course, be blocked out with opaque pigments.

Bright-line spectra can be made by covering a glass entirely with opaque varnish, and ruling out clear spaces with a pointed instrument. Spectra of bright lines on a less bright spectrum can be shown by very slightly smoking a glass, and ruling out the clear spaces for the bright lines. Absorption bands of liquids, &c., can be exhibited by coating a glass with the dammar solution, and shading in the bands with a soft lead-pencil and stump. A great advantage of this plan is that any new spectra that may be required can be prepared in a few minutes without difficulty.

Some little care and patience is required, in the first instance, in preparing the front glass in order to get the colours to imitate those of the spectrum exactly.

Gelatine films can be had everywhere of all tints, and if none are conveniently to hand, are easily made by tinting a solution of gelatine with aniline dyes and pouring upon a levelled glass, stripping the film off when quite dry.

This plan for exhibiting spectra has proved so simple and useful to me, that it may be not less so for others; and having often derived valuable hints from the English Mechanic, I shall be glad if the above is of any assistance to our numerous readers. **Harold Holcroft, M.A.**

THE PERPETUAL ALMANAC.

[21061.]—The object of this paper is to show a simple means by which the usual contents of an almanac may be found for any day in any month of any year, past, present, or to come. The desirableness of such a method is illustrated by the use made of it in De Morgan's "Book of Almanacs," which is now becoming exceedingly scarce. By means of the propositions which follow, all the details of the old almanac, which is seldom at hand, of the older almanac, which never existed, and of the future almanac, which has yet to be made, can be exhibited in succession. As all the operations are to be performed by the reader, tables become unnecessary; and thus errors in printing (a contingency most difficult to be guarded against) are altogether avoided. A few examples are added for practice.

Prop. I.—To find the day of the week, corresponding to any day of the month in any year, past, present, or to come.

Add together the year, its fourth part, the fourth part of the century with which it commences (omitting fractions), and the day of the year. Next, subtract the century from the sum, and divide by 7. The remainder is the number of the day of the week, Sunday being the first.

N.B.—In leap years take one less than the day of the year.

Example: The Queen's birthday was on May 24, 1819, required the day of the week.

Here we have		1819
Its fourth part		454
The fourth part of the century		4
The day of the year	Jan.	31
	Feb.	28
	March	31
	April	30
	May	24
The sum is		2421
Subtract the century		18
		7)2403
		343-2

Hence it fell on *Monday*, the second day of the week.

In old style, *i.e.*, before September 3rd, 1752, the rule is simplified. Add to the year its fourth part, and the day of the year (one less in leap-year), divide the sum by 7, and take 2 from the remainder, borrowing 7, if necessary. If the year be B.C., subtract 1 from it, divide by 532, subtract the remainder from 532, and operate on the result.

Prop. II.—To find the moon's age on any day of the month, in any year, past, present, or to come.

Divide the year by 19, multiply the remainder by 11 (rejecting multiples of 30), and note the result. To this result add the third and fourth parts of the century beginning the year, the number of months from March (inclusive), the day of the month, and the number 8; and from the result subtract the century. The remainder (rejecting multiples of 30), is the moon's age.

N.B.—January and February in any year are to be reckoned as the 11th and 12th months of the year preceding.

Example.—The Battle of the Nile began on the evening of August 1st, 1798, and lasted all night. What was the moon's age?

Here 1798, divided by 19, gives remainder 12; and this, multiplied by 11 gives 132;—i.e., 12 (rejecting multiples of 30); also, the third part› 17 is 5; and its fourth part is 4, and August is the 6th month from March inclusive. Adding 12, 5, 4, 6, 1, and 8, the sum is 36; from which subtracting 17, we get 19—the moon's age in days, which shows that there was partial moonlight.

If the year be Old Style, the rule is simplified: To the result first noted, add the third part of the century, the number of months from March inclusive, the day of the month and the number 6. The sum (rejecting multiples of 30), is the moon's age.

If the year be B.C., we proceed as follows:—Subtract 1 from the given year, divide by 19, subtract the remainder from 19, multiply the difference by 11 (rejecting multiples of 30), and note the result.

To this result, add the number of months from March inclusive, the day of the month, and the number 5, and from the sum subtract the third part of the century. The remainder (rejecting multiples of 30) is the moon's age.

Prop. III.—To find the Golden Number.

Add 1 to the year, and divide by 19; the remainder is the Golden Number.

Prop. IV.—To find the Sunday Letter.

Old style: add to the year its fourth part, and divide by 7; subtract the remainder from 3, borrowing 7, if necessary. The result is the rank of the Sunday Letter, A being the first.

New style: add to the year its fourth part, and the fourth part of the century with which it commences, omitting fractions; subtract the century from this sum, and divide by 7. The remainder, taken from 8, gives the rank of the Sunday Letter.

Prop. V.—To find the Epact.

Old style: divide the year by 19, and multiply the remainder by 11, rejecting multiples of 30.

New style: To the Epact found by the foregoing rule add the third and fourth parts of the century and the number 8; and from this sum subtract the century.

N.B.—When the Epact found by the foregoing rule gives 29, it must be called 30.

Prop. VI.—To find the Solar Cycle:

Add 9 to the year and divide by 28; the remainder is the Solar Cycle.

Prop. VII.—To find the difference of days between the Old and New styles:

Diminish the century by its fourth part and subtract 2. To change old style into new add this number, and *vice versâ*, subtract it. Caution must be used at points, at which the leap-year affects the old style, but not the new.

Prop. VIII.—To find Easter-day, which is the first Sunday which falls next after the calendar full moon nearest to, but after, the 21st of March.

Subtract the Epact from 23 (borrowing 30 if necessary); divide the difference by 7, and add 3 to the remainder. Subtract this remainder from the number of the Sunday letter (borrowing 7 if necessary), and add the first-mentioned difference. The sum, added to March 21, will give Easter-day.

In Old style, subtract from 15, instead of 23, and proceed as before.

Examples in the foregoing propositions:—

1. Prove that May 28, B.C. 585, fell on a *Wednesday*.
2. Show that the full moon in March B.C. 4 happened on the 13th of that month.
3. Prove that the moon was at full on Christmas day in A.D. 828.
4. Ven. Bede says that the 26th of March, A.D. 668, was Sunday. Verify this.
5. Prove that Easter-day in A.D. 1720 fell on April 17.
6. Find the dates of the moon's changes in 1815.
7. Investigate the following *Common Notes* for 1803:—Golden Number 18: Epact 7; Sunday Letter B; Solar Cycle 20; Easter-day, April 10; Advent Sunday, Nov. 27.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Jan. 15.

LEGAL REPLIES.

[21062.] — Parish — Liability to Support (49273).—The querist is not liable to pay towards the support of his wife's father by the parish; but his wife herself would be liable if she had any means of her own.

Friendly Society—Proceedings (49274).—The best way would be to sue for the arrears of sick-pay in the county-court. This is not a fit case in which to apply for an order to wind up the Society, unless it can be proved insolvent.

Manager—Notice—Will (49296).—This question is not very clear. How is the will worded? Is the business left wholly to the son? It seems, however, that as against the deceased the querist would have a right to a quarter's notice; but whether or not he can have such a claim against the executor, I cannot say upon these facts.

Copyhold Enfranchisement—Cost (49313).—There are many statutes relating to enfranchisement of copyholds, and it is always an expensive process. Without knowing whether the enfranchisement is to be by agreement or compulsion, and what are the customs of the manor, and the amount of the fine payable. It is impossible to give any idea of the cost. I never heard of any fixed percentage.

Widow and Illegitimate Grandchild—Parish (49314).—The father and the mother of an illegitimate child are liable to pay towards its support by the parish; but no other relation can be. So that in this case the widow would clearly not be responsible.

Declaration of Trust (49315).—To answer these several questions fully would require a column; and indeed it would amount to a short treatise on Trusts. A declaration of trust must be by writing, and should be by deed. It is better by a separate deed, to save complications of the legal estate; unless it be desired to fix every possible purchaser with notice of the trust. As a deed it would require stamping and attesting, and if the land is in Middlesex or Yorkshire, it had better be registered. All equitable estates are liable to duties in the same way as are legal estates. Every kind of property can be the subject of a trust, and at all events under the New Married Women's Property Act, 1882, husbands and wives can declare that they hold in trust for each other.

Will—Copyholds—Lapse (49341).—It is not safe to advise upon the effect of a will without seeing it; or to deal with questions affecting copyholds without knowing the customs of the manor. But with these warnings, I think the property would go to the children of the deceased married daughter. Usually if the person to whom property is given, dies before the testator, the legacy lapses and is at an end. But the Wills Act makes an exception in favour of bequests to the testator's children, and this is a case within the exception.

Promissory Note—Statute of Limitations (49342).—Any rate of interest that is agreed upon by the parties can be charged upon a promissory note. The limit of 5 per cent only applies where there is no agreement. Payment of the premium under the circumstances mentioned would be sufficient to take the case out of the statute if the querist could prove that these payments were made on account of this interest; but the whole burden of proof would lie upon him, as the presumption is that the debt is barred by the lapse of over six years.

New Road—Liability of Adjoining Owners (49356).—There is no doubt as to the right of the Corporation to call upon the owners to contribute their proportionate shares towards the paving and making of this new road. That the querist has paid rates does not affect the matter, for those are paid to maintain all the roads in the parish, after they have been made into highways and dedicated to the public use. Those who buy houses in unmade roads should always remember this and allow, in the price they pay, for the payment they will assuredly have to make towards the completion of the road by the local authorities.

Friendly Societies—Registration (49372).—As far as I know the Act of 1875 did not make it necessary that these societies should be registered over again. It was rather a consolidating statute, and if the society were validly registered under a former Act I do not think it can need re-registering.

Poor Rates (49394).—There is some little confusion about this question. But as far as I can understand it, the querist came into possession at Christmas, and if that be so, and the rates are collected half-yearly, from Michaelmas to Lady Day, he can only be made to pay the rates for the quarter of his occupation—i.e., from Christmas to Lady Day, and he should see and explain to the collector.

Executor—Costs—Wife (49403).—Unless an executor has acted improperly in his administration of the estate, no Court would order him to pay any costs of a suit, so that if the querist has done his duty in his office he need not be afraid of the litigation, as, on the contrary, if there are any assets, his costs will be paid out of them. For the rest, a deed of gift to a wife is, fortunately, void as against the husband's creditors, and I should decline to explain in these columns, even if I knew, any method by which the claims of creditors can be defeated by private arrangements between man and wife.

Right to Support—Damages (49427).—In this case the owner of the upper land has a clear right to support from the lower, so that his surface shall be kept level. If his land subsides by reason of the querist's excavation, the owner could claim as damages the value of the land to him in a level condition, though it is not easy to see how they could be estimated, any more than it is possible rightly to answer this question without reading the lease and knowing how the upper land is used.

Will—Legacy—Search (49434).—A will, if proved, can be searched for and read at Somerset House, London, between ten and four, on payment of one shilling. If the prisoner authorises the executor to pay his wife the legacy, he can do so if he likes at once; but he cannot be compelled to pay it over until after the expiration of a year from the death, and then only upon proof that he has sufficient assets.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

BRAKE FAILURES.

[21063.]—The long letter by "Meteor," 20974, p. 455, will no doubt be read with interest by a great many; but after being read by those who have had practical experience, will know that all he knows both of the running of trains and the working of the automatic vacuum brake on the Midland Railway is theoretical, which knowledge is of great value to all, especially to those working the brake, thanks for "yours," which I have read with interest for a long time.

But when reading those letters, (before I was called upon to work the brake), which have appeared from time to time, I have often asked myself, Has the brake no friends to speak for it? But still, up to the present, I have not seen any letter that would lead me to think it has; so with your kind permission, I will say a few words both for the drivers and the brake.

First, then, I must thank "Meteor" for his figures, letter 20974, p. 455, as I have no doubt they will be read with interest by many who have not yet seen the pamphlet he mentions; but all drivers know who have the working of the brake that 10in. initial vacuum is of no service to stop a train. So they never think of running with such a quantity and think they have a fair stopping power.

Then a vacuum of 20in. on the gauge is not above the average, as a vacuum of 21in. or 22in. is the easiest to maintain, as the small ejector will obtain that, and it is a very hard thing to regulate without shutting it off—and that we are not allowed to do; but, suppose 20in. is below the average, he does not say that with the size pistons and cylinders the M.R. carriages are fitted with, that 15in. of vacuum is sufficient for all practical workings.

So we can afford to leave Captain Galton's figures out of the question, also the theoretical brake-power required, according to the above pamphlet.

With regard to the driver who reduced the pressure in his boiler from 140 to 90, he must have used very bad judgment, or have had next to no fire on—perhaps both; but I have certainly not heard of, or seen any account of a M.R. driver being fined for losing time, especially when there is a sufficient cause to put the time to, so they neither get in the frying-pan or the fire. As to the coal consumed, there is nothing to learn from the scanty comparison that he, "Meteor" gives. Perhaps the vacuum train was a stopping train, and I never yet found two engines alike, and there is certainly a great difference between drivers, as I know from experiences, and so "Meteor" may see by looking at the sheet at any large loco. station.

Respecting the little narrative given of a driver running down a heavy bank, I must say it is a rather curious one; as, after he first puts on the brake, he feels no fear of it leaking off, as it will soon bring his train to a stand unless he releases it with his large ejector; and that is where all the bad mistakes are made, through the driver not first bringing his train well under control; because, if he does so, he will then be able to release his brake and re-create an efficient vacuum, which can be done in half a minute, sufficient to stop a train running at full speed—how much easier a train whose speed has been reduced to ten or fifteen miles per hour. So that the mistake is not with the brake, but the driver, I am sorry to say; and so these accidents, as they are called, will happen so long as drivers tell their foremen that they thoroughly understand the brake, when, if you was to ask them what atmospheric pressure was, they would tell you they did not know there was such a thing.

So, you see, the brake is able to give satisfaction to those who understand it, as far as efficiency goes; and, if the leakage past the piston-rod can be stopped, "which, I believe, is being done," it will make it much easier to work, and will also be a great saving of steam; but the risk to those who do not thoroughly understand it will, perhaps, be increased. Perhaps this letter will account for some of the so-called failures not being reported to the Board of Trade; for, if the brake is not allowed to act by the driver, how can it be a failure of the brake?

I should like to see a letter from some other practical man who thoroughly understands it. Then, I think, the readers would see I am not alone in my opinions. **Automatic Vacuum.**

It is stated that glass pump-barrels are bored in Berlin by ordinary lathes and tools specially hardened, aided by dilute sulphuric acid.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47784.]—**Cistern.**—A. B. and C. together fill 50 gallons per minute; but C. fills 10 gallons per minute less than A. and B. ∴ Twice C. fills 40 gallons per minute; or twice C. fills 20 gallons per minute; consequently C. fills the cistern in 60 minutes, and A. fills the cistern in 90 minutes. Hence, by question:—B. fills $\frac{1}{24} - \frac{1}{90} - \frac{1}{60} = \frac{1}{72}$ of the cistern in 1 minute, i.e., he fills it all in 72 minutes. Answer: 90, 72, 60 minutes.—Towcester School.

[48483.]—**Henry Lord Clifford** (**U.Q.**)—Was son to the Lancastrian Lord Clifford, who is a character in Shakespeare's "Henry VI.," and who was killed at Towton. After this battle, Henry Lord Clifford fled to Lonsborrow, and there—and afterwards elsewhere—lived altogether for twenty-four years, as a shepherd. At last Henry VII. restored him to his rank and honours. He owned Skipton Castle. Southey quotes from an old MS. The following are extracts from it:—"This Henry Lord Clifford, after he came to be possessed of his said estate, was a great builder and repairer of all his castles." "This Henry Lord Clifford did, after he came to his estate, exceedingly delight in astronomy, and the contemplation of the course of the stars, which it was likely he was seasoned in during the course of his shepherd's life. He built a great part of Barden Tower (which is now much decayed), and there he lived much, which it is thought he did the rather because in that place he had furnished himself with instruments for that study. He was a plain man, and lived for the most part a country life, and came seldom either to the Court or London, but when he was called thither to sit in them as a Peer of the realm, in which Parliament, it is reported, he behaved himself wisely and nobly, and like a good Englishman." As he was one "who could write nane, But just the letters of his name," it is not likely that his delight was other than a purely imaginative one, or that he made observations useful even in that age. Wordsworth penned a poem upon him.—S. M. B. Gemmill.

[48696.]—**Saddles** (**U.Q.**)—I will do what I can (if I am not too late) to help "Saddler," if he will state what kind of saddle he means.—J. S. Saddler.

[48752.]—**Adulteration of Tea.**—I think your correspondent, A. François, is speaking a little at random about a thing he evidently knows nothing of. A tea mill, properly speaking, is a tea mixer, and may be seen at any large grocer's, and, for adulteration, is really useless. To obtain a good flavoured tea, you must have several kinds put together, to obtain what is called the blend. Some teas are large leaf, which is put through a small grinder on the top of the mill, passing into a large drum beneath, into which the small teas may be put direct: where, by a few revolutions the whole is mixed ready for use, thereby saving the old-fashioned labour of rubbing through a sieve and mixing in a tray. This, I think, will blow A. F's. theory of tea-mill adulteration.—Robjant.

[48807.]—**Neuralgia.**—To "W. S. W."—Does every jar contain the copper of one couple and the zinc of another, with the corresponding copper and zinc turned into the neighbouring jars, and so on right through the series? That is how it should be, and if it is not so, no current would be obtained. Perhaps you have not made a good connection between the last pieces of metal and the conducting-wires, or between the wires and the brass handles; or, perhaps you have hung your couples on a rack of some conducting material, such as metal. If so, you would get no current. The rack should be of dry wood. Your riveting instead of soldering would not stop the action of the battery while the pieces remained clean, provided you have made a good metallic contact; but it would be far safer to drop a little solder in where the pieces join. Are you sure you have got copper, and not what is called "gilder's metal"? If you are right on all these points, increase the strength of your solution; but the fault is most likely in the connections, as the difficulty usually is to prevent the generation of too much current. There is no necessity for having the couples at exact distances apart.—W. S. W.

[48950.]—**Weighted Governors** (**U.Q.**)—For the loaded governor fix on the number of revolutions. First find the height as if a simple governor, then add together the weights of the revolving balls, and twice the weight of the centre weight. Multiply the sum by the height found, and divide the product thus obtained by the sum of the weights of the revolving balls. The quotient thus found will be the height of a weighted governor. Suppose we want a governor to revolve 268 times per minute, the weight of the balls to be 3lb. each, the centre weight to be 90lb. 187·5 / 268

= ·7 × ·7 = ·49; then ·49 × (6 + 180) = 91·14 + 6 = 15·19in.—Ferer.

[48823.]—**Roman - Candle Stars.**—I would caution all pyrotechnists as to J. S. Rochard's "pump." Roman-candle stars should have a hollow in the middle; and if coloured, a large and conical hollow is of great importance. I see no provision for this in the "pump." It is waste of time to make any stars, save Roman candle stars, cylindrical.—J. F. E.

[The annexed cut was omitted from the reply last week.—Ed.]

[48993.]—**Yellow and Red Timber.**—1. Pinus sylvestris.—The Dantsic fir tree, Scotch fir, redwood, imported from Dantsic, whence one of its names, and is grown in Prussian Poland and upon the borders of Russia; used in all descriptions of domestic architecture, and also in ship-building. There is a variety of the above imported from Riga, called Riga fir; it is lighter in colour, and is used for the same purposes. It grows chiefly in the interior of Russia. 2. Abies excelsa.—Spruce fir, imported from and grown in Norway. Used for the coarser kinds of joined works and for ships' spars. It is sometimes called "whitewood." 3. Abies Canadensis, A. nigra, and A. alba.—Hemlock, Canadian and St. John's spruce. The names indicate where they come from. The first quality is used for the same purposes as the Pinus sylvestris, the coarser kinds for rough work. It generally goes by the name of "American whitewood." 4. Abies larix (the larch) is produced in Scotland, Italy, and Russia; but the Scotch, which of course is very limited in quantity, is considered by far the best; principally used in boatbuilding. 5. Larix Americana and L. microcarpa.—From Virginia to Hudson's Bay; largely used in shipbuilding. 6. Pinus resinosa (the red-pine tree) takes its vernacular name from the colour of the bark, and is known as yellow pine from the colour of the wood, which is used in first-class joinery for panels, &c. 7. Pinus strobus, the yellow pine tree, the Weymouth pine from North America. Is used for the same purposes as the last, and goes amongst joiners by the same name. There are a number of other pines or firs used, but I think the above details will assist in clearing up the obscurity which has been caused by the recent correspondence on the subject in the "E. M." Any one wishing to obtain further information should procure "Timber and Timber Trees, Native and Foreign," by T. Laslett, published by Macmillan and Co., 1875.—M. G. F.

[48993.]—**Yellow and Red Timber.**—There are three points in "W. J.'s" letter on p. 458, which I shall be glad if he would note:—First, I am represented by him as having said that "yellow pine" and "yellow deal" are identical, whereas I know them to be different species of the genus "Pinus." Second, he says, "What the Swedish and Russian shippers call 'redwood' contains two species which are not distinguished in some parts of this country." Will he please say what the two species are, in what parts of this country they are distinguished, and by what names? I know of only one "redwood" from those parts. It truly varies a good bit in character, according to the soil and climate of the parts it grows in; so much so, indeed, that the work for which it is suitable when grown in one district is altogther unsuitable for the growth of another region, but it is all the produce of the same species (Pinus sylvestris). Third, will "W. J." tell us in what way fir-timber varies from yellow deal, and red-pine timber from red-pine deal, except that the timbers come to us generally hewn and the deals generally sawn, a difference simply in the manufacture, and not at all touching the species of the wood. "Shipwright" asks for an explanation as to how the confusion of pine and deal got about. This has no doubt arisen from the fact that they are both of the same genus (Pinus), and so it is in a certain sense correct to speak of any of the woods of this genus as pine-timber, but for trade purposes we have to distinguish the woods of the different species of this genus from each other, and as the proper Latin botanical names are not simple enough for the workmen and others who have to deal with the woods, we resort to the more homely and old-fashioned names of pitch-pine, red-pine, yellow-pine, spruce, white-deal, yellow-deal, &c., all of the same genus and correctly spoken of in a broad sense as pine-timber, though by no means identical. I should hardly fancy it would be of much interest to the readers of "ours" to know the botanical names of the above woods; but if they wish it I could no doubt furnish them.—Timber Merchant.

[49016.]—**Gilding upon Silk.**—This query has been answered many times. The silk is prepared with isinglass size, but as a matter of fact, any clear size answers the purpose. The parts to be gilt will be anointed with gold-size in the usual way. Would recommend querist to look up back volumes.—E. M. B.

[49020.]—**Writing on Glass.**—Coachmaker's black japan is the article used by gilders on glass. Black japan can be thinned with turpentine; and as to being too transparent, there must be some mistake. However, gilders use two or three coats to get dense black, and wash off part of one to make the shadow fall away when such an appearance is required. Has your correspondent really got hold of coachmaker's japan, because there is a great difference in "japans"?—S. M.

[49040.]—**Ormolu.**—The brass ornaments are, I believe, merely pickled, scratch-brushed, and burnished in the ordinary way, and then coated with lacquer to preserve them from tarnish.—S. M.

[49066.]—**Envelope Machine.**—Why not refer to the patent you name? It will, doubtless, give the description you seek, and copies of the patents are sent, when published, to most of the town-halls or libraries throughout the country. Do not copy before referring to the Patent Laws.—Rera.

[49072.]—**Use of Marine Glue.**—I thank A. E. B. Smith for noticing my query on the above subject. Would he kindly say how the marine glue is to be melted? That is my difficulty.—Ellen E. Richards.

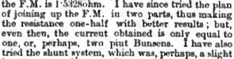
[49105.]—**Artificial Foot.**—I shall feel obliged if "Ex." would, as he suggests to "Timber Toes," give full particulars of making the foot he speaks of.—G. Bouteil.

[49105.]—**Artificial Foot.**—In reply to this query, I beg to say there are two makes lately out which I and my fellows consider as near perfection as possible. Some time ago I had the pleasure of examining one of them which had been sent to us for approval, and the one I refer to was a real work of art. I was acquainted with a person who had also just got one, and he estimated having walked 90 miles in about 15 days. So far, my professional advice to you would be, have one made by a first-class hand if you can afford it. Using one not made well and correctly is a serious matter; this differs greatly in cases; at the present I cannot state the maker's name of these new patents, but they have received the approval of the F.R.C.S.I. Still our correspondent's "Ex's" offer may suit you, and I for one would like to see his or any other's description for such, or any other scientific improvement, with their remarks.—F.R.C.S.I.

[49151.]—**Brittle Brass.**—I am afraid you will not get copper chains anywhere; I never saw any myself. Why not try the patent continuous chain, of a stouter kind than that which you now have? Get it as large as will run freely in the wheels without catching on the sides. I have always found it give perfect satisfaction; it will wear a long time in any atmosphere. Try it.—Gas Engineer.

[49176.]—**Dynamo Machine.**—To Mr. Lancaster and "A. J. S."—Thanks very much; but I think the F. magnets are rightly wound; at all events, the poles at the top are both north, and those at the bottom both south. I find, however, that the resistance of the wire on the F.M. is much too great. By calculation, I made the resistance of the armature (page 440), ·9286ohm, while that of the F.M. is 1·5328ohm. I have since tried the plan of joining up the F.M. in two parts, thus making the resistance one-half with better results; but, even then, the current obtained is only equal to one, or, perhaps, two pint Bunsens. I have also tried the shunt system, which was, perhaps, a slight improvement; but, surely, one ought to obtain a much more powerful current from such a machine. The cores of the magnets weigh 35lb. or 40lb. Will you kindly give the case your consideration, and tell me what current I might reasonably expect from it?—S. S.

[49179.]—**Glass Sweating during Frost.**—About eight winters ago I was much annoyed with the frosty windows in my workshop; when warmed with a stove, it caused the water to trickle down among the tools, &c. I had new sashes made, double glazed, leaving a space of ¼in. between the two glasses. Ever since then, I never had the glasses even steamy in the coldest weather, with a good heat inside, 60°. Old sashes could be double glazed without much trouble, by simply tacking on some deal cleeths inside, so as to form a rabbet, leaving a distance between the two glasses, say, from ¼in. to ½in. Glaze with good soft putty, so as to hermetically seal the space between the glasses: otherwise they would steam. See sketch, which explains itself.—G. C. P.



[49203.]—**Gas and Paraffin**—My actual experience gives results differing from those stated by Messrs. Lancaster and Fletcher on p. 484. Six years ago I burnt gas in a small house in the North of London; five, and sometimes six, lights burning; price of gas, 3s. 8d. per 1,000; average yearly cost, £4 10s. Now I burn paraffin, same number of lights—one of them a Jones and Willis' 40-candle triplex (least often used); cost of paraffin at C.S.S.A., 6½d. per gallon per 40-gallon cask: yearly cost under 50s. The triplex lamp above mentioned is a good one; but the best of all lamps is undoubtedly the "Empress," which you described and illustrated in "ours," July 1, 1881. No smell, no smoke, no chimneys to break, and burns little oil, and gives a better light than gas. No one who has not tried the Empress lamp knows what a white, pure light can be got from paraffin. Its cost is heavy—too heavy a great deal, I think; but if my lamp lasts five years, it will more than repay its extra cost, and it is certainly a luxury. Where I live now gas costs 5s. 6d. per 1,000, in a town situated on the main line which brings coal to London, and only ten miles away!—Harrovian.

[49203.]—**Gas and Paraffin.**—I discarded gas four years ago in favour of paraffin, and have congratulated myself ever since, first, on account of the greater purity of the air in sitting-rooms, secondly, on account of the comparative cheapness. A duplex lamp, well placed, effectually lights every corner of a room 16ft. by 15ft. at a cost of 1½d. for six hours. I pay 10d. a gallon for an odourless paraffin, delivered in the suburbs of London in five gallon cans. Our kitchen lamp, which is now alight seven hours a day, costs under 3d. a week, and the hall lamp the same. Private householders who complain of gas companies have the remedy in their own hands. Effective lighting and better health may be secured by using paraffin at little more than one-third the cost of gas.—Nidderdale.

[49218.]—**Plain Malt Spirit.**—In the "trade" this does mean alcohol obtained from malt alone, though "Nun. Dor." would have us believe not. He seems to be compounding the grain spirit with the malt spirit distiller. The former uses only a small portion of malt, and the crude spirit produced is afterwards rectified to make British compounds; the latter uses malt only, and does not rectify his spirit to make it one of the liquors of commerce.—Rera.

[49220.]—**Mechanics.**—If both arms were equal the weight required must be equal. If you double the length of one arm you will require half the weight; treble the length one-third the weight, and so on. Or call length of short arm A, the weight on the same B, the weight or power required C, and the length of the long arm D; then D = (A × B) / C, or C = (A × B) / D.—Rera.

[49228.]—**Bookbinding.**—The reply furnished on p. 506 to this query is altogether wrong, and does not in any way answer it. The reply in question is an unprofessional attempt to describe the method or process of backing, and has nothing whatever to do with the process of rounding the backs of books. The querist, evidently trying his hand at binding, inquires how the backs of books are rounded. I replied to this query, and told him in as clear a manner as possible, how it should be done; but still I admitted (as my reply will show) that nothing but practice would enable him to round the backs of books properly. Rounding and backing are two different processes altogether. The books are first glued at the backs, then allowed to set, then afterwards rounded. After this (if they are intended to be cut in boards) comes the process of backing, which consists of making a joint to admit the boards forming the cover. The description of this process on p. 506 is absurd, for every book does not require a joint (or a "recess," as it is there termed) ¼in. in depth. The depth of the joint depends on the thickness of the boards forming the cover. Then, again, it is not necessary, or yet customary, to glue the back in the process of backing. This should be done previous to the rounding of the backs. The latter process is accomplished before the books are backed. The process of backing is accomplished by placing the book between two backing-boards in a lying-press. The backing-boards are placed as far from the edge of the back as the thickness of the boards which are to form the cover. The book is then screwed up tight in the press, and the upper edges of backing-boards being slightly bevelled, the back of the book is hammered over on each side over the edges of backing-boards for the purpose of forming a joint to admit the boards on each side to form the cover. If the glue on the back of book has been allowed to dry hard, it should be slightly damped previous to the process of backing. A joint or "recess" of ¼in. depth is only suitable for an exceptionally thick board, and also for a book of rather large dimensions.—G. Feyer.

[49231.]—**Polishing the Edges of Leather Straps.**—Before I could answer your query properly, I should want to know what kind of straps they are, whether black or brown, lined or solid, and what thickness; but the following may be of use: First you will want an edge tool. If only a light single strap, a No. 1 will do, which is run down the edge to take it off and make it round. Next rub it down with fine sandpaper; then, if for brown leather, get some Harris's harness blacking, put as much as you want to use into a cup, dissolve some oxalic acid in water, and pour in as much as will turn it a light brown, apply it to the edge of the strap, and rub down with a clean cloth till the edge is smooth and glossy. Next you will want a screw-crease (which you can procure at the tool-shops), which is heated in the fire or gas till it is just hot enough to mark the leather without burning it; you can set it with the thumb-screw to any width you like, up to ⅛in. or ⅜in. Lay the strap on a flat piece of planed board; then, holding the crease firmly in the hand, you run it down the strap; alter the width for every mark or line.—J. S. Saddler.

[49232.]—**Eyes Glowing in the Dusk.**—Part of the light that enters the eye is reflected and part absorbed by the black pigment. The less pigment the more light is reflected in a cat's eye; in that of an albino a vast deal of light is reflected on account of the scarcity of pigment, and the eye thus appears luminous. In an ordinary human eye so little light is reflected that you cannot see it in daylight; but in the dusk, when the pupil dilates, and there is no strong light to drown the feeble reflected rays, if a person is sitting near the fire and you at a proper angle, you can see the reflected light of a red or pink colour.—Medicus.

[49246.]—**Steam-Cocks.**—I notice "J. C." experiences difficulty in grinding plugs in cocks, and, therefore, take the liberty to give him my method of grinding-in. If the plugs are much cut, I draw-file them until I get the rings out; then get a little bathbrick, or mud from grinding-stone and moulder's sand if they are very bad, and require a lot of grinding; get a pail of water, and damp the plug, smear the sand round, and thrust the plug in its seat, give it a half turn, and withdraw it again, and so on; don't turn it round and round in one position, or rings will appear.—G. Sumner.

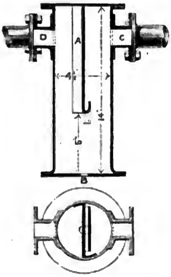
[49246.]—**Steam Cock.**—Dabbing oil and bathbrick or glass powder at random all over the plug, and turning it round and round, is much more likely to make it worse than it was before. It should be worked round in the shell either in the hand or lathe—the latter is perhaps the best—and at the same time pull it slightly out, so that it is very loose, then gently press it in again, and keep repeating this. After so working it for a short time, wipe both, and see what progress you have made, and so on. Remember to put the grinding mixture only on the parts requiring it, and do not put a lot on.—Gas Engineer.

[49247.]—**Wire Resistance.**—The following is a table of resistances of insulated wires which are only correct for fine copper (about 7 per cent. must be added for ordinary copper):—

B.W.G.	Size in French Millimetres.	Length in feet per pound.	Resistance in feet per ohm.
8	4·32	11·18	2861·0
10	3·55	16·87	1892·2
11	3·17	21·16	1511·6
12	2·79	27·32	1170·6
13	2·41	36·63	873·0
14	2·15	46·28	691·0
15	1·92	58·77	544·2
16	1·65	78·24	408·8
17	1·587	101·75	314·3
18	1·274	132·22	241·9
19	1·143	163·25	196·0
20	1·016	206·60	154·8
22	·813	322·81	99·1
24	·635	528·90	60·5
26	·483	915·78	34·9
28	·406	1291·0	24·8
30	·355	1690·4	19·0
31	·305	2295·6	13·9
32	·254	3305·6	9·7
33	·250	3586·8	: :
34	·244	: : : : :	8·9
35	·221	4367·3	7·3
36	·200	5296·6	6·0
37	·170	7363·7	4·0
38	·147	9826·4	3·3
39	·106	18739·0	1·71
40	·099	21732·0	1·47
41	·084	30354·0	1·05

—Electric.

[49268.]—**Engine Query.**—I send a sketch (1½in. scale), of a separator, which I think "Bend Orr" will find answer his purpose. I made one for myself some time since, and find it answer very well, keeping the steam quite dry when entering the cylinder. I think the sketch explains itself. A is a dash-plate, the bottom of which is struck out with a radius (in this case 2½in.), B hole for drain-cock; the steam enters at C, strikes the plate which separates it from the water, which runs down the plate, and the groove passes it down each side, where it is carried away by the drain. The steam passes under the plate and out at D, which should be as close to the engine as possible. The Separator is made from a 4½in. copper pipe, and all the flanges are brazed. In the one I made for myself (19in. diameter) I put a perforated plate half-way between the bottom of the dash-plate and separator to prevent the steam carrying any of the water through with it; but I do not think it is necessary in so small a one: and if "Bend Orr" keeps his pipes well lagged, I think he will find very little water will get into the cylinder. A common straightway cone cock will do quite as well as a stop valve to admit the steam to the slide case; but I cannot say if a 1½in. pipe will be large enough, as "Bend Orr" does not state the pressure or power of his engine.—J. S. Davenport.



[49271.]—**Speaking-Tubes.**—Here we have them in zinc half that length. Never cost a penny after first cost. Go to your gasworks or plumber. Fix compo. pipe length required. The cost will be very small.—J. E. Bird.

[49271.]—**Speaking-Tubes.**—(1) Much depends upon the material employed. Biot (using the empty water-pipes of Paris) found that the lowest whisper was perfectly distinct at a distance of 3,000ft. He concluded "that the only possibility of not being heard was not to speak at all." (2) Yes; if you put a mouthpiece of bone or some similar material at each end, in order that the sound may go down the inside, and not the outside of the piping.—A Young Astronomer.

[49286.]—**Lubricating Oils.**—A mixture of equal parts of pure lard-oil and pure rape-oil constitutes the finest machine oil that it is possible to use, and is far superior to the abominable mixtures of vile rubbish sold as "machine" or "engine-oil."—Experimenter.

[49288.]—**Copper-plating Pewter.**—I must apologise for not replying to this before, as it was addressed to me; but I really have not much information to give. I have before explained that pewter is not much in my way. It is a bad conductor, and requires considerable electromotive force to overcome the extra resistance. Couple the batteries for intensity—that is, zinc to copper, and copper to zinc; by using a sufficient number of cells joined up in this fashion, you will, I have no doubt, succeed.—Os.

[49291.]—**Asbestos and Plumbago.**—Both of these articles depend for their value upon their quality: asbestos, not particularly to its length of fibre, but to its texture and colour. There is plumbago and plumbago; and before values can be fixed it would require to be technically examined. If "Miner" will communicate with me, I shall be happy to afford him further particulars.—Geo. G. Blackwell, 26, Chapel-street, Liverpool.

[49294.]—**Low-Pressure Air-Reservoir.**—To "Labor Omnia Vincit" and "C. S."—Thank you for your replies; but the air flows from the small reservoir intermittently and in uncertain quantities. Can you kindly further advise?—A. C. H.

[49295.]—**Cement.**—That sold as bicycle cement would no doubt answer the purpose admirably. A mixture of hard pitch and indiarubber melted together forms a good binding cement.—Experimenter.

[49297.]—**Science Exams.**—In answer to "Waiting," there are three good books that, I think, would suit you. Tarn's "Science of Building," 7s. 6d.; Baker's "Land and Engineering Surveying," 2s.; and Noad's "Students' Text-Book of Electricity," by W. H. Preece," 12s. 6d. These are published by Messrs. Crosby Lockwood and Co., 7, Stationer's Hall-court, London.—F. Everitt.

[49299.]—**Clarifying Extracts.**—You should have made your tincture of coffee with rectified spirit. The water in the proof spirit is the cause of the turbidness of your tincture. I have lately made some tincture of coffee by percolation, in the following proportions: Crushed unroasted Mocha, 1 part; rectified spirits, 9 parts. You could prepare it by maceration.—J. W. Bond.

[49307.]—**Enlargements.**—In the absence of a lantern, large camera, or other special appliance for enlarging, the simplest plan is to block up the window of a room, except a small space for the negative, and then to arrange a small camera and lens (or a light wooden framework covered with an opaque cloth would do) in such a manner that no light can enter the apartment except through the negative and lens. If the window is in such a position that little or no light from the sky falls upon it, put a whitewashed board outside at an angle of 45° or thereabouts, so as to throw the light on to and through the negative. Focus to size required on a piece of plain white paper, and then take your enlargement on a sheet of gelatino-bromide paper. Unless, however, you are able to work up the enlargement artistically, or can afford the expense of having it done, I should certainly recommend you to confine your efforts to much smaller dimensions than life-size, for even when done by expert professional enlargers, plain enlargements of any size approaching life are anything but satisfactory productions.—Wm. Robinson, Junr.

[49308.]—**Siphon.**—As it is the pressure of the atmosphere which causes the liquid to rise in the bend of the siphon, the highest point in it must not exceed 34ft. if water is used; this being the limit that the pressure of the air is able to balance.—Rzra.

[49317.]—**Ingot Joints.**—I would suggest letting the zinc run out at the other end of the mould till the air is all expelled. The exit could be fixed on the upper side of the mould, which would, of course, be level, and when you cease to pour at one end it would cease to run at the other.—Os.

[49322.]—**Induction Coil.**—All information relative to induction coil construction can be obtained from Dyer's book on "Intensity Coils," which can be purchased at nearly all electrical shops.—Walter H. Ince.

[49324.]—**Joshua, the Sun and Moon.**—Joshua had, like some of our recent commanders in our latest war, different castes of religion in his army. Every regiment was known by its banner in those days—and in ours too,—so that anyone reading by the light of common-sense can see that Joshua had two regiments, one having on its banner the "Sun," and the other the "Moon." Joshua saw that he had already won the fight, and gave orders to the "Sun" and the "Moon" to stand still. They were not required to finish the work of death, no more than the Guards were in Egypt.—Ego Alpha.

[49328.]—**Blowpipe Apparatus.**—If "Fidelis" does not want to blow with the mouth at all, he should get one of Fletcher's foot-blowers; or, if he is going to blow direct, he should get an indiarubber bladder made like a football bladder, only with a pipe leading out of it to the blowpipe, as well as the one from the mouth to the bladder. Any rubber manufacturer would easily make this for a few shillings.—C. E. A.

[49328.]—**Blowpipe Apparatus.**—If you carry out the following you will be able to make a very serviceable blowpipe at a very small cost:—First take a bladder, which must be rubbed with a mixture of equal parts of glycerine and water, to keep it pliable and soft; next, place an elastic ring round the middle of the bladder, to give it additional elasticity; next, select a long glass tube, to which you must fix a small cork; pierce the cork, and to one end stick a small piece of leather to form a valve; next, take a larger cork, bore two holes, pass the tube with the valve attached through one hole; place the cork at the mouth of the bladder, and firmly tie it on, letting the tube with the valve come to the bottom of the bladder; through the other hole put a short tube of glass. The next thing to be considered is the form of blowpipe. You can either attach the short tube to a common mouth blowpipe by an indiarubber tube or to a Herapath gas blowpipe (this is the most convenient).—Walter H. Ince.

[49331.]—**Reflector.**—To find the power of a

Huyghenian eyepiece you must divide the focus of the object-glass, or reflector, by that of a single lens whose focus would be equal to the two lenses of the eyepiece. This is called its equivalent, and its value may be ascertained by dividing twice the product of the two lenses by their sum. If, for example, we suppose the field-lens to be 3in., and the eye-lens to be 1in., focus, the numerical formula would run thus: $(24 \times 8 \times 2) / 8 = \frac{384}{8}$; dividing this by the sum, or $\frac{32}{8}$, we get $\frac{12}{8}$, or 1½in., as the equivalent focus of such an eyepiece. To obtain its power on a reflector of 84in. focus, multiply by 8 and divide by 12, which will give 56 diams., or, approximately, the lowest power required by "Telescopic." This calculation is made from an eyepiece of known focus to the reflector; but where the eyepiece is not already made, it would be much easier to work backwards from the reflector to the eyepiece. This may be done by multiplying the focus of the reflector by any given number, when the multiplier will represent the equivalent, in fractions of an inch, and the result the power; thus: 84 × 6 = 504; therefore, to obtain that power, the equivalent focus of the eyepiece must be ⅙in. A convenient way of getting the focus of either lens separately, is to double the equivalent for the field-lens, and to divide the result by 3 for the eye-lens, which would give ⅓in. and $\frac{1}{9}$in. respectively for the highest power required. The intermediate powers could, of course, be obtained in the same way. The diameter of the eyehole may vary from $\frac{1}{16}$in. with the highest power, to ¼in. with the lowest, though I do not think this is a matter of any importance. The power of a Ramsden eyepiece is also calculated from its equivalent. If the lenses are of equal focus, and are placed at two-thirds of the distance of either focus apart, the equivalent value will be three-fourths the focal length of either; consequently, for a power of 32 on the same reflector, they should each be of 3½in. focus, and should be placed nearly 2⅓in. apart.—ALDEBARAN.

[49332.]—**Colouring Steel without Heat.**—I do not understand "Lincoln's" difficulty. He can put the Prussian blue into the spirit at the same time as the lac, or after the latter is dissolved. Shake the mixture well.—ESSAR.

[49335.]—**Bi-oxide of Barium.**—The method indicated by "Terras," in reply to this query, is not at all suitable for an amateur, such as "S.I" proclaims himself to be, owing to the great heat to which the BaO has to be raised.; but, by using a current of oxygen instead of air, less heat is needed, and the process is quite within the amateur's reach, —A YOUNG ASTRONOMER.

[49335.]—**Bi-Oxide of Barium.**—This compound, BaO_2, is made from the nitrate. This is calcined, and forms BaO. Steam is passed over this, and forms a hydrate. Heat is applied, and air passed over the hydrate, when steam is driven off, and BaO_2, or barium di-oxide, formed. I think, however, it can be bought cheapest.—GEO. G. BLACKWELL.

[49335.]—**Bi-Oxide of Barium.**—Per-oxide or binoxide of barium (BaO_2) can be either made by heating the oxide or hydrate of barium (BaO or Ba2HO) with free access of air or oxygen. The barium oxide can be made by heating the nitrate of barium thus:—$2Ba2NO_3 = 2BaO + 2NO_2 + 3O_2 + N_2$, then $2BaO + O_2 = 2BaO_2$. It is generally used for making hydric peroxide (hydroxyl H_2O_2) by treating with hydrochloric acid, thus:—$BaO_2 + 2HCl = BaCl_2 + H_2O_2$.—WALTER H. INCE.

[49336.]—**Bichromate Battery.**—I should think the crystals are chromate of zinc. I don't see what else they can be. I have noticed them myself.—OS.

[49336.]—**Bichromate Battery.**—The crystals are understood to be "chrome alum"—i.e., crystals of the double sulphate of potassium and chromium. —GEO. G. BLACKWELL.

[49337.]—**Electrical.**—You could most certainly substitute plates and solutions, as suggested; but with respect to the silver plates in chromic acid solution, my advice is—Don't try it, as the silver would dissolve away and form silver chromate—a red, insoluble precipitate.—GEO. G. BLACKWELL.

[49337.]—**Electrical.**—I tried the Smee battery with bichromate solution, producing the most disastrous results, the silver plate being entirely converted into chromate of silver. You could use the carbon and zinc couple in the Smee solution, forming Walker's battery, as used on the South-Eastern Railway.—WALTER H. INCE.

[49337.]—**Electrical.**—In reply to "S.," I would tell him that I once tried the bichromate solution in a Smee battery, and got a much more powerful current, but the platinised silver was used up very quickly; in fact, it did not last an hour. I have not tried the zinc carbon couple in dilute sulphuric acid, but should think it very much inferior to the bichromate solution.—R. B. P., Manchester.

[49344.]—**Violin Queries.**—"V." wishes to know how a violin tuned to perfect fifths can be played with a piano or other instruments that are tuned to a tempered scale. It is only the open strings that are tuned so perfectly; but by means of fingering, any variation of pitch can be made, and so the question is answered by not playing on the open strings. As this is generally known, I can't help thinking that "V." is poking fun at us; but many a true idea has come out of a jest, and so I would ask, *per contra*, How is it possible for a violin to play in tune with itself when its own harmonics are not in tune with its fundamental tones? By tones I mean those belonging to the strings, leaving out the great normal tone of the violin as not to be considered. I suspect this idea is a novelty even to the musical world, so a little explanation is necessary. I take the covered string G, and produce an harmonic by placing a finger on the third position, or that will produce C when firmly placed. This harmonic corresponds to an upper G, which is two octaves higher than the open silver string. Now you may not know it, but the upper harmonic is not in tune with the lower open or fundamental tone. If the violin is tuned in perfect fifths, you will find that the G produced on the first or E string will be out of tune with the harmonic made on the G string. Suppose we make a sufficient number of strings to represent all the harmonics that compose a fundamental tone, and sound them all together, should we get a fundamental tone from them? No; because other harmonics would be introduced that do not belong to the pitch tone. Query: Then what becomes of these numerous harmonics when a string is vibrated? What becomes of these so-called overtones? But they are not over-tones: they form part of the whole; and the reason why they are distinguished is because the centre of sound is not powerful enough to form them in concord (I must not say unison) with itself, and in its own primary diameter. But if the volition or motive power is strong, or, perhaps, numerous enough, then the tone becomes more equal. It is something like a circle that has a serrated edge, which, when turned quickly, presents an equal edge all round the disc. An organ may have a stop which is out of tune all through, yet when the full organ is played the difference is not heard; but a true pattern is induced by the force of the major vibrations. Nevertheless, if that stop is peculiar, distance will reveal the cheat, because the vibrations will not be so strong, or so rapid. It will be easily seen how a piano would cover any slight deficiency in the violin, as regards pitch, when heard in a room; but go further afield, and it is differently appreciated. The great difficulty of playing in tune is greatest where few instruments are in use, as in a trio for violin, tenor, and 'cello, and the wonderful peculiarity of the three kinds of vibrations are heard; each is prominent without being intrusive, and nothing but exact manipulation will insure harmony. The violin, by the joint action of bow and fingers, can produce vibrations impossible on any other instrument; therefore the compositions made for it should be peculiarly its own. Beethoven and Haydn composed largely, and had a fine appreciation of the beauty inherent in the violin; but the ancient masters are better worth study. Tartini is incomprehensible until he becomes wonderful, and Viotti's imagination surpasses them all; but their music ops. would not do for any other than the violin. To resume our subject, I may remark that a clarionet played by a street musician will sound differently in pitch in reference to the position of the listener: if played round the corner, in the next street, the pitch will be lower, and, *vice versâ*, will be higher when heard close to. So, you see, distance lowers the pitch; and I do not conceive how the theory of sound-waves can account for this, for even a return echo is lower than its inducer. A wave has no return action, but is ever forward until it becomes attenuated; a circle has a centre which governs it, and as one centre propagates another, and acts as a series of wheels, so any one of these wheels, however distant, receiving an impulse, would instantly reinforce the primary centre, and induce reaction. But the force is not the same, being secondary; so the diameter is less, and the pitch made lower. When "V." says a man's voice will not reach higher than middle C, I laugh.—FIDDLER.

[49345.]—**Hoist.**—Thanks to "Labor Omnia Vincit," for his proffered assistance. At page 22, Vol. XXXIII. "E.M." "Carino" gives a sketch of a hoist. At page 72, same Vol., "Tubal-Kain" gives another sketch. At page 286, Vol. XXXII. "E.M.," "M. M. R." gives another sketch, "Flour-Mill Hoist." Now, looking at these sketches, I think that "Tubal-Kain's" is the most simple and serviceable of the three diagrams mentioned for ordinary warehouse purposes. I would feel obliged if "L. O. V." or "Tubal-Kain" would give dimensions and probable cost of a hoist similar to sketch at page 72 "E.M." as above stated. "Tubal-Kain" does not say how his "hand-rope hoist" is lowered? Would a hoist similar to "Tubal-Kain's" be suitable for lifting goods to a height of 50ft. in 30 seconds? Revolutions of shaft 85 per minute.—EGO ALPHA.

[49357.]—**Ventilation of Rooms.**—An effective extracting ventilator may be made as follows:—Remove a brick just over the centre of the mantelpiece, and on each side of the aperture fix vertically a piece of wood about 2ft. 6in. long and 3in. wide; to these nail a piece of cardboard and paper it over, so as to make an airtight shaft open at the top and communicating with the chimney at the bottom. In front of this shaft the usual mantel-glass will stand, and effectually conceal it. I have seen such an arrangement in operation for 12 months, and there has been no back-draught; the room in which it is fitted was previously unbearable, and now, after hours of gas-burning, the temperature at the ceiling is lower than it is from 4ft. to 7ft. from the floor. If more is required, or if the draught under the door is objectionable, the difficulty may be met by adopting "Sigma's" plan (described at page 485), for admitting air from the passage.—NIDDERDALE.

[49358.]—**Locomotive Boiler.**—To MR. T. CLARK.—I should screw the tubes in fire-box end, and then sweat them with soft solder at smoke-box end. I should not advise you to waste time and material in making such a boiler, for it would never be satisfactory. I have made one, with a 3in. square fire-box and tubes, the ordinary portable pattern, but have not been able to even burn charcoal; but another copper boiler that I made, 7in. diam. and 14in. high, with one central tube 1¼in. diam., will burn coal well, and drives a 3in. cylinder. The vertical class is much easier to make, and gives better results.—G. SUMNER.

[49359.]—**Bassoon.**—The notes above top A are always harder to get than those below. If the reed be too soft (too much rubbed down) it increases this difficulty. This explains why the notes come more easily when the reeds dry (being in that condition stiffer). For the bottom octave of all, the tip of the reed just rests on the lips. As you ascend, the reed must enter the mouth; for the top octave the lips nearly touch the wire. New reeds are usually sold unworkably stiff, each performer preferring to rub them down to his own particular softness. The part to be rubbed is the "bridge" of the reed—the strong rib which runs down the centre of either side. I am at loss to understand what "Student" means by "some reeds are broad and some narrow," &c., since all bassoon reeds are made to one particular size. The corner cutting is to prevent breakage. The small crook-hole is to facilitate the production of the upper octaves, and is closed by a key for the lower one.—F. D.

[49361.]—**Heating Boiler by Gas.**—I have had no personal experience with gas-heated steam-boilers, but have been informed by those who have, or have had them, that the average gas consumption is about 100 cubic feet per brake horse-power per hour. Where either a gas-engine or a coal-fired boiler is available, the cost of gas for making steam for power is almost prohibitory.—THOS. FLETCHER, Museum-street, Warrington.

[49363.]—**Cement.**—Resin is added to cements that are required to be waterproof. The following recipe may be of use to you:—To hot starch-paste add half its weight of turpentine. This makes an excellent waterproof paste.—W. HENLEY RICHMOND.

[49365.]—**Blowing-up Vessel.**—Dynamite would be the best explosive for your purpose. It can be procured at Messrs. Thorne and Co.'s, 85, Gracechurch-street, E.C., at 1s. 7½d. per lb. I should say 20lb. would be sufficient for your purpose. It had better be used in four blasts of 5lb. each, and each blast divided into five charges of 1lb. each, fired simultaneously by Richford's patent igniters and instantaneous fuses, or by electricity. In either case a detonator to be used, which is a large copper cap, filled with fulminate of mercury. The explosive can be placed in waterproof bags.—TOBY.

[49365.]—**Blowing-up Vessel.**—This can be done with either dynamite or gunpowder. If If the former is used, I should recommend fixing the charge in position at low water, and firing it when the tide is high. If you have not had any experience with dynamite (or gunpowder for the matter of that), it would be much better for you to get someone who has to do the job. The method of using dynamite is very simple, and is as follows: —Take one end of your fuse, and cut off the end with a clean, dry knife, examine the detonator, and see it contains no sawdust inside. Insert the cut end of the fuse in the cap of the detonator to about ⅜in., or as far as the cap will allow, taking care to use very little force; with a pliers close the cap on the fuse to make it watertight; now take one of the small cartridges of dynamite, unfold one end, and push the detonator as far into it as possible; tie the loose paper to the fuse with a piece of string; well grease the connection, and wrap up this with your charge and place securely in position. Unwind your fuse, and fasten the other end somewhere above high water. In firing, you may fire the fuse direct by applying a light to the powder, or preferably you may burn the fuse in two by placing a lighted candle in some convenient position, and then withdraw to a safe distance. Be sure of one thing—see that in firing the fuse gets ignited. It is not pleasant looking up a miss-fire. If you fire the charge at low tide, seek shelter as far off as possible, as pieces of the wreck will be carried a considerable distance. There should be no difficulty in your getting dynamite, as Nobel's Company have agents in every mining district in England.—M. M. S.

[49373.]—**Rain Forecasts.**—I have for some time experimented with rain-band spectroscopes, but cannot make much out of the rain-band, as described by Prof. P. Smyth, and also by Mr. J. Rand Capron in his interesting little book, "A Plea for the Rain-band." The band, besides being ill-defined, appears to vary so much with the intensity of the light and the width of the slit employed. Fortunately, however, there is a clear and well-defined line near to D towards the red, at or about 5942 on Angstrom's map (D being 5892). This line (5942) is at times so fine that it can hardly be seen; at others even darker and heavier than the D line itself. These variations certainly, as a rule, coincide with the changes of the weather: the line being fine and slight before and during dry and fine weather, and thick and dark before wet. Anybody will be able to see this line with a suitable spectroscope, and can hardly fail to notice its variability. But still there remains the difficulty of making some kind of scale, so as to roughly estimate the quantity of the rain-producing moisture in the air. Now, this line is generally visible near the horizon, rarely at the zenith. The finer the weather is going to be, the nearer the horizon will the line become invisible. So if we measure the angle of disappearance day by day, we shall get some kind of a scale of intensity; or, perhaps, it may be better to measure the various angles at which this very variable line appears to equal in intensity some invariable line. I don't think we should throw the "rain-band spectroscope" to one side: there is something in it; at least, it is a very long-reaching hygrometer. It detects moisture in the planets, and, probably, in some of the fixed stars; shall it not be able to detect it a far-off in our own atmosphere?—R. P. G.

[49379.]—**Cylinder Cover.**—This may be removed with safety by drilling two holes in cover (about same size as those used in bolting cover on), tap the holes, and make set-pin to fit, place set-pin in tapped hole in cover, and screw it down until it comes in contact with cylinder flange, and lifts the cover from it. If large cylinder, three holes would be best. They are usually put in well-finished engines, when newly made, as a provision for removing cover.—W. CLIFFORD.

[49379.]—**Cylinder Cover.**—If there are no holes tapped in the cover for forcing it away from the cylinder, the only way that I can see will be to get three or four cold chisels, drawn very thin, and drive them in the joint at equal distances, when they should force them apart. Hit them rather steady, or you may break the cylinder-flange, and hit first one, and then that opposite. I am supposing the joint to be made with red-lead.—O. P. Q.

[49380.]—**Watchwork.**—You want a proper riveting-stake to rivet on wheel to pinion. You will never succeed with pliers; you will get one of any material dealer for 6d. See that your pinion has a nice shoulder, so that the wheel will go close up to it; then you want a box of punches, 3s. 6d., or you can buy them single at 4d. each. When you have got them, place your pinion in the "stake," take a punch that fits the pinion properly, and rivet gently; don't use pliers by any means.—HAMLET.

[49380.]—**Watchwork.**—To "ALFOJOE" OR "HAMLET."—To rivet a pinion to wheel, you must turn the pinion with a true and square shoulder, so that the wheel will fit on tight, and leave only just a little above the wheel, this should be undercut. Fix the pinion in a steel stake in vice, and press the wheel on the pinion down to the shoulder with a hollow punch—a few light taps with a small hammer will drive the wheel home; then rivet the pinion with a punch rounded a little at the end, and finish with one flat. If you are careful in turning, and fitting, and riveting, the wheel should be perfectly flat or true; but it requires a lot of practice to do nicely. You can purchase, with the turns, finished runners and brass runners not shaped, but only a plain piece; the screws in runners are for the purpose of supporting the burnisher, in order to get the pivot parallel.—G. SUMNER.

[49380.]—**Watchwork.**—To "ALFOJOE."—I am not surprised that you cannot make a satisfactory job of your wheel-riveting. By your plan it would be almost impossible to get a wheel riveted on a pinion flat and true. You must procure a flat stake or slab of steel, in which is a hole smaller in diameter than the pinion to be riveted. This should be fixed in a vice, or laid solid on the work-bench. Having the pinion-shoulder turned up true, and the wheel broached out only so much as to set on the pinion with a little force, take a small half-round punch and close the protruding part of each pinion-leaf over the wheel. Do this with gentle and measured taps of the hammer, passing round and round until all is secure. Do not finish riveting each leaf at once. Should the wheel rise a little to one side, hammer the pinion-leaf near to it a little extra. Now revolve the wheel, when the pinion is held loosely between finger and thumb at the extremities of the pivots. If not quite true, bump the bars a little as may be needed until correct. If you have a pair of turns or a pair of calipers, either is better than the fingers to test the truth of the wheel. I gave an illustration of a riveting stake in an article of mine upon "Mainsprings" several months ago.—ALFOJOE.

[49381.]—**Watch Turns.**—To "HAMLET."—Make the two gunmetal centres, like drawing on p. 412; the two screws are to keep your file from filing away the centre, and they also protect your pivot; but if they are in the road, take them out, as they are as well out as in.—HAMLET.

[49384.]—**Photo.-Lens.**—The following errors appeared in my query last week:—8th line—"whether it would be *made* rapid," should be "whether it would be *more* rapid." 13th line—"thick diameter," should have read "1¼in. diameter." I should also have asked what distance the lenses should be apart?—T. W.

[49384.]—**Photo. Lens.**—Although a doublet could certainly be made in the manner described, it would be a mistake to suppose that it would work as satisfactorily as a Ross rapid symmetrical, or other similar specially made doublet, and therefore, before incurring what might prove useless expense, it would be as well for you to state exactly what you wish to do, and at same time give diameter and focus of the front lens you have. The price of another plano-convex lens would depend upon the size, and the size of plate the combination would cover would depend partly (and principally) upon the focal length, and partly upon the aperture of stop used.—W. ROBINSON, JUNR.

[49387.]—**Electro-plating.**—The colour of the anode will show when fresh cyanide is required; it ought to be clear white; if brownish or discoloured, add cyanide. The silver ought to maintain itself, if properly worked. The bright process mentioned is used in every factory, and the scratch-brush has nothing to do with durability, except that it develops unnoticed defects of adhesion, &c., but is not suited to working in amateur fashion; it is very apt to spoil the solution.—SIGMA.

[49387.]—**Electro-plating.**—I find the want of cyanide is generally indicated by a discoloured condition of the anode; when the anode works clean, I seldom consider the addition of cyanide necessary. I think the scratch-brush is very useful as indicating somewhat the durability of the coating, as, if it is any way loose, the brush will take it off. I never tried the bisulphide of carbon. It is used by making a saturated solution of it in cyanide, and then adding a little of that solution to the bath.—Os.

[49394.]—**Poor-Rates.**—Until recently rates were not chargeable upon an incoming tenant if a void house were entered by him after a rate was made; but if he succeeded a tenant who was there when the rate was made, he would then be expected to pay his share, though I do not think it could be enforced. Now, however, tenants are liable at all times for any unexpired term of the time for which the rate was made. "J. A. G." is, therefore, only liable for the time he has been in the new house; and he will do well to refuse to pay any more, as no tax-collector can demand, neither can any magistrate or county-court judge make him pay, more, however trivial or otherwise the amount may be.—FAIR PLAY.

[49396.]—**Regulating Atmospheric Burner.**—You do not say of what form your burner is. Probably it is too small for the pressure of gas which you require. Are you sure that it does not flap at the air-supply, in which case it is no longer atmospheric. Either your burner is altogether too small, or it may be only the fault of the air-hole. Try and make it larger. If that does not cure it, you must either be content with less gas or get a larger burner.—GAS ENGINEER.

[49398.]—**Lantern Slide.**—The kaleidotrope is the slide "Avidity" inquires about; it was described in these pages some time ago by Mr. Woodbury in a series of articles on experiments with the lantern. These articles are reprinted in "Lantern Manipulation," which I can send to "Avidity." The kaleidotrope consists of a perforated plate attached to a spiral spring, and when rotated the apertures appear, from the persistency of vision, as lines or loops of light. The plate is also made to rotate, when it produces a beautiful figure.—A. PUMPHREY.

[49405.]—**Thickness of Cylinder.**—With wrought-iron plates (double-riveted), ⅝in. thick, the safe working pressure for 12in. diameter is 538lb.; for ⅞in. thick, 753lb.; and for 1⅛in., 969lb. This is one-fifth of bursting pressure.—W. CLIFFORD.

[49407.]—**Tension of Piano Strings, &c.**—If the tension of the wires on an iron back be greater than that on a wooden one, it is caused by the wires being either thicker or longer for the same notes. This is frequently the case on iron backs, simply because they will stand the greater tension with less flexure than a wooden one, and this enables pianos with iron framings to keep in tune better and for a greater length of time. Wood is more elastic than iron, and piano-backs, as usually made, allow the strings to pull the wrest-plank over to some extent, and thus lower the pitch, unless the framing be iron strutted in front. This is because the wrest-plank and its bridge overhang the "posts" of the framed back, and this tends to arch the posts, and this more so in the middle of the compass. The breaking-strain of wires is, *cæteris paribus*, always equal within small limits, and does not, I assure you, depend one jot upon what framing it is strained on. If you could read up in back volumes the valuable contributions of our late correspondent, "The Harmonious Blacksmith," you would learn more practically of piano construction, the defects, and the remedies, than from any other book I know of.—J. C. L.

[49408.]—**Cylinder.**—Two cylinders 1⅜in. dia., 3in. stroke, and assuming 400 revolutions per minute with 10lb. pressure, would be equal to ¼ horse-power; a single cylinder, of same horse-power and piston speed per minute, would require to be 2¼in. diameter with 4in. stroke.—W. CLIFFORD.

[49417.]—**Patent Knotting.**—It is shellac dissolved in methylated spirits.—SIGMA.

[49417.]—**Patent Knotting.**—This is a kind of varnish—a solution of shellac in methylated spirit.—Os.

[49420.]—**Positive Element.**—There is no advantage in enlarging the zinc in a manganese cell. It is better as a rod within the porous cell, and with the outer pot filled with manganese and carbon. The other form is only used for convenience of making. The mixture should be well shaken into place, so as to secure contact; but open so as to allow the liquid to circulate. Distance of zinc is of no consequence.—SIGMA.

[49424.]—**Broken American Watch.**—If the spring is not broken bend it nearer the centre (with a pair of round-nose pliers); don't meddle with the barrel-arbor (pin-head like), that is, if it's all right; but I should say that there is something wrong, or it would not have slipped. Try again to open the front, as I never saw one yet but what would open; perhaps it has no joint; but it is obliged to open, or the hands could not have been put on at first. Try to open with pocket-knife, but mind the dial.—HAMLET.

[49424.]—**Broken American Watch.**—The little pinhead-like, generally called arbor hook, may have come off, or, the watch having run down, the spring may have unhooked. If the hook is still there, close the inner coil of spring, so that it will fit tight round the arbor. If the hook is gone, you must drill a hole and fit a new one in. You can get at hands by taking off the rim which contains glass. You will find it has no joint, but simply snaps on. A knife will ease it off if you have not a watch-case opener. The hands are only pressed on tight.—G. SUMNER.

[49424.]—**Broken American Watch.**—If the arbor-hook is torn away or made useless, you will, of course, have to remove the remaining portion, if any, and insert a new one, or drill a fresh hole for one. The pin or hook is always short, so that which may appear to you as a broken one is, possibly, really correct, but the spring has got away from it. If such is the case, close up the inner coil of spring, and slightly nick the front part of the hook so as to catch the spring more securely. As regards the glass, it should come off, together with the rim in which it is secured. Press the edge of a penknife in the groove which you will find near to the glass, and the rim will come away readily.—ALFOJOE.

[49425.]—**Battery for Electric Light.**—Don't trouble yourself about the battery referred to. It is extremely doubtful whether such a cell was ever worked.—T. P.

[49432.]—**American Clock.**—Take out balance from clock, take hold of hairspring collet with a pair of nippers, or open it with a screwdriver, and turn it on the arbor to the left: turn it half-round, then put the clock in beat, and try it; or you could alter it by pinning hairspring end in the stud; hold the balance firm, and turn the hairspring collet with anything that you can get in, till you get it in beat.—HAMLET.

[49432.]—**American Clock.**—I can hardly understand wherein the fault lies with your clock, unless you have got the escapement too shallow in putting the new pallets. Has the pendulum the same arc of vibration it had previous to the alteration? Is the brass crutch loose in the pallets where connected? If the escapement is shallow the clock would gain. If the pallets are loose on the crutch, it would also gain. See that the part of crutch which engages with the pendulum-rod is not set too wide. The side-shake should be only just sufficient to allow perfect freedom for the play of the rod. I cannot advise you further than this.—ALFOJOE.

[49432.]—**American Clock.**—To regulate your clock the spring will have to be turned on the staff, in just the same manner as watch-springs are turned—i.e., by the collet. The spring is then unloosed at the split stud and pinned up afresh nearer the end of the spring. This increases the working length of spring, and makes the oscillation of the balance slower. There is only one correct position for the pin which engages with the fork of the pallets, so you must be careful in shifting the spring that the escapement is not made incorrect. As you observe in your letter, when the spring is drawn through or slackened the pin is pulled away from the fork. Keep that pin in a line with the staff itself and the pallets staff. You will not then be far from correct.—ALFOJOE.

[49433.]—**American Clock.**—You can alter the clock by putting stud (that the pallets work on) nearer the escape-wheel, and if it won't go when you have raised stud, you must conclude that your pallets are wrong; and if you can't alter it, if you will advertise your address, I will help you.—HAMLET.

[49436.]—**Sizes of Nuts.**—The following are the Whitworth sizes of nuts. The exact sizes are given in decimals, and the nearest approximate size in 64ths of an inch. The thickness of nuts is in all cases the same as the diameter:—

Dia. of Bolt.	Width of Nuts across Flats.		Dia. of Bolt.	Width of Nuts across Flats.	
1/4	·525	33/64	1 1/2	2·41	2 13/32
3/8	·709	45/64	1 5/8	2·57	2 37/64
1/2	·919	59/64	1 3/4	2·75	2 3/4
5/8	1·10	1 7/64	1 7/8	3·02	3 1/64
3/4	1·30	1 19/64	2	3·15	3 5/32
7/8	1·47	1 31/64	2 1/4	3·51	3 35/64
1	1·67	1 43/64	2 1/2	3·89	3 57/64
1 1/8	1·86	1 55/64	2 3/4	4·18	4 3/16
1 1/4	2·04	2 3/64	3	4·53	4 17/32
1 3/8	2·21	2 7/32			

—W. CLIFFORD.

[49437.]—**Separating Power.**—Not exactly. The question of "light-grasping power" has also to be taken into consideration. If the magnitudes of the components of a double are within the range of the querist's instrument (which he may readily ascertain by another formula), he certainly ought to be able to divide them, providing their distance does not exceed the value obtained by the formula 4·56 ÷ by aperture. Separating power, in fact, depends almost entirely on the aperture, and has little to do with the observer's eye, whilst "light-grasping" depends on both.—A YOUNG ASTRONOMER.

[49440.]—**Cod-Liver Oil.**—Try taking it in a little orange wine.—PHILOS.

[49440.]—**Cod-Liver Oil.**—Personally, I find a pinch of salt added to the oil makes it almost pleasant to take; but if this does not suffice for "Helicote," let him take it on quinine-wine, which will effectually mask the oily taste complained of.—A YOUNG ASTRONOMER.

[49440.]—**Cod-Liver Oil.**—I have taken cod-liver oil for many years, in as many ways, but find none so good as the juice of half a lemon put in a wineglass with a teaspoonful of oil on top; hold the head back, pour the oil gently in the mouth until it is all at the back, then swallow the lot. If this is carefully done, there is scarcely any taste, and it does not repeat. I take two doses each day.—E. K. L.

[49440.]—**Cod-Liver Oil.**—If "Helicote's" difficulty in taking the oil simply arises in its passage over the palate, let him firmly hold his nose whilst so doing, and for a few seconds subsequently. Neither taste nor smell will then be perceptible. Before releasing the grip, a little bread may be eaten, but is not necessary. It would, however, quite cleanse the mouth. If the difficulty arises from after-eructations, follow the oil immediately with a little pepsine in wine or spirit. No harm in the sugar unless otherwise counter-indicated.—EXPERIENTIA DOCET.

[49440.]—**Cod-Liver Oil.**—An agreeable emulsion of cod-liver oil may be made as follows: Rub thoroughly 3 drachms of finest powdered tragacanth in a large mortar, with 3oz. of glycerine; to this add 10oz. (half-pint) of boiling-water, and after cooling, mix in *gradually*, and with plenty of elbow grease, 13oz. of the best cod-liver oil; this mixture should be about the consistence of a custard, and may be flavoured according to taste with essence of almonds. "Helicote" should take twice as much of this emulsion as he usually takes of the oil, for a dose, and should mix it, on taking, with about an equal quantity of water.—E. G. T.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, S. M. B. Gemmill has replied to 48483, J. S. Saddler 48696, Ferer, 48859.

48721. Platform Scales, p. 304.
48737. Model Engine, 304.
48748. Microscopical, 304.
48750. Working Models, 304.
48754. Musical Box, 304.
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QUERIES.

[49442.]—**Electric Clock.**—Would any correspondent give drawing and illustrations of the controlled electric clock in the Edinburgh museum? I hope Mr. Edward M. Nelson will give us his drawings, descriptions, &c., of his electric-clock motion.—APPRENTICE WATCH JOBBER.

[49443.]—**Canoe.**—Could any reader inform me how to put a wooden deck on my canoe? What is the best wood and what thickness should it be? The body is made of thin ribs, then covered with canvas and painted (length 12ft., width 2ft., depth 1ft).—W. H. STEPHENS.

[49444.]—**Band-Saw Machine.**—I want to make a band-saw machine, and should feel very thankful if some machinist would send a working sketch, or tell me where I could purchase one cheaply? I am anxious to improve myself, and would like the names of some good works on cabinet-work containing full instructions.—CABINET-MAKER'S APPRENTICE.

[49445.]—**Engine.**—What weight should a double cylinder engine working in single gear lift with 35lb. pressure, cylinder 5in. bore and 10in. stroke, four revolutions of engine for one of drum, drum 1ft. diameter? An answer would greatly oblige.—T. K.

[49446.]—**Feed-Water.**—I have an upright boiler, 7ft. 6in. by 3ft. 6in., from the funnel of which I observe the flame from furnace to rise almost 2ft. above it. If a cistern was put on top of boiler, and the funnel to pass through this cistern, would the heat inside funnel heat the water inside cistern, and to be used to feed boiler? The exhaust steam passes through the funnel, and cannot be used for heating the feed-water, as boiler would not keep up steam without it. An answer to above would oblige, with hints as to size of cistern, and what to make it out of?—J. H.

[49447.]—**Dumb Piano.**—Would some one kindly inform me how to construct a dumb piano? I should like it for two hands, if possible, with some means of regulating the stiffness of the notes. What is the construction of Kalkbrenner's "guide-mains," as I hear that its use is advocated by professors?—CYRUS.

[49448.]—**Beech Chuck.**—I shall feel much obliged to Mr. Evans, or any other subscriber, who would advise me how to bore out, or otherwise, "true" the newly fitted jaws of a beech chuck?—H. E.

[49449.]—**Detector Galvanometer.**—Would Mr. Lancaster, or any other authority on electric subjects, give me directions how to make a "Linesman's" galvanometer?—H. E.

[49450.]—**Weathercocks.**—Is there any way of putting into working order a weathercock on top of a church spire, without going to the expense of a scaffolding? The spire in question is 180ft. high. There is a staircase up the tower about 100ft.; but no means of getting higher. The parish is too poor to afford an expensive scaffold, but it is rather a nuisance to have the cock always pointing due west.—GALLUS.

[49451.]—**Bar Lathes.**—Would Mr. Evans, "F. W.," "Alfojoe," or some other correspondent, kindly give a paper on turns and bar lathes, which appear to be almost omitted in books on the lathe. It is just mentioned in Holtzapffel, if I remember right; but I want description of the tool, and how to use it? What work can and what cannot be done with it?—GUY BOW.

[49452.]—**Dissolving Old Loom Pickers.**—Would any correspondent inform me of a recipe that would dissolve old loom pickers, which are made of buffalo-hides?—J. C. C.

[49453.]—**Carbon in place of Copper.**—Will one of your readers inform me if there would be any difference in E. M. F., or any inconvenience whatever, by using carbon plates in place of the copper ones used, in the battery made up of two coppers and one zinc, in a solution of 1 sulph. acid to 20 water?—E. T. R.

[49454.]—**Siemens' Latest Armature.**—Will some one kindly inform me how to make the above, with full particulars as to winding the coils, and making and connecting to the slips in the commutator? I want to make one about 10in. long and 2in. diameter. Should be obliged for best lengths of coils for this. What other kind of armature could I make of the same dimensions? Is an Edison too difficult? See advertisement (Wanted).—THANKFUL.

[49455.]—**To Mr. Wetherfield.**—I am a grocer. During the hurricane last Friday morning, I had a shop window blown out. Can the landlord make me put in a new one, or ought he to pay for the putting of it in? If I put it in, can I stop it out of the rent? Our inner door, the one between the house and the shop, had a panel of glass in it when I took possession. One day, some time since, the then landlord was coming in at one door, at the same time that the opposite outside door was open, the inner door went-to with a bang, and the glass was smashed to atoms. I put in a temporary wooden panel. The shop has changed owners, and I am going to leave. Can the present owner make me put a glass pane in, or can I leave it with nothing in? The door-latch was broken at the same time, and I bought a new one, but the landlord would not pay for it. When I leave can I take off the new one and put on the pieces of the old one, as I have them by me still?—L'EPICIER.

[49456.]—**Aniline Dyeing.**—I have been dyeing some bone buttons with red and blue aniline. The red took very well, but the blue did not seem to take hold of the bone at all; and although I have had them in the dye three times as long as the red, and used more than three times as much dye, they are only a sort of mauve colour, and very uneven. Do they require a mordant, and if so, what? I may say I boiled them in a solution of soda to remove any grease there might be?—LONDON.

[49457.]—**Steam-Boiler.**—Your kind correspondent, "Labor Omnia Vincit," was kind enough to answer my query of page 344, No. 48827, and promised to help me. I had my engine and boiler examined by the maker of the engine. He reports, the engine is in first-class condition, but blames the setting of the boiler for not making steam. The draught is good; but seems to take all the heat up the chimney. He advises me to have the boiler setting altered; but before doing so, I would like to have the advice of our kind friend. The setting he advises is to have draught carried from centre flue under boiler, and to get three pillars at equal distances under boiler; the pillars from centre of boiler to one side, completely shutting up one side, next pillar shutting up the other side, and so on, making the smoke and gases take a zigzag course under boiler, then up side at furnace end along top of boiler to chimney.—WANTING STEAM.

[49458.]—**Boiler.**—I have an egg-end iron boiler 2ft. long, 1ft. diameter. The middle piece has one row of rivets, but neither of the end pieces have; the ends lap over the middle piece, and have a brassy appearance in the joints; it is tapped each end for 1in. pipe. Can you or any reader tell me what it has been used for; how the joints are made, having no rivets, and if safe to use for ½h.-p. engine, and how can I test it with water?—and greatly oblige—W. HOWES.

[49459.]—**To Dr. Edmunds.**—My son, aged 19 years, has suffered for over 12 months with "scabies," for which he has tried different remedies, internal and external, but cannot get rid of it. He also suffers from flatulency and heartburn; would that induce a bad state of the blood, and so prolong the complaint?—G. SIMS.

[49460.]—**Chemical Atoms.**—Can any chemical correspondent refer me to any good book or books in which a clear and substantial reason is given for calling oxygen 16 instead of 8, or why H_2O is written in place of the simpler HO, or why such abominations as N_2O_5 are now dragged into inorganic chemistry. Admitted that such incongruous formula may be allowed in the organic kingdom; but why such gross monstrosities pushed into the well-known field of inorganic matter? I have often tried to digest this notation, but have as often been compelled to give up in perfect disgust; but having been repeatedly urged to pass the South Kensington examinations in order to take up a chemistry class in connection with the local science department, and also so as to be able to connect my analysis class with South Kensington, I am again making strenuous efforts to gulp down the nauseous draught; but alas—it won't go!—not for Joe! I have hunted over many books, but can find no why and wherefore given, and if any of our correspondents can direct me to some book in which the two theories are placed side by side, and the infinite superiority of the O 16 theory fully shown, I shall be immensely grateful, for I really cannot bring myself to swallow the disagreeable dose at present, notwithstanding supreme efforts.—EXPERIMENTER.

[49461.]—**Silvering Mirror.**—Will some of our readers kindly inform me how mirrors are silvered? Also how the brown-coloured back upon some of them is produced? Please do not refer to back numbers, as I do not keep them.—MECHANICIAN.

[49462.]—**Lathe Mandrel.**—Will some reader give me a sketch, with dimensions, of a first-class steel mandrel for screw-cutting lathe of 5in. centre? Should there be one or two cones?—MECHANICIAN.

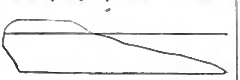
[49463.]—**Legal.**—A. and B. are partners. C. is a workman. C., after being discharged by A., was employed by B. to do a job for D. Meanwhile, a dissolution ensued between A. and B., who came to conclusion that A. was to receive all moneys and pay all debts; so B. came out clear. Afterwards the bill of C. came to A. Is A. entitled to the money?—TORMENT.

[49464.]—**Chemical.**—To MR. ALLEN.—Would Mr. Allen kindly recommend a process for the estimation of sulphur in oxides of nitre and copper? The oxides dissolve with difficulty in acids, and the percentage of sulphur does not exceed one-tenth of a per-cent. Also a process for the estimation of nickel in an alloy containing about five per cent. carbon and silicon, and 20 per cent. iron? As I am well acquainted with analytical manipulations, a mere outline of the processes will suffice.—SIC EST VITA.

[49465.]—**Wood-Turning.**—Is there such a book published as sketches or drawings for wood-turning? Could any reader give a sketch of a chuck for turning a round ball?—A NEW READER.

[49466.]—**Watchmaking.**—Would "A Fellow Workman" give the rule how to find the proper number of teeth for 4th wheel and 'scape-wheel pinion? What number of beats per hour he considers best for the following train of verge watch which I wish to convert into lever?—Centre-wheel teeth, 48; 3rd-wheel teeth, 45; 3rd wheel pinion, 6; 4th wheel pinion, 6.—Apprentice Watch-Jobber.

[49467.]—**Indicator Diagram.**—Would some of our readers please give opinion of the above? I would send one from the other end of cylinder, but the tap is not right. Condensing beam-engine, double D valves, 2ft. stroke, 21in. diam., 35 revs., 30lb. press., 15th scale, 30 spring.—Young Engine Tenter.



[49468.]—**Liability of Town Commissioners.**—To Mr. Wetherfield.—A town is governed by a commission (granted by special Act of Parliament in 1856, it has also since come under the Local Government Board Act), who extended its district about six years ago, and took over all roads in the new district except one, which they decline to repair or to give a reason for so doing. It was then in good repair, and the rateable value much higher than other roads. I may add they have put in a sewer and partly repaired the footpath, but will do no more unless the owners of adjoining property pay for it.—F. W. D.

[49469.]—**Worm-Eaten Floor.**—The deal floor of a bedroom in an old house has become very much worm-eaten, and I should feel obliged if any of our correspondents could suggest something to be done to prevent the dust settling in it. Is there any material which, by flooding the floor with it in a fluid state, on drying, will fill the depressions so that the whole can be beeswaxed, polished, varnished, or even painted?—Subscriber.

[49470.]—**Leaky Boiler.**—The cast-iron boiler attached to one of the ordinary closed kitchen ranges has become cracked from top to bottom of the side next the fire, and the water, which is at no pressure, flows from it into the fire through a rent which is from 1-16 to ¼ of an inch at widest part. When attention was first directed to it the firebrick between the boiler and the fire was found to have crumbled, leaving the side of the boiler exposed to the fire. What I want to know is, Whether there is any sort of cement that would effectually fill the crack and allow the boiler to performs its former function—viz., heat water?—Subscriber.

[49471.]—**Singapore.**—Can any reader inform me of the climate, mean temperature, number of habitants, life, &c., in Singapore, and if it would be a likely place for one to get on in as merchant?—Leo-Trieste.

[49472.]—**Resistance of Galvanometers.**—Will some reader kindly give me the resistance of the quantity and intensity coils of the Indiarubber, G., and Telegraph Works Co.'s portable Lineman's Galvanometer (vertical needle) and the deflection on its scale equivalent to 1, 2, 3, &c., volts., for the quantity and intensity coils?—Iolanthe.

[49473.]—**Patent Leather.**—Will any reader kindly tell me how the above is made—how the composition is made and put on? I have seen a recipe somewhere in back numbers, but I cannot find it now. If anyone can refer me to the same I shall be much obliged.—J. S. Saddler.

[49474.]—**Insulation.**—I have a set-screw ⅜in. in diameter and ¾ long, through which I wish to pass two copper wires insulated (electrically) from each other and from the screw. I wish to do this if possible with glass. The vessel into which the screw passes will contain water at a high pressure. Can any of your correspondents tell me how to do this so as to make a perfectly tight job?—H.

[49475.]—**Comets' Tails.**—To "F.R.A.S."—When a comet has a curved tail, does it always turn back as if the motion of the nucleus were the cause of the curvature of the tail, the correctness of Mr. Proctor's theory of solar repulsion being assumed as an axiom? Also, would not the repulsive force exercised vary as the inverse square of the distance of the comet from the Sun's centre? And one more question: Do you believe that the appearance of the great comet, which Lt. Thomson observed, sufficiently accounted for by curvature of tail?—An Engineer's Son, Sheffield.

[49476.]—**Ferns.**—I am told of an ever-living fern, Acapulus, from Mexico. It is a brown colour, and when dry about the size and shape of an onion, but when placed in water it spreads out to about 7in. in diameter. Is it the Rose of Jericho, a stunted cabbage kind of plant called Anastatica, or is it a South American plant of similar habits? I cannot find any such name among Fern genera.—Eclecticus.

[49477.]—**American Clock.**—I am much obliged to "Progress" for replying to my query (48420) of converting American clockworks to chime quarters and hours, &c., but I wish to imitate Westminster chimes both in tone and changes, and I wish all to need winding but once in eight days or a week, so I thought to use the second going train for the musical part just as a striking part. I also thought of making a new framework of brass rod about ⅜in. by ⅜in., and to fix all to the back of clock case, and so make a front case to cover of a Swiss cottage design.—Ohio.

[49478.]—**Model Boiler.**—Will any kind reader assist me with the following?—I want to make a copper boiler 18in. long and 12in. in diameter with a fire through the centre, so constructed that it will have a good draught.—Molo.

[49479.]—**Chamber Organ.**—Glad to find our old friend "Uranium" still willing to help. From his and Mr. Dresser's instructions I have succeeded in building a small organ, as follows:—1 manual, CC to G, 56 notes; pedals to man., CC to G, 20 notes; stops—1, Open Diapason to Tenor C, metal; 2, Stop Diapason Bass, CC to B; 3, Tenor C to G alto; 4, Tenor C to G; 5, CC to G. I want pipes for the last three named slides. What should you advise me to put in? I require a nice quiet tone. If you could give me a little information on tuning I should be glad, as this bothers me worse than voicing. I intend to add a small Bourdon.—G. T. B.

[49480.]—**Dynamo-Machine.**—I finished a short time ago a small dynamo having a Siemens armature 3½in. by 1½in., wound with ½lb. No. 22 B.W.G. silk-covered wire. It is similar to the one described by G. Tolman in the issue of the "E.M." for June 23, 1882, but the field-magnet is much heavier than the one there described; it is wound with No. 18 B.W.G. cotton-covered wire. This lights well a 10 candle-power Swan's lamp when revolved from the foot-lathe. Will some reader of the "E.M." please say if this is good work for such a machine?—C. P.

[49481.]—**Noise in Water-Pipes.**—Will any correspondent kindly state the cause of the vibration in water-pipes on turning a tap suddenly on or off?—F. W. B.

[49482.]—**Oxygen.**—On p. 336, No. 965, Dec. 15, 1882, there is a suggestion for making oxygen by means of bichromate potash, nitric acid, and bioxide barium. I have tried it, following directions closely, but with the exception of a few bubbles the first second or so, failed. Now, why did I fail? Has any other brother-reader tried the dodge? If so, will he kindly give us the benefit of his experience?—S.

[49483.]—**Massachusetts Washing.**—In conversation with a laundry man I was recently informed he adopted an economical and effective method of washing clothes practised in Massachusetts, but not known in England, which consisted in boiling them "with the dirt in" some time, after which the slightest hand manipulation sufficed to remove all superfluous matter and left them pure and beautifully clean. In England, with our process, we find boiling "with the dirt in" the reverse of judicious. The person in question would not further enlighten me, but regarded his knowledge as a trade secret. I do not see, however, that it could disadvantage him if the knowledge were common to those interested, and should be glad if anyone could inform me whether there is such a process known, and, if so, in what it consists? Possibly there is a method of soaking in cold water or soap-suds, and subsequent bringing to a boil. My provoker told me it was more economical than any steam laundry operations, and that he washed in that way for some seventy families.—Soap-Bubble.

[49484.]—**Legal Questions.**—A lady by marriage settlement gives her husband a life interest in certain real and personal property, which afterwards is to go to the next-of-kin according to the law of intestates; but from the settlement deed it is not very clear whether the next-of-kin living at the lady's death or at the husband's death is intended, as the lady dies first, and if it is intended for her next-of-kin living at her death to have a claim on her property, although they cannot come into possession until the husband's death. I have to ask if such next-of-kin would not have the power to will their interest under the settlement deed. And the next question is, Supposing any of the next-of-kin living at the lady's death die during the husband's lifetime without making a will to dispose of their interest under the deed of settlement, what would become of their interest in the real and personal property? Would the heir-at-law of the dead person take the real estate, or would both real and personal estate go to the next-of-kin of the dead person, as provided in the first instance by the marriage settlement according to the law of intestates? It will be seen that if the heir-at-law could claim the real estate, the next-of-kin might come off very badly, although the marriage settlement seems to provide for the next-of-kin equally.—Constant Reader.

[49485.]—**Bluish Colour of Shadows.**—In Rood's "Modern Chromatics" it is stated that in a dull light colours have a more blue tint compared with those in a stronger light; also, that if red and blue of the same luminosity are darkened simultaneously, the red colour would darken quickest. I suppose the explanation of this is that a dull light may be compared to a slight disturbance on water, which would make smaller waves than a large disturbance, the smaller waves, in the case of light, being the blue waves. I shall be obliged if anyone will tell me whether this is correct.—J. E. B.

[49486.]—**Refining Olive Oil.**—To "Jack of All Trades."—Having seen in the Mechanic some time ago how to refine olive oil with soda, I have tried it, but failed. Would you please say how it is as I have a lot of olive oil, the waste from necks or bearings, which I am desirous of using over again?—Firer.

[49487.]—**Ostend Rabbits.**—Will any reader who is acquainted with the system of rearing rabbits in Belgium for the London and other markets give a detailed account? In these times of agricultural depression and foreign competition in grain which render wheat growing unremunerative the production of animal food seems to be the sheet-anchor of our farmers. Rabbits are extremely prolific, and the rearing of them for market in a properly organised fashion might form a profitable source of income to many.—Hornea.

[49488.]—**Blast and Exhaust in a Flour-Mill.**—I have a blast going 650 revolutions, the exhaust 800 revolutions; the monkey-truck is 11 by 9in., and conducts into a stive room 10ft. high by 6ft. by 6in., this is furnished with baffle partitions the whole height; yet I find my meal-spouts blow, and a considerable quantity of flour is ejected at the outlet, which is situated two floors above the first stive room, there being another smaller canvassed space intervening. Can any of ours inform me where the mistake is? I feel sure the waste would go greatly towards paying my wages.—Celt.

[49489.]—**Lead Pencils.**—Will anyone kindly inform me in what manner lead pencils are rounded, and by what kind of machine?—Uranium.

[49490.]—**Speed of Shafting.**—Would some kind reader oblige by giving the rule for working out the following and similar queries? What size pulley will be required to run a machine at the rate of 700? Main shafting is 2¾ and runs at 90. Pulley on machine is 14in., and it is driven from a counter-shaft. Is the distance of one shaft from another to be taken into consideration in the calculation? Is there any book published on the subject?—Survey.

[49491.]—**Stout.**—Can any one tell me what percentage of proof spirit there is, on an average, in Guinness' stout as sold in bottles?—E. G. T.

[49492.]—**Mining Queries.**—(1) Would some correspondent work me out the following questions? There are two airways, one 500 and the other 200 yards in length, passing 10,000 and 6,000 cubic feet of air per minute respectively. If you reduce the pressure so that there is only a total quantity of 8,000 in the two splits, what quantity will you have passing in each split? (2) If 40,000 cubic feet of air were entering a down-cast shaft 14ft. diameter, and temperature 60°, what must be the diameter of up-cast shaft to pass that quantity—the velocity being the same in each case, and the temperature of up-cast shaft being 100°? (3) There are three boreholes, A, B, C, at the extremities of an equilateral triangle, each side 200 yards, A 50 yards deep, B is 60 deep, and C is 70 yards deep: supposing the surface to be level, what is the direction of water level and the direction of full dip, and amount of dip?—Non Valeo.

[49493.]—**Legal.**—To Mr. Wetherfield.—A. put B. in court for debt; B. agrees to pay five shillings per month through court, and paid two instalments. B. gets married—has A. got any claim on her now?—if so, what proceedings must A. take?—Constant Reader.

[49494.]—**Chemical.**—Will any of ours kindly help me out of the following difficulty? I had a pound of iodide of sodium spoiled by keeping, and wished to recrystallise it. In order to make the bulk larger, I added 3 ounces of iodine, and a quantity of carbonate of soda, thinking they would combine—which they did not. The lot now is a mixture of free iodine, sodic iodide, and carbonate. How can I recover the lot as iodide of sodium, or other useful iodine salt?—Maddler.

[49495.]—**Induction Coil.**—Would "Ernest," Vol. XXXV., No. 910 (letter 20457), kindly give me a few hints as to making a coil the same as the one described? I have a coil which I constructed some years ago, containing about 2½lb. of No. 36 silk-covered copper wire, wound from end to end with guttapercha-paper between each layer of wire, and as it only gives 1in. spark with five Bunsen cells, pint size, although well insulated from primary, I wish to take it to pieces and reconstruct it, adding another pound of wire to secondary. The core was of No. 20 iron wire, 1½ in diameter, and 11 in length, wound with No. 16 cotton-covered wire. (1) Had I better use silk-covered wire for primary, or will the old do? (2) Do you make a paper tube for the iron core to fit in, or wind on it without anything between? (3) Do the mahogany ends fit on the ends of the 9in. ebonite tube? (4) Would the paraffin wax-candles melted serve for insulating purposes, or is there a special kind—about how many pounds are required? (5) When the blotting-paper discs are fitted on the ebonite tube, how are they kept stiff in their places?—does not the wire press them outwards when being wound on? (6.) Does the wire require any insulation when wound in the sections beyond passing through the melted paraffin, and also when one section is filled, which way does the wire pass, and how insulated in order to begin the next? (7) What are the number and size of tinfoil sheets used in condenser, and also of insulating papers, to give best effect? (8) How is the wire best wound on?—Ross.

[49496.]—**Tramway.**—I have a large quantity of stone to get down from a hill to the railway, a distance of 500 yards, and am desirous of doing so by means of a tramway as the road up the hill is very steep, and severely tries the horses in carts or waggons. As the main parish road is directly in my way, although I have permission from the authorities to lay a tramway across it, I am prevented using an endless rope. Will some of your numerous correspondents kindly inform me whether I can fix any kind of brakes to my trams which will be certain to stop them on an incline of 1 in 10? The total weight of tram and load could be from 28 to 30 cwt. I should also be much obliged for information as to where I could see waggons working on an incline as steep?—Hampshire.

[49497.] — **Focal Image — Diameter of in Telescopes.**—Will "F.R.A.S." oblige me by explaining this more fully than he does on p. 315? I can work decimals and logarithms, and have tables of natural sines and cosines, lengths of circular arcs; also tables of logarithmic sines, &c., for every degree and minute of a quadrant, calculated to a radius of 10,000,000 or log. $\frac{\pi}{2}$ = 10,000,000; but I do not understand trigonometry, beyond knowing what is meant by the words sine, cosine, tangent, secant, &c. The working of one example would be sufficient.—J. C. L.

[49498.]—**Skrivanoff's Dry Cell.**—Would any reader who has tried Skrivanoff's dry battery, described on p. 82 of this volume, kindly answer the following questions?—What size are the plates of carbon and zinc giving an E.M.F. of 1·5 volt.? What is the internal resistance? How often does the paste require renewing? Would they not be suitable for electric lighting?—Seaweed.

[49499.]—**Lathe.**—I have a 10in. centre lathe, wood bed, overhead-motion, driven by engine, with ordinary slide-rest. How can I make it self-acting? Any information on the subject will greatly oblige—Amateur.

[49500.]—**To Mr. Wetherfield.**—I should be glad if you will inform me if a person has added considerably to the original fixtures, gasfitting, &c., in a house with the rent in the usual manner, he may remove them when he leaves, if the landlord or incoming tenant refuses to buy them; would he be allowed to take up the floor where required to remove the pipes, &c., providing he repaired the damage? Does the same apply to kitchen ranges, &c.?—Gas Engineer.

[49501.]—**Telephone.**—Will someone help me out of the following difficulty? Having tried to construct a pair of telephones, I find on joining up the connections I get but little sound, if any, out of them. My modus operandi was as follows. I procured at the chemist's two 3in. tooth-powder boxes and cut away the middle of the lids of the boxes and fitted between the lid and the box a ferrotype plate, so that the margin of the lids not cut away held the plate in its place. I glued a popgun tube into the bottom of the box and fitted into it a bar magnet about 4in. by ¼in., and on the end of the magnet towards the plate I put a cardboard reel wound with about half an ounce of No 36 silk-covered wire, and fastened the ends of the coil to the threads of two brass wood screws inside the box at the side; the heads of the screws outside the box forming the connections for the line wires. I kept the magnet (the rounded-off end being next the plate) fairly tight in the popgun tube by means of two pieces of wood in each and a brass screw. I placed the magnet quite close to the plate, but not touching it. The ferrotype plate was slightly bruised, and did not fit the box too tightly. I used a line wire sold on purpose for the job. There was more wire on one reel than on the other. Why have I failed?—IGNORAMUS IN ELECTRICAL MATTERS.

[49602.]—**Electro-Magnet.**—Will Mr. Lancaster, or some reader tell me how the apparatus is arranged that Messrs. Pears and other firms use—viz., the frame that the name is on, which is kept shaking and that makes the name appear to move, as inside each letter there is swinging a round piece of bright metal. I was told the magnet was hinged. How is it done?—as I want to apply the same idea to something else?—VENUS.

[49603.]—**Right to use Party-Wall.**—A row of houses built 14 years ago by the same builder, and then owner, with gardens at the back, and which gardens are divided by a wall about 5ft. high. The present owner of one house (say A) having built on one of these party walls, has his next-door neighbour (say B.) equal right to fix the beam of a children's swing in the wall which A. built, and which would be higher than the top of the original 5ft. wall? As B has had fixed without permission the beam now some twelve months ago, can A. make a claim for a year's rent for same? And would A. be likely to succeed in recovering a charge of, say, a few shillings for the year's rent in the county-court? Also, which would be the right person for A. to sue, the tenant or owner of B's. house?—H. EMSON.

[49604.]—**Electric Switches.**—Will some reader describe, with sketch, the switches used in connection with the Sawyer-Mann, Edison, and Swan lamps. Any hints on above will oblige—DIELECTRIC.

[49605.]—**Flax.**—Could anyone kindly inform me what are the chemical constitutents of the linum or common flax? Also what gas it emits when steeped; and what are the relative strengths of silk, hemp, flax, woollen, and cotton, taking an equal size or quantity of fibre, or an equally made thread?—SPINNER.

[49606.]—**To Mr. Lancaster.**—I have a good quarter-plate camera with Ross lens, and I want to know how to put it in connection with a 4in. and a 3in. achr. in order to photo. the moon, and, if possible, sunspots. I saw a similar request in the "E. M." some time ago, and a few plain directions would greatly oblige. I should also be thankful for a few hints as to the exposure required for different celestial objects? The 4in. refractor has a good driving clock.—C. J. R., Ventnor.

[49607.]—**Parrot.**—Can anyone tell me what to do with a parrot that has suddenly, without any apparent cause, become drowsy, and vomits any food that is given it? It can keep nothing down. There is no mention of sickness in the parrot-books, and I am afraid it will starve if not cured soon.—C. J. R., Ventnor.

[49608.]—**Electric Engine.**—To RANKIN KENNEDY.—I have seen a small electric engine in the "E. M." which you gave on May 1st, 1881. I should feel obliged it you would give me full details, as I want to work a sewing-machine?—COLE.

[49609.]—**Grinding Hard and Tough Seeds.**—Being desirous of grinding down to a fine meal, a seed (about the size of a horse-bean) of a hard and horny nature, I should be glad if any of "ours" can give me information as to what class of grinding machinery would be most likely to answer the purpose. Only a small quantity would require operating upon at first, so that a hand-power mill would be much preferred.—K. N. S.

[49610.]—**To Mr. Wetherfield.**—Eight days ago I bought a pony for £20; I had it on trial three days, and at the end of that time decided to buy it. Since then it has turned out that the person who had advertised it for sale had had it on trial himself from some one else, and aftering receiving my money has omitted to pay for it. Now the original owners are threatening to make me give up the pony. I can prove payment by the cancelled cheque through my bankers, and by a veterinary surgeon, who was present when I paid the cheque. Can I be made to give it up? The person I bought it from has disappeared.—HENRY FRAZER.

[49611.]—**Mixture of Glycerine and Permanganate of Potash.**—Would some one kindly explain the chemical action that takes place when glycerine is mixed with "solution of permanganate of potash"? I had occasion to mix some, and directly I had mixed it I corked it up, and the consequence was, that the bottle burst in my hand.—CURLY.

[49612.]—**Sugar-Coating Pills.**—Could any one give me a good form for varnishing and coating pills (sugar-coating)? I find a difficulty in getting them to look white; and sometimes when I have finished them they crack, and thus spoil the look of the pills. If any one could help me out of the difficulty he would greatly oblige—CURLY.

[49613.]—**Transfer Inks.**—Can any of your readers give me recipe for making transfer ink or paint in various colours; such as that used by manufacturers of the paper patterns for ladies' crewel-work, the patterns of which can be transferred to any cloth by pressing with a warm iron?—A BRITISH WORKMAN.

[49614.]—**Comets, &c.**—Will any correspondent oblige me with the following particulars? (1) The period of the following comets, and the date of their next return (month and year): Halley's, Mechain's, D'Arrest's, Faye's, Winnecke's, De Vico's, Biela's, Brorsen's, and Encke's? (2) The perihelion and aphelion distances of Mechain's, D'Arrest's, and Winnecke's comets? (3) The periods of the variable stars, γ Virginis, α Cassiopeiæ, β Lyræ? (4) The names of the satellites of Mars?—H. P. CORRIES.

[49615.]—**Catching Moles.**—Will anyone kindly inform me of the cheapest, safest, and the best and surest way of destroying moles without traps? As I am collecting the skins, I do not wish to lose them; and I should like to be able to find them without difficulty. I do not want to have anything to do with poison, but if they cannot be caught without being poisoned, the safest instructions will do.—MOLE-CATCHER.

[49616.]—**Galvanometers. Coils.**—To "SIGMA."—Would "Sigma" kindly tell me whether in winding a galvanometer, it is better to have the wire arranged so that it covers the needle (when deflected)? I mean what width should I wind the wire in proportion to the size of the needle? Also whether there is any rule or formula for calculating the quantity or size of secondary wire in coils? Up to a certain extent, I imagine the tension of the current increases with the quantity of wire; but when this limit is reached I should think it would decrease. How can I find out what battery power any given coil will stand?—IB.

[49617.]—**Coal Analysis.**—Will any of your numerous readers kindly supply me with an analysis (or inform me where it can be obtained) of the seam of coal known as the "main coal" of Moira, the principal bed of the Leicestershire coal field? And also inform me whether it contains anything favourable to generating spontaneous combustion, so common to many, especially to thick seams?—W. S. GRESLEY.

USEFUL AND SCIENTIFIC NOTES.

Saccharifying Power of the Saliva.—Mr. A. Béchamp, in an article contributed to the first number of Brown-Séquard's *Archives de Physiologie* for the present year, after commenting upon the circumstance, at one time considered remarkable, that whilst the saliva of man possesses the power of converting starch into sugar, no such power is exerted by the saliva of the horse, dog, or ox, undertakes to show—first, that human buccal saliva is not indebted for its diastatic power to any alteration effected by the air on the various immediate organic principles which are secreted by the glands and discharged into the buccal cavity; secondly, that the power of converting starch into sugar belongs to a peculiar and special zymase which is contained in the saliva, and that this zymase is the outcome of the action of the microzymes proper to the salivary glands, of the microzymes of the anatomical elements which line the buccal cavity and the tongue, and of the microzymes and infusory animalcules that accumulate in the interstices of the teeth. Lastly, that the parotidean saliva of the horse and that of the dog do not saccharify boiled starch naturally, but that they acquire this power when they are placed in contact with the buccal organisms of man. In the course of these experiments he found the buccal infusory animalcules to have an extraordinary power of converting starch into sugar, one-thousandth part of a gramme of the matter adherent to the free border of the gums of a healthy man, after being frequently washed with a weak solution of creasote, acting powerfully on starch paste. This material was formed of the débris of epithelial cells, of numerous molecular granules, and of many moving or stationary short or long bacteria (probably segments of Leptothrix buccalis), and no doubt some remains of food. The buccal organisms or granules are the bodies he endeavours to show are the really active bodies, for he has accomplished the removal of the other elements, and found the saliva of man still to retain its powers, and he supplies evidence to show that they are not identical with the bodies which develop in the saliva either of man or of the animals named after removal from the body and filtration.

Heating Apparatus for the Microscope.—Thoulet describes in the *Bulletin de la Société Mineralogie de France* a new method of heating objects upon the stage of the microscope. He has constructed a small "stove," or chamber, to rest upon the stage, and to contain the object and the thermometer. It consists of a glass tube fitting into a copper cylinder which rests upon a disc of copper, furnished with lateral prolongations, which can be heated by a gas jet. The whole is insulated by resting upon a disc of cork. The temperature of the chamber can be raised by heating the prolongations of copper and lowered by introducing a current of fresh air through a small tube fixed in the side. Very exact measurements can be taken with this simple apparatus, so well adapted for determining the temperature of the disappearance of bubbles in liquid inclusions, for studying the formation of crystals at various temperatures, or for other micro-chemical investigations.

FOR cutting narrow slots in a hardened steel plate a disc made of Muntz metal, revolving at about the speed that would be used for turning wrought iron of the size of the disc, and using fine quartz sand and water, has been found to work better than discs of other material.

THE Emperor of Germany has ennobled Professor Helmholtz.

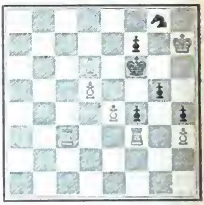
THERE are in the United States about twenty-eight establishments devoted to the manufacture of matches.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden W.C.

PROBLEM DCCCXXI.—By W. MEAD, Brighton.

Black.



White. [7+6

White to play and mate in three moves.

SOLUTION TO 817.

White.	*Black.*
1. R-Q B 3	1. Anything
2. Mates	

SOLUTION TO 818.

White.	*Black.*
1. Q-Q R 8.	1. K moves.
2. Q-K 8 or Q R 4, accordingly	2. K moves.
3. Q mates.	

SOLUTION TO 819.

White.	*Black.*
1. Kt-Q 3.	1. Anything.
2. Mates.	

SOLUTION TO 820.

White.	*Black.*
1. R-Kt 4.	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 819, 820, by A. F. Scott, Schmucke, A. Briggs, Donald Mackay, John Bright, J. B. of Boxford; to 817 by W. T. Bayne, Schmucke, T. Gaskell, Lucky Sam, A. Briggs; to 818 by P. C. Pavitt, A. Briggs; to 819 by Douglas Folwell (that to 820 is incorrect, as there is no mate if 1. $\frac{\quad}{\text{B takes R}}$); to 815 by Susan.

We have pleasure in drawing attention to a collection of 75 problems by the well-known composer Mr. T. Taverner to be published in February. The price is half a crown. Orders may be sent to the author, Holmhurst, Christ Church, Hants.

The following is the final award in the *Brighton Guardian* Two Move Tourney. First prize, T. P. Lea. 2nd, A. F. Mackenzie, Jamaica; 3rd, W. Funsen, Denmark; 4th, A. F. Mackenzie; 5th, J. Jespersen, Denmark; 6th, A. F. Mackenzie; 7th, Lieutenant Noack, Germany; 8th, J. G. Nix, Jennessee. There were 28 competitors. We hope to be able to give some of these problems shortly.

The great fire at Kingston has totally destroyed the office of the Jamaica *Family Journal*. Mr. Mackenzie is one of the principal sufferers, as type, chess books, and problems have been all burnt. A subscription is being got up in England in aid of the employés, who are now out of work. Those who wish to help should write to the Chess Editor, of the *Matlock Register*, Dovedale House, Matlock Bath.

Brown Tint for Iron and Steel.—Dissolve, in four parts of water, two parts of crystallised chloride of iron, two parts of chloride of antimony, and one part of gallic acid, and apply the solution with a sponge or cloth to the article, and dry it in the air. Repeat this any number of times, according to the depth of colour which it is desired to produce. Wash with water and dry, and finally rub the articles over with boiled linseed oil. The metal thus receives a brown tint, and resists moisture. The chloride of antimony should be as little acid as possible.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.
"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.
Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.
The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 7, and unacknowledged elsewhere:—

Rev. T. Calliphronas.—W. A. Smith.—Crossley Bros.—H. Cormick.—J. A. Cheshire.—J. T. Chapman.—Swift and Son.—Rev. F. de Soyres.—Dr. Holmes.—Controller of Stores Office.—J. Bridges.—J. E. Gore.—J. P.—Chime.—W. G.—Cato.—Rock Salt.—J. H.—T. R. Allinson.—Refractory.—C. H. D.—J. D.—H. G.—Thos. Clarke.—Nonplussed.—H. A. Wassell.—Auld Reekie.—Pattern Maker.—X. Y. Z.—J. B. Poole.—G. D. G.—H. L. Crate.—J. S. Fisher.—W. J. B. R.—T. West.—S. M. B. Gemmill.—First Caller.—Orderic Vital.—Lamplighter.—A Fellow of the Royal Astronomical Society.—Fellow Workman.

One in a Fix. (We really do not see how any patent could be had for the mere position of the wheels.)—Poore. (You might find the information you want in back volumes; but as we do not know what you mean by "renovating," we cannot say. The bright appearance is usually obtained with rouge and a brush; but possibly some articles may require dipping.)—Gen. Konnuts. (You can do nothing more than warm it by holding it in front of the fire—not close.)—Commutator. (We must refer you to recent replies and the indices.)—R. M. (What is the cause of the large toe-joint? No useful remedy without knowing that; but you will find information on pp. 211, 215, 452, Vol. XXXIV.)—Inquirer. (If you cannot say more definitely what it is you wish to do, we can only recommend you to look at the indices.)—S. M. H. E. (The tar and the ammonia liquor. See p. 566, last volume. Worth collecting, certainly; but value depends on the distance they would have to be carried. Probably it would be most profitable to utilise them on the spot.)—Pat. (Yes; why not arrange it as you wish? We do not see how anyone can help you with the bare description you give.)—Scovandyke. (Seeing that his pupils are sworn to secrecy, a full account has not been published. We do not know where he is now. You will find a great deal about systematic memory in Vol. XXVII., pp. 171, 221, 330, 374, 424, 476, 520, 565.)—Linneus. (A candidate for the fellowship of the Linnean Society must be proposed by three fellows at least, who must, from personal knowledge, certify as to his qualifications. The council elect. Full particulars on p. 487, Vol. XII.)—A. C. Ashton. (The Great Northern; about 1,000; 8ft. 1in.)—A Novice in Electricity. (First question answered in Prof. Thompson's lecture, p. 389. 2. Yes, if properly arranged.)—One who Wants to Know. (We gave a brief description a short time ago, and in some of the electrical papers you will find illustrations.)—Bad Throat. (Better consult a medical man.)—A. B. C. (More, because a ton only gives about 10,000 cubic feet of gas, and leaves more than half a ton of coke, which would be consumed in the engine furnace. 2. No, the alum will crystallise out on cooling. 3. As a rule, it is decomposed. 4. Rub a little on the hands. See pp. 42, 71, Vol. XXXI., and for the spectrum p. 95, Vol. XXXIII.)—Young Photo. (The tent is instead of a dark room. It does not replace the studio. See the indices of back volumes for many descriptions, and p. 377, this volume.)—Danum. (The reply would be simply an advertisement. You will find plenty described in back volumes. See pp. 458, 524, Vol. XXXIV.)—A Subscriber. (Was it vulcanised? Mineral naphtha will dissolve pure rubber, but it should be cut fine and kept in a warm place. 2. On p. 621, Vol. XXV., the formula is given as extract of liquorice, 1lb.; sugar, 1½lb.; cubebs, 4oz.; gum-arabic, 4oz.; extract of conium, 1oz.)—W. Morland. (Briefly, lines are cut with a graver and silver wire forced in. As the line is undercut, the silver is held in. An inferior process is to etch the steel and fill the lines with gold or silver by electrolysis.)—M. H. W. (Music-stand, p. 313, Vol. XXXIII.; p. 194, Vol. XXVII. 2. Cheaper to buy than to make; but a recipe will be found on p. 470, Vol. XXVI.)—Inquisitor. (See p. 480, No. 800, and the indices of recent volumes; also p. 467, last volume.)—Robert J. Houlton. (If the question refers to watches, see p. 184, No. 762. Cannot be done without heat.)—Wood Turner. (Similar questions inserted. Watch for the replies.)—J. M. O. (Yes, we believe so.)—Donald Warren. (Any salt; therefore the cheapest for experimental purposes. Chloride or sulphate. 2. Full directions for making spectroscope in Vol. XX., pp. 190, 215, 239, 357, 408, 536.)—Hydrostatics. (Several in back volumes, but none to work by clock-train. How do you imagine that could be done?)—J. K. (No such book in existence. See the papers now appearing in these pages, and recent back numbers.)—Iolanthe. (So far as we have heard, no word has yet been coined for the purpose.)—C. N. W. (The City of London proper is about 1¾ mile in extreme length, and three-quarters of a mile in breadth, and has an area of 667 acres.)—J. B. S. (The deepest coal shaft in the United Kingdom is the Ashton Moss Colliery, Lancashire, main seam, which on March 5, 1881, was cut at a depth of 2,691ft.)—G. H. (The son would, of course, have to pay the costs if he endeavoured to upset the will and failed, as he undoubtedly would fail if the facts are as you say.)—F. W. P. (The money would be divided equally between the children of both wives.)—John Spencer. (We do not see that they can compel you to go from the bargain.)—R. B. White. (The "Hall Type-writer" is patented in England. We do not know the number of the specification. The journal mentioned has just abandoned the practice you recommend—we suspect for the very good reasons which induced us never to adopt it.)—A. T. B. (Pitman's system. The instruction books can be obtained through any bookseller.)—James W. Bond. (In that, as in all other things, the will of the majority must prevail, and as, judging from the correspondence which reaches us, the great majority are interested in astronomical subjects, we expect astronomy must continue to occupy the large share of our space it does at present.)—Thos. Rhodes. (If he does not send you the goods, sue him in the county court for the money sent to him.)—Colloquian. (If you will embody your request in a brief query, it shall appear. The query you refer to was not a theological one.)—T. M. (Simply the results of a violent cold, which, as your doctor tells you, will probably disappear with the advent of milder weather.)—Albert Lloyd. (Consult a medical man personally at once. It may be a symptom of serious lung disease.)—X. Y. Z. (You are not obliged to pay your servant's travelling expenses home under any circumstances, unless you agreed to do so at the time of the engagement. The articles on "Motive Power for Amateurs" appeared in Nos. 796, 799, 803, 807, 812, 816, 819, 824, 829, 833, 838, 843, 849, 853, 871, and 882.)—A. Holman. (If you sent your question to Mr. Davies direct, he would be able to answer you fully. He gave the sizes recently.)—Unknown Astronomer. (See pp. 496, last week, and the indices. 2. Yes, there is some reason to suspect it, but nothing definite.)—Twist Drill. (See p. 323, last volume, and the indices. You will find so many that you will experience a difficulty in deciding which is the best.)—Walsal. (It depends on what plant you have. You require a pot to hold the melted zinc, which is covered with grease or sal-ammoniac, and a pickle-pot containing solution of sulphuric acid in which to clean the articles. They are scrubbed with sand, and washed, dried, and immersed.)—One Puzzled. (No, when such appears to be the case, it is usually an optical illusion, though of course it may happen to occur just at the time.)—H. C. (Birdlime is made from the inner bark of the holly, boiled until soft, and then placed underground to ferment. It is then washed with water and kneaded, and finally placed in an earthen vessel and covered with a little water. It is also made from elder shoots, mistletoe-berries, &c.)—Thos. Redford. (See p. 311, Vol. XXXI., and the indices.)—J. H. A. (See list of Back Numbers, published last week, and the indices. On p. 250, this volume, there is just what you want.)—W. G. C. (Glue will do. A little bichromate of potash is added to render it insoluble. The mould must be well oiled, and, if porous, filled up with grease.)—B. B., Birmingham. (Perhaps by a modification of the process described on p. 445.)—E. F. B. (There is no further information at present. There is no doubt about the tracks. The question is, By what animal were they made? Dr. Harkness, of San Francisco, has written a paper on the subject.)—F. M. (Presumably you mean, fill up the holes. You can try filling up with rubber paste.)—One and All. (By machine. Bag-making machine no use for the purpose.)—J. Jones. (What do you mean by black iron? You must have a clean surface to tin iron.)—J. D., Cwm Avon. (Have you read the description on p. 426? Is your spark thick or thin? Does your machine work in all conditions of the atmosphere?)—Ethoxo. (You will find the information in back numbers; but if you want a book, probably Messrs. Piper and Carter, Castle-street, Holborn, can supply you.)—No Sig., Bunsen Battery. (Empty the cells after each working, and soak them in water. You might get a small arc; but it really requires about 40 volts, and as the E.M.F. of the Bunsen is only about 1·8, you will require about 40 cells to have an arc that can be depended on. The cost of 20 cells would be about twopence an hour for acids. The consumption of zinc would depend upon its condition as regards amalgamation—say, roughly, fourpence an hour.)—Very Hard-up. (Most likely Mr. W. C. Burnet, 10, Bloomfield-street, Finsbury-circus, can give you all information.)—One in a Fog. (Perhaps you did not cast with a sufficient head, or did not ventilate the mould. See p. 19, last volume.)—O. P. Q. (If you mean an eyepiece-end, it would be possible; but show it to an optician, as your suggestion is much like buying a boat to fit a mast.)—Malt Beer. (You should procure one of the handbooks on the subject, or consult the cyclopædias. Briefly, the crushed malt is macerated with water at a temperature of 170°, stirred vigorously for half an hour, and then covered up and allowed to stand for two hours. The wort is then drawn off, and a further quantity of hotter water put on the malt, the process being repeated a third time, but with a decrease in the time of repose. The wort is then placed in the copper, and hops are added when it boils. This process continues for about two hours, and then there is the cooling, fermenting, cleansing, and storing, all details which involve so many nice points that it would require a whole number to give really practical directions, and then they might not be suited to your climate.)—C. H. Cooper, Kentucky. (We believe it can be obtained second-hand only. A small advertisement in the "Wanted" column would no doubt procure a reply.)—Northern. (If you consult the catalogue issued by Mr. Calvert, Great Jackson-street, Manchester, you will probably find lists of books that will suit you. 2. They can be amalgamated in all proportions, we believe. The price varies, but it is about 2s. or 3s. per pound respectively. Addresses of merchants could be found in a directory.)—E. H. (We do not see how any one can answer such a question. The prices of telescopes can be found in our advertising columns.)—Glen. (Only repolishing. 2. Platinum contacts are always advisable, but brass would do in the case mentioned.)—A Worker. (You will find much information on the subject in back volumes; but have you matriculated?)—One in Need of Help. (Boil slow until a little sets when put on a cold plate. You do not use enough sugar, and do not boil long enough, if it is sloppy. No chemical required; but the covering papers might be dipped in salicylic acid. Most cookery books contain directions.)—Kettle. (Why not try the experiment in one cell? We should think the remedy worse than the disease.)—Amethyst. (All your queries have been answered recently. Look through the back numbers. Saunier's "Watchmakers' Handbook," published by Tripplin, Bartlett's-buildings, E.C.; and Britten's "Watch and Clockmaker's Handbook," Kent and Co.)—Fastidiens. (Not a "skin disease" at all: simply particles of sebaceous (or fatty) matter, the ends of which are blackened by dirt. Squeeze out with your finger-nails, and to allay irritation, apply a mixture of glycerine and rose-water.) W. J. (The dialysed iron would undoubtedly benefit you; there is no "mixing" wanted, directions as to dose, &c., on the bottles. Dr. Edmunds does not prescribe in these columns, and we think he would say at your age you must have patience, and hardly expect other than "slow progress." Second query next week.)—Auricola. (You must see a physician personally for both ailments. 2. We regret the great pressure on our space just now forbids us to invite specifications of parish-church organs, even though they may be good specimens.)—Patentee. (1 and 2. We do not know. 3. By International P.O.O.)—H. H. B. (Have you tried soaking in warm water?)—Fred. Brown. (In type.)

Swiss Walnut Stains.—Walnut stain is made of bichromate of potash and vandyke brown in oil, dissolved in hot water. A simple stain is made of brown umber and size, and brushed over the wood hot, then fill up the grain for varnishing. Chestnut is the best wood for retaining that clear white so much admired; sycamore is next, and lime-tree is as good. White wood will not be so clear and light-coloured if any varnish or polish is put upon it, but will appear whiter if waxed with white wax and polished by friction; but preference should be given to white French polish and white hard varnish. This merely deepens the colour and gives an ivory appearance. For dark wood, varnish with French polish, one part brown and hard varnish two parts. For light work, two parts white French polish, three parts white hard varnish.

Metals and Oils.—M. Chevreul found metals to have, in certain cases, a remarkable influence on the oxidation of oils. Recently, M. Livache has used, in this relation, finely divided metal (such as is got by precipitation), instead of metallic plates, and the effect is greatly increased. He thus tried lead, copper, and tin, and found lead to have the strongest action. If precipitated lead, moistened with oil, be exposed in air, an increase of weight is very soon observed, and this is greater the more siccative (or drying) the oil. With linseed oil, the increase of weight reaches a maximum in 36 hours; whereas, exposed alone to air, the oil would take several months to reach this maximum. A solid and elastic product is obtained. With non-drying oils, the increase of weight is much less, and takes much longer to be completed. The result in question, M. Livache points out, cannot be attributed to a simple division of the matter, allowing more active circulation of air, for the same experiment made with various other substances in fine division, does not result in any like increase of weight; the effect here is merely like that in the case of a thin layer of oil exposed to air. The change in the other case must be attributed to a direct action of the metal. Operating with different oils, M. Livache found the increments of weight proportional (except in the case of cotton-seed oil), to those observed in the fatty acids of the oil exposed to air for several months. He suggests that industry may derive certain advantages from the facts observed. Thus, a rapid method is indicated of distinguishing drying from non-drying oils. Further, the heating of oils might be advantageously replaced by a circulation, in contact with air and in the cold state, over iron or fine plates having precipitated metallic lead on their surface. The oils so obtained would be always less coloured, and would retain great fluidity, while the objectionable odours and the danger of fire which attend the present mode of treatment would be avoided.

Reflecting Telescopes.—It is not a little curious that, with all the inventive activity in the United States, reflecting telescopes have not yet made much progress in that country, although isolated specimens of great excellence have been manufactured. The late Dr. Henry Draper was, probably, the most successful constructor. But there has just been finished for the Rev. John Peate, of Greenville, Pennsylvania, a very large and powerful instrument. It is the production of Mr. John A. Brashear, of Pittsburg, who for many years has made a special study of these instruments. The new telescope is 7ft. 6in. in length; the reflector is 12¼in. in diameter, and will bear a magnifying power in the eyepiece of from 50 up to 1,000. The silvered glass telescope was first made by Dr. Draper, at Hastings-on-the-Hudson, and at the time of his death he owned the two largest reflecting telescopes in the United States—the one being 28in. in diameter, and the other 15½in. Both these instruments the doctor himself constructed.—*Times.*

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OUR EXCHANGE COLUMN.

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"**Facts in Mesmerism,**" containing over 300 12mo. pages. Exchange for Chemistry Books, or offers.—G. PICKARD, Dalry, Ayrshire.

Lathe, 3in. back-geared, gap bed and accessories, in good order. Exchange for Bicycle or Tricycle.—ROBERT PARKES, 4, Frederick street, Caledonian-road.

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Great Quantity of **Minerals**, about 200 specimens; many cut and polished, clothing to 30s. for the lot.—H., 4, Pratt's-place, Brooksby's-walk, Homerton.

Two Small **Microscopes** and quantity of interesting objects, various, take clothing to 6s. the lot.—H., 4, Pratt's-place, Brooksby's walk, Homerton.

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THE SIXPENNY SALE COLUMN.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 16, 1883.

THE DANIELL CELL.

By JOHN T. SPRAGUE.

THIS is the only galvanic battery which gives us an approximately constant current, and has, therefore, many important uses. It is not, however, so constant as is generally supposed; but is subject to variation from several causes. These causes call for and repay a careful study, because they illustrate many of the principles of electricity, as well as for their own practical importance.

A battery which would at all times, and under all variations of external work, generate a uniform electromotive force would be invaluable; most of the books indicate that the Daniell does this, and define its electromotive force as being volt. 1·079. Unfortunately, this force is by no means so definite. Let us first clearly understand what we require and mean.

Constancy means, that having once set up a battery under certain circumstances, giving a certain current, then that current shall be steadily maintained till the materials of the battery are exhausted. This involves several considerations: current depends upon two conditions; (1) the electromotive force; (2) the resistance of the circuit. Of course, the conditions assume that the external resistance remains unchanged; therefore, inconstancy, or fluctuation of current, may arise from variation in either the force generated, or in the internal resistance of the battery. As to this latter, there is an inevitable change, due to the formation of sulphate of zinc. Where the cell is charged with dilute acid the conductivity is materially diminished as the zinc salt accumulates; the same occurs when the cell is originally charged with sulphate of zinc; but the difference is less because the original resistance is greater.

Duration is quite distinct from constancy; it depends entirely on the cell containing materials enough to continue working the required period; this is, therefore, a function mainly of size of cell, as related to the required work. This is more readily comprehended by aid of my "chemic" unit of current than with the ampère, because it requires 1 chemical equivalent in grains of every agent taking part in the work for every 10 hours, and as 5·68 chemics = an ampère current, the calculation is simple for any required conditions. The essential reaction of the Daniell is the substitution of zinc for copper in the sulphate; therefore in any case there must be provided a supply of copper sulphate of 126 grains per chemic per 10 hours; or multiplying this by 5·68, we have 72 grains per hour per ampère of good quality sulphate, containing 24 per cent. of copper. On this point it should be understood that sulphate of copper is often very impure, iron and zinc replacing the copper, and therefore the salt should be examined. Of course there will be a loss in local action dependent on the conditions, and greater in proportion as the cell does less electric work. Of course, also, it is useless to supply the salt in excess of the quantity of zinc available, and for prolonged working it is necessary to provide for removal of the water arising from the dissolved salt.

The *electromotive force* of the Daniell is subject to many causes of variation which have been only slightly studied. According to the chemical theory, it should correspond to the heat of combination or replacement of copper by zinc, which, according to the determination of Julius Thomsen, is 50,130 calories per gramme atom, agreeing also with the actual heat generated electrically, which he found to be 50,292 calories; these numbers being for the two equivalents, bring out the electromotive force as 1·065 volt as the theoretical value, using the values formerly received. Dr. Wright, who has examined the subject, using other values, makes this equal to volt 1·105, and his experimental determinations of the force with solutions of acid of different strengths give values.

Sp. gravity of liquids	1·010	= volt	1·123
"	1·050	"	1·133
"	1·090	"	1·142
"	1·175	"	1·163

Sulphate of zinc at the zinc plate has advantages over acid because it does not set up appreciable local action. I have endeavoured to measure its comparative force; but the various disturbing causes presently to be considered prevented my arriving at any certainty. I believe the force to be the same with sulphate of zinc half saturated, and with acid of 1·100, which is one part acid to ten of water by measure.

The difficulty of getting exact measures is at the zinc plate. I find that cutting several strips of zinc from the same sheet, amalgamating them alike and at the same time, they will give forces varying as much as volt ·03. Besides this difficulty, the mere motion of the zinc plate in the liquid will produce a similar amount of fluctuation, though no appreciable effect results from moving the copper plate. This is probably due to the disturbance of the small bubbles of gas which form at all defective points of the plate, and protect it from further action; on these being shifted, a fresh action takes place on the zinc, which lowers its available force for the time. Dr. Wright states "it was found that but little difference was produced by using pure commercial, or amalgamated, zinc, or zinc coated with a film of copper." This is entirely different from the received opinions, and very different from my own experience. I find that amalgamated zinc has the higher force by about ·01, as compared with new sheet-zinc, and more as against corroded zinc, and that the E.M.F. of any zinc plate is always increased by cleaning off the residuary impurities, and renewing the amalgamation.

The effect of copper deposit on the zinc is very marked, and may be easily tested; if the zinc plate be touched with a copper wire the force falls ·03. This is not, as sometimes said, an effect of *contact* lowering the potential; it is a direct chemical action: there was already a copper contact in the wire conductor soldered to the zinc; in fact, merely touching with copper out of the liquid produces no effect; the copper must be under the liquid, so that it sets up a local action. I found that by adding a little copper sulphate to the zinc solution, so as to throw down copper on the zinc plate, the force fell ·03, and then the touching with a copper wire produced no effect. It is evident, therefore, that where a constant E.M.F. is desired, the zinc plate used should not be free from copper. But all loose deposits of copper should be removed at intervals.

Variation of temperature affects the E.M.F.—Heat raises the force; it does so by affecting the solubilities of the two salts, and supplying externally the energy absorbed in solution. I find that between 32° Fahr. and 52° there is a difference of volt ·01, and between 50° and 60° also ·01, and between 50° and 100° about ·025.

These experiments were carried out by means of cells consisting of U-tubes; the bends of which contained sand mixed with oxide of zinc, to prevent passage of the copper salt. I found these remained in perfect action for a week without a trace of copper passing; the tubes were mounted in stands with mercury cups, and the plates of metal had wires attached, so that they dropped into the cups as the plates were inserted in the tubes, and could be readily exchanged.

The galvanometer used was a reflector of 9,000 ohms resistance. The plan adopted was to oppose two cells and observe the deflection due to any difference in the forces. These deflections were valued by a simple, though only approximate process, which may prove useful to experimenters, as it places at their disposal any desired electromotive force. I connected a large Daniell cell with my resistance instrument of 1,000 ohms arranged in decimal sets. Now, by the law of distribution of potential, this gives a complete range of E.M.F., because any interval at any part of the circuit of, say, 1 ohm furnishes a force of volt ·001, provided we use it against a large resistance. Therefore, by including in the circuit of the experimental cells and galvanometer, different intervals of the resistance instrument, I could add just so much E M.F. as was necessary to balance the conditions which increased that of one of the cells, or value the actual deflections: in this experiment volt 0·01 produced a deflection of 110 on the scale. Unfortunately, I had not the means of making the more difficult measurement of the actual force of the Daniell in any given condition, for which different experimenters give values ranging from ·9596 to 1·2, though the figure generally accepted is 1·079.

It is generally considered that the Daniell is not subject to "polarisation"; that is to say, that its E.M.F. is constant whatever the external resistance may be: this is not exactly the case: it is affected by the "density of current" derived from it. According to Dr. Wright, a surface of 125 sq. centimeters (19·5 sq. inch) will maintain its E.M.F. up to a current of ampère ·001, and will lose 1 per cent. if called on to produce ·006, and as much as 10 per cent. if worked to ampère 0·4. These figures are, however, entirely special, applying to a particular construction. The cause at work is very clear; it is, that the current developed must be proportioned to the supply of copper salt presented to the copper plate: if the solution is not strong enough to meet the demand, we have copper, not in copper salt, but in sulphuric acid, because the copper has been removed from the molecules adjoining the plate: this can only be corrected by the process of diffusion. His battery appears to have been arranged for the experiment in the very worst manner possible, with the copper plate at the top in a weak copper solution floating above a denser zinc solution. My object in these experiments was to discover the best arrangement to provide a constant and reliable electro-motive force, such as is needed for experimental purposes, and one which could be set aside ready for use at any time.

M. Gaiffe some time since devised a form for this purpose: it consists of a compound inner cell, the upper part of which is alone porous; this contains the copper and copper salt. The outer cell contains the zinc in form of a ring at the top of the cell, and a plate or wire of copper at the bottom connected to the ordinary copper pole: the idea is that as the copper salt passes through the porous cell it will sink by its greater sp. gravity, and form a stratum at the bottom when circuit is closed, the resistance between the zinc and the external copper being less than that to the interior of the cell. This outer stratum of copper salt will be first reduced.

I have modified this by making the inner cell consist of a copper cylinder fitted with an upper part of porous earthenware cemented to it, and have also placed the zinc in the inner cylinder. This cell is useful for many purposes, but cannot be relied upon as a steady electromotive force, and copper salt does reach the zinc, though not nearly as much so as in the common form.

The simple gravity battery, generally called the Callaud, has been much used in the American telegraphs, and seems tempting. But Mr. W. H. Preece says of it, "Based on a fallacy, it leads to wasteful and ridiculous excess: its maintenance costs 5s. 5d. per cell per annum, while the simple Daniell with porous earthenware cells costs less than 1s." But this is for the telegraphic purposes. Mr. Cromwell Varley, who originally introduced it in 1854, still maintains its value and economy. It is known also as the Menotti when packed with sand, and was used by Siemens packed with paper pulp, and by others with sawdust. But all these consist of a layer of crystals of sulphate of copper with a copper plate at the bottom of the cell, a solution of sulphate of zinc with or without some packing, and a plate of zinc at the top which should have a conical form to allow gas to escape; the packing is meant to prevent diffusion, which it only delays, and adds materially to the resistance. Recently a layer of animal charcoal has been used, which has the property of taking up metallic salts.

I have tried a form of gravity cell which has some advantages: it consists of a containing cell with a central tube going nearly to the bottom, and fitted with a sliding rod carrying a plate of indiarubber which can be lifted up by the rod so as to close the bottom of the tube; a grating in the tube carries crystals of sulphate of copper, which dissolves and flows out upon the face of the copper-plate lying on the bottom. When out of action the rubber is lifted, and prevents the copper salt escaping.

ANALYSIS OF IRON AND STEEL.

QUERIES have appeared from time to time asking for information relative to the Analysis of Iron and Steel, and, owing no doubt largely to the difficulty of replying to them in full in a moderate space, they have not always been adequately answered. The processes in general use are not described in the usual textbooks, and I shall endeavour as clearly as possible to give such details of them as will, I hope, enable those who have the necessary knowledge of chemistry and manipulation to carry them out.

I shall assume that the reader has all the usual appliances of a laboratory, and a good balance capable of carrying a load of 50 to 100 grammes in each pan, and turning with half a milligramme. He will also do well to get a flat iron plate, 12in. square and $\frac{3}{16}$in. thick, supported on a Fletcher's 8in. radial burner. This will be found more convenient than a sand-bath for boiling and evaporating. It should be kept well blackleaded, not only to preserve it from rust, but also as a very useful tell-tale if any spitting should occur during evaporation.

Determination of Manganese.

Reagents required:—

1. *Pure hydrochloric acid*, diluted with distilled water till the sp.gr. = 1·11 by hydrometer.
2. *Pure nitric acid*, diluted till the sp.gr. = 1·2.
3. *Pure liquid bromine.*
4. *Solution of ammonium acetate*, made as follows:—Measure 1 volume of pure strongest ammonium hydrate, and add to it 4 volumes of pure acetic acid. Well mix and allow to cool. Then add either more acid or more ammonia, with thorough agitation, till the liquid just turns blue litmus paper red, but *does not turn red paper blue*. If there be organic (tarry) matter present in either reagent, it will interfere with the separation of the iron. In that case the acetic acid must be re-distilled and the ammonia boiled in a flask, and the gas led into the re-distilled acid till just alkaline. The cold liquid is then to be acidified as before.

Weigh 2 grammes of the iron or steel (or 1 gramme of spiegeleisen or ferromanganese), in the form of clean drillings, transfer to a tall beaker of about 40oz. capacity, cover with about $\frac{3}{4}$in. of hydrochloric acid, and heat on the iron plate with a cover-glass on the beaker till dissolved. While solution is taking place, set on a good-sized flask of distilled water to boil. As soon as the iron is dissolved, proceed to oxidize it thus. While the solution is boiling briskly, draw the cover aside and gradually drop nitric acid into the boiling solution till a violent evolution of gas suddenly occurs, which immediately subsides, leaving the solution transparent and of a rich golden colour; a further addition of HNO_3 no longer causing effervescence. Then rinse and remove the cover, and let the liquid boil down rapidly to a small bulk, to remove excess of acid, &c. The next step is to neutralise the free acid with ammonia, and precipitate the iron. Dilute the solution with about 20oz. of boiling-hot water, replace the cover, and as soon as the solution boils *briskly* drop in ammonia (taking care the precipitate produced by each addition re-dissolves) until the liquid is very dark-coloured, and no more ammonia can be safely added for fear of producing a permanent ppt. Then at once pour in sufficient *boiling* ammonium acetate to cause the ppt. of basic ferric acetate thrown down to separate in distinct flocks of a dull chocolate colour. Let the liquid boil for about 10 minutes, and then remove the beaker from the plate and let it stand covered until the ppt. has nicely settled. Now fold a Rhenish filter-paper of about 6in. diameter and pour the whole of the *hot* clear liquid through it, without stopping, into a 40oz. flask, so as not to disturb the ppt., and when the filter has completely drained pour upon it the remainder of the liquid containing the ppt., and rinse the beaker, neglecting any of the ppt. which adheres to the sides. As soon as the filter has again drained completely, give it one washing with hot water containing a little ammonium acetate and let it drain again. Now wash back the ppt. into the beaker with boiling water, through a hole in the bottom of the filter, and re-dissolve it by heating with HCl. Then dilute the solution with boiling water, and proceed to re-precipitate the iron just as before, and wash the ppt. twice.

Meantime pour your first filtrate (which ought to be *clear* and *colourless*) into a half-litre porcelain basin, and let it boil down gently to about two-thirds of its bulk. (By doing so you will find a little more iron separate, which would otherwise contaminate the manganese ppt.) Pour the hot solution through a filter, and when you get the second filtrate treat it similarly. Then rinse the basin thoroughly, wash the filter, and get all the filtrate and washings back into the 40oz. flask. The solution in the flask should now contain all the manganese, free from iron; and it ought to be clear and perfectly colourless. In order to precipitate the manganese proceed as follows:—

Have the solution *perfectly cold* (which is absolutely essential for success), and dilute it, if necessary, till the flask is rather more than half-full. Add about 2cc. of liquid bromine, and agitate the solution till it is saturated, and a *slight* excess of bromine remains undissolved. At once pour in a considerable excess of strong ammonia, and again agitate thoroughly until the peroxide of manganese begins to separate. Then place the flask on the plate, and gradually heat the solution to boiling, violently shaking it at intervals to cause the ppt. to separate nicely. Let the liquid *just* boil, and then remove the flask, filter off the ppt., and wash with hot water till free from chlorides. When about half the filtrate has run through, it may be removed, thoroughly cooled, made acid with HCl, and again treated with bromine and ammonia to make sure that precipitation has been complete. If any further ppt. should be produced, of course the whole of the filtrate must be similarly treated, and the ppt. filtered off and added to the first. The portions of ppt. which adhere to the sides of the flask may be detached by pouring in a little hot water from the wash-bottle and violently shaking it about in the flask. If the ppt. is not allowed to get dry on the sides, this will readily detach it.

The filter containing the washed ppt. is dried, carefully folded up, and dropped into a tared platinum crucible. The crucible is then heated in the Bunsen flame till the filter takes fire, when the flame is removed until the filter has quietly burnt away. The charred paper is then ashed as usual, and the crucible and contents are further heated as hot as possible in the blowpipe flame for about 3 to 5 minutes, to convert the MnO_2 into Mn_3O_4, cooled and weighed. The weight of Mn_3O_4 obtained × ·72029 = the weight of *Manganese* in the 2 grams of steel or iron operated upon.

The ppt., after weighing, should be tested for iron. Detach it from the crucible with a pointed glass rod, and transfer it to a small beaker of 7oz. capacity. Warm some HCl in the crucible to dissolve any traces which remain, *and which must only be traces, or the free Cl will act on the platinum*, pour this acid on the ppt. in the beaker, and heat till it is dissolved. Then, after boiling off chlorine, rinse the crucible and dilute with cold water to about 4oz. Carefully add dilute ammonia to the *cold* liquid till it is only just acid, but distinctly so, to litmus-paper, then add a little ammon-acetate and boil. In this way any iron present will be precipitated free from manganese. Probably there will be none, but it is necessary to make certain; and if there be a small ppt. it must be weighed and deducted from the weight of Mn_3O_4. The difference is then calculated to Mn.

In separating iron and manganese with acetate, as above, you must pay particular attention when precipitating the iron: (1) To neutralise, as closely as you can, but *leave the solution acid;* (2) to use *acid* ammonium acetate.

If your solution is too neutral, manganese comes down with the iron; if too acid, the iron is not thoroughly precipitated. I will now explain some of the reactions involved:—

1. If *excess* of ammonia be added to a solution of ferric chloride, ferric hydrate is precipitated: if manganese be present, the ferric hydrate invariably carries down hydrated manganic peroxide. Hence the two metals cannot be separated by ammonia.

Ammonia produces no ppt. in solutions of manganese containing NH_4Cl; but, on exposure to the air, the whole of the manganese is gradually precipitated as dark brown hydrated peroxide. It is in consequence of this tendency of manganous salts to become oxidised and precipitated in the presence of excess of ammonia, that the separation from iron by this means is rendered impossible. Valentine says the separation succeeds best if the excess of ammonia is *immediately* boiled off.

2. If the acid ferric solution be rendered nearly neutral by ammonia, and then excess of ammon-acetate be added *in the cold*, no precipitation occurs, but deep-red soluble ferric acetate is formed. At the same time the free hydrochloric acid remaining in the solution is replaced by free acetic acid. Thus:—

Cold.—$Fe_2Cl_6 + 6\,NH_4\bar{A} = Fe_2\bar{A}_6 + 6\,NH_4Cl$

and

$$HCl + NH_4\bar{A} = H\bar{A} + NH_4Cl$$

On now boiling this solution, the soluble ferric acetate reacts with the elements of water, forming an insoluble basic acetate and liberating acetic acid. Thus:—

On Boiling.—

$$3Fe\bar{A}_3 + 6H_2O = \left\{ \begin{matrix} Fe\bar{A}_3 \\ Fe_2(HO)_6 \end{matrix} \right\} + 6H\bar{A}.$$

(This ppt. carries down a trifle of manganese, which can be removed by a second precipitation, or by boiling with fresh water containing a little ammonium acetate.)

3. To precipitate the manganese, it is simply necessary to make the solution alkaline and oxidise with bromine or a hypochlorite, when hydrated manganic peroxide separates out. Ammonia must be used, otherwise the ppt. will carry down fixed alkali, which cannot be readily got rid of. The precipitation may either be made as I have described above, or as follows:—

The filtrates from the basic iron precipitates are so far concentrated in the basin as to occupy about 10oz. after filtration. The filtered solution is then heated, made ammoniacal by addition of ammonia, and then treated with bromine, or bromine water, in small quantities, until the manganese is completely precipitated, which may be readily inferred from the appearance of the solution.

Crum's Test for Manganese.—It is sometimes advisable to test the basic iron precipitate on the filter for manganese, to make sure that the separation has been complete. For this purpose, take a large wide test-tube, and introduce into it some of the ppt. by means of a clean spatula. Heat this with a little nitric acid till dissolved; then add excess of silver nitrate to precipitate the chlorides. Dilute the solution till the test-tube is three-parts full, add a little lead peroxide, and boil for a few minutes. Then, on allowing the solid matter to settle, if any manganese be present the clear liquid will have a pink colour. This reaction is exceedingly delicate, so much so that unless the pink tint is very marked, the absence of more than a trace of manganese may be safely inferred. **L. A.**

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—LX.*

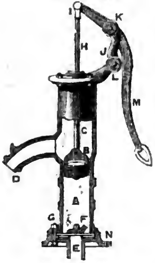
By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 492.)

Cottage or Iron Jack-Pump and Tilt Sucker-Box Valves.

FOR this kind of pump refer to Fig. 303. This kind of pump is used on account of its cheapness, especially by gardeners. It has a rocking or vibrating standard J, which is hinged at L, K; the pump-rod works through a hole in the top, so that children cannot put stones, &c., in the barrel. E is the suction-pipe, F the tilt-valve, which can be fixed open by lowering the bucket to the bottom of the barrel in such a manner that the bottom of the bucket will rest upon the spur F of the valve. This is very handy in the winter. The pump is screwed down upon planks, &c., as at N.

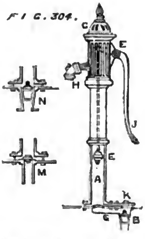
FIG. 303.



Full-Sized Iron Pump.

In this pump, Fig. 304, is to be seen a valve-box B, covered by a plate K, and which is very convenient when repairing the sucker-valve. The bucket, as may be seen, works within the barrel A, and has a long stroke. Such pumps are handy where there is much knocking about, but are bad for winter work on account of the frost. Of course, the same pump may be fitted with valves fixed direct under the bucket. Such valves are shown at N and M in the same diagram.

FIG. 304.



These valves may be fixed between flanges, as at M, or a sucker-box may be used as at N.

Party-Wall or Double-Handle Pumps.

These pumps are used for double dwelling-houses having party-walls, the pump being built in the brickwork and having swinging handles on each side. The spout of the pump runs into a kind of sliding dish, or trough B, Fig. 306, the bottom part of which has a partition O, and two compartments with nozzles as shown at D,F; this sliding dish rests upon the brickwork or wall G, and is worked as follows. Suppose the people on the D side of the wall require water, the slide B is right for the water to run from the nozzle into the slide, and from thence into the compartment C, and out at D. But suppose that water is wanted in the compartment E, then the slide B must, with the hand, be pulled by the handle K over the partition O, so that the slide may empty into the compartment E, when the water will run out at the spout F. Of course it is not necessary that the well should be under the wall, but may be at any distance away, when, if deep, it must be worked by rods, &c., to be hereafter explained, and for which see E,F,G,H, and M,N, O,P,Q, Fig. 349.

FIG. 305.

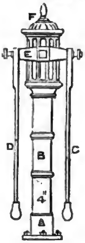


FIG. 306.

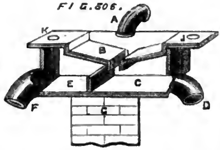


FIG. 308. FIG. 307.

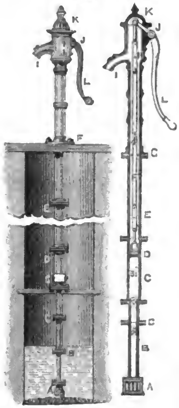
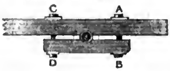


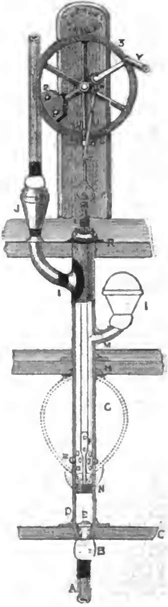
FIG. 309.



Floating Pole Pumps.

For this class of pump refer to F H, Figs. 307 and 308. This is an iron pump having a floating instead of a balanced pole F, for actuating the bucket D, and will be readily understood from the illustration and the following description:—

FIG. 310.



A is the strainer or blast-holes, which must be fixed upon a good solid foundation, unless otherwise fixed upon stages, or at the top of the well, which is sometimes done by cutting two semicircular holes in two 6in. by 9in. or 11in. pieces of timber, and by fixing the flange G of the pump between these timbers (for this see B F, Fig. 309). Now suppose all to be screwed together, as illustrated in the above diagrams, the bottom or barrel part being supported or steadied by the stage C, a plan of which is shown at Fig. 309. F is the main stage and E the clip-block, which is bolted to the main stage with the bolts A, B, C, D. There is an advantage in using such stages as these: the stage is not weakened by boring a large hole through the centre of the wood, and another is that they hold the pipe as firm as you may choose to screw the block to the main stage. Of course, such stages may be of iron or gun-metal. Having everything in the well right, next provide the pump-pole, which should be at least from 1½in. to 2in. diameter, made of oak, or other good lasting material. Fasten the forks of the pump-rod to the pole, as shown at E, Fig. 207, and also the coupling at H. It may happen that an extra coupling will be required to connect two or more poles together, or this may be done with two iron plates with the pole bolted between them. Having the lot the exact length, proceed to lower the first pole, then the next is bolted on, and the next, until the desired length is obtained. Now pour some water into the pump and work the handle, as before explained in jack-pumps. The pumping at first will hang very heavy on the hand, and most likely cock the handle, but as the water rises up the pump so the rods will float, and the whole thing become light on the hand. Such pumps generally work lightly, and will last a long time; but it will readily be seen that they cannot throw water above the handle; but happily we can with another kind. Such a pump is illustrated at Fig. 310. Here is a lead pump barrel reaching from bottom stage C to the top. Of course the ordinary clack sucker-box may be used in conjunction with this bucket and floating pole. It is easily repaired and works with freedom, either from a frame or any of the handles to be hereafter referred to. See Figs. 330, 350, 351, 356, &c. This pump is known by the name of a lift and force-pump; and now it is time to consider what will be the pressure upon the sides of the barrel and bucket of pumps. In this case suppose the well to be a deep one; then you must use a pump-barrel of suitable size for the easy working, and the materials of proper thickness to withstand the pressure. Take into account the height of the pipe or rising main which is carried above the top of the well, because this, as a matter of course, adds extra pressure to the water within the pump-barrel.

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(*To be continued.*)

THE MODERN LATHE: ITS MANUFACTURE AND USES.*

By J. H. EVANS.

(*Continued from p. 519.*)

HAVING briefly described the construction of this lathe, I will give a few details of the manner in which it is used. It produces both internal and external screws, with absolute certainty, and this, it is needless to say, reduces the difficulties of screw-cutting to a minimum: where its advantages are most obvious, will be found in such work as an ivory box with a short screw, and only sufficient material to fit the top and bottom together, so that a failure in striking the screw would render it useless.

The work being turned to the size required, the cap at the rear end is removed, and the steel guide, whichever is selected, put on its place. The corresponding screw in the conductor is then placed under it, and the eccentric turned round until it comes in close contact with the guide, so that it will work without any shake. The motion being now given to the mandrel, it travels forward at the rate given to it by the pitch of the screw on the guide; the T-rest must be so arranged that the mandrel will recede without running away from it, at the same time it must be placed so that the face of the work will not come in contact with it.

The fly-wheel must not take an entire revolution, but work backwards and forwards, the throw of the crank pointing each way alternately. This will require a little practice. The action must be as regular as possible, and the foot should not leave the treadle. It will be observed that the fly-wheel, being very much larger in diameter than the pulley on the mandrel, its partial revolution causes the pulley to make several complete turns, sufficient for all short screws. And where a longer screw is required, the cap may be re-placed, and the thread carried along, which, having obtained a true lead, will not be found such a difficult matter.

I will, with your permission, now proceed to a description of a few of the more complex tools, used for ornamental turning. First, I should like to dispel the prevailing idea, that before any work of this kind be accomplished, a very large outlay is necessary. It is no use my trying to hide the fact that ornamental turning is a somewhat expensive hobby; but still, with a good lathe and some of the more simple instruments, a very fine collection of specimens can be produced.

A short list of the instruments necessary for this may be useful. Assuming, then, that a well-made lathe (traversing mandrel will be best) is obtained, all that will be wanted, in the first place, will be an an overhead motion, compound ornamental turning slide-rest, eccentric cutter, a vertical cutter, and a drill-spindle, with about three dozen cutters to each.

1st. Then the overhead motion: there are various descriptions of these. That upon the suspension plan is still made by some makers, and is a very useful one; but, at the same time, there is room for considerable improvement, inasmuch as where a number of instruments with any considerable difference in the size of the pulley are used, separate bands are necessary.

In the one you see attached to the lathe I exhibit, you will observe that there are two standards, one being fixed to each side of the lathe-frame by strong bolts; across the top a triangular bar is fixed, by a nut at each end also. There you will see a rigid framework is formed; upon this bar a metal carriage is fitted, which slides from end to end; upon this again is fitted another crosspiece, working upon two centres, through which another long bar passes, having on the rear end a counterbalance weight, and in the front a pair of guide-pulleys; these are for the purpose of conducting the band, from the drum that works below, on to the instruments that are used in the slide-rest; the round bar, as you will see, carries a long drum for spiral work, and a metal pulley, which is driven from the fly-wheel below. The advantages of this pattern are, in my opinion, first, that it facilitates using the whole length of the bed, if desired; secondly, that one band will answer for all the instruments; thirdly, that the tension upon the band can be more readily adjusted; fourthly, it is more steady and less likely to vibrate, which is an important thing.

I may mention that the best proof of the advantages over other patterns, is the large number that have been made, not only by myself, but by other makers.

We will now consider the ornamental turning slide-rest, a few details of which will probably be interest. This is an instrument which forms a most important part in ornamental turning, and one in which perhaps more improvements have been made than in any other parts of the lathe, especially within the last few years. The original rest, of which this is one, was, as you see, extremely short, and fitted only to a common rest-pedestal without any means of adjusting the height of centre, or to turn a surface and cylinder, beyond using the T-square, and raising it by hand. These movements were, under any circumstances, uncertain. The next advance was a ring fitted under the top slide, to raise and depress the height of centre; but the means of setting with any certainty, to turn a surface or cylinder, were still wanting. Without dilating further upon obsolete tools, I will now give a few details of those now made, and I think the slide-rest I have here will clearly illustrate the advantages they possess.

You will see that a metal cradle is fitted to the lathebed, and a transverse fitting is planed perfectly square to it; when this is done the body of the rest is almost planed to fit it; the metal cradle, having one side loose, it can be adjusted to slide most accurately; the body of the rest is then carefully chucked on a true face-plate and bored or turned out to 1½in. diameter; that part upon which the ring works must be screwed before it is removed from the chuck. In making a rest of this description, great accuracy is required, and this will depend in a great measure upon the truth of the chucking and turning. The body, thus far, is ready to receive the stem of the main slide; this should be carefully planed up, and then chucked on the face-plate in a similar way, and the stem fitted accurately to the hole. These form the most important fittings, and, if properly done, it will be obvious that, when put together, whichever way it is turned, or in whatever part of the slide the tool is used, it will be positively at the same height of centre, I need scarcely point out that, if the hole is not bored true to the face, the upper slide cannot be correct, and if the error is of the most minute degree, it will multiply to a very serious extent in the length of the slide. The metal ring used for raising and depressing the height of centre has now two screws fitted at opposite sides, their purpose being to fix the ring when the height is determined. Until these were introduced, considerable annoyance was experienced by the tool being at different heights when turned from one point to another, and it was found that the weight of the top part of the rest carried the ring round with it, and consequently caused the difference; the fixing screws, however, entirely overcome the difficulty.

We now come to the upper part; it will be seen that in this we have several improvements. First, by an extra collar on one of the adjusting-screws, were are able to place the top slide under control without the use of the lever at all. I know many gentlemen who have turned for a long time, who still prefer the lever: but when used to the screw I consider it a great advantage, and never use anything else myself. Another addition is the metal cover to the main screw for the purpose of keeping the shavings and dirt out of the screw: this saves a deal of wear and tear, and inconvenience to the turner. The main-screws both for the long slide and the top are all made ten to the inch.

I am now making another slide-rest of a still more elaborate description; it has a longer main slide, and the upper part is fitted with a quadrant to the slide; this enables the tool to be set at an angle without altering the lower part, and is of great service when using moulding tools, either fixed tools, or revolving drills. On the end of the screw a tangent wheel is fixed, which forms the micromites for the divisions in the front; a tangent screw fitted to a metal frame is thrown into gear by a cranked lever, and can be made to act instantaneously. This screw having a pulley on the end, it can be driven from the overhead motion and a self-acting cut can be taken its entire length. I will point out an improvement I have made in the fluting stops, which, for accurate work, has been found a great help. The plain stops, it will be seen, have a set screw which passes through the centre, and are sometimes divided on the head, a reading line being marked across the metal; as long as the head of the screw and the line are close together they will answer; but for doing large star patterns I found that it was impossible to read accurately when the lines becomes separated, which they do by the movement of the screw. To overcome this I have introduced what may be called a spring reader, this being cut out to fit the screw head; the lines are always close together, and can be read with the greatest ease and accuracy.

The metal-turning slide-rest again is a most useful tool, not only for turning metal but for roughing out large pieces of wood. There are various descriptions of these rests. The one generally made to accompany ornamental lathes you will see exhibited on the table below; it consists of a metal cradle fitted to the bed of the lathe, having on one side an angle, the other square; a massive cast-iron base is fitted to this, on the top of which another slide is fitted. I have now adopted a new plan of arranging this slide—that is, to make it take a complete revolution by fitting the holding-down bolts into a T-groove. There are several advantages derived from this. In the first place, the slide can be brought round so that a surface cut may be taken with the main or lower slide; this, I consider, offers a considerable advantage over having to use the top slide, which must bear all on one end, when used for the same purpose. Then again, the fact of being able to turn the slide to any desired position without removing the bolts to different holes is of great importance, and there being no quadrant slots for the bolts necessary, there is no opportunity for shavings, &c., to get in. Another improvement is, having a powerful dovetail slide fitted to the lower part to hold it securely to the bed, instead of relying upon the cradle to do so.

We will now pass on to consider the eccentric cutter. This is made to run in a steel stem, which fits into the tool-box of the slide-rest, and is driven from the overhead motion. It has been suggested by many gentlemen that I have met in the course of my experience, that the eccentric cutter and eccentric chuck are identical in their productions: to a certain extent the remark applies, inasmuch as many patterns that can be executed with the cutter may be done with the chuck; but in working them out separately, it will be found that a vast number of very beautiful patterns can be cut by means of the chuck that could not possibly be done by the cutter. Then, again, we have the combination of the two, the effect of such work being very interesting indeed. First, then, with the eccentric cutter; all such patterns as represent the intersection of circles are easily cut, and the variety may be said to be infinite for the simple reason that a very slight alteration in the settings will make quite a different pattern. There are various ways of altering the aspect of the work, either by a different division on the pulley, a more or less acute angle to the tool, or a larger amount of eccentricity to the cutter. The pattern that is generally practised first is what is termed the barleycorn. This is cut with a double angle tool of about 45°, and a division that is most suitable to the diameter of the material. The diameter of the circle cut is also governed in the same way. Having cut a series of patterns with the double-angle tool, it will be interesting to study the different effects to be obtained by the two single-angle tools, which are made to cut right and left, by using these tools at precisely the same settings. As for the double angle tool, the different effects will be so apparent, that it will be unnecessary to expatiate further upon them.

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* Paper read before the Society of Arts on Wednesday, Feb. 7, 1883.

In these three tools we have those that are principally used with this instrument for face work. There are, of course, a large variety of tools of different patterns, such as round-nose, hollow, bead quarter hollows, and rounds. These are used for working up mouldings and many other purposes.

(*To be continued.*)

DYNAMO-ELECTRIC MACHINERY.—VII.*

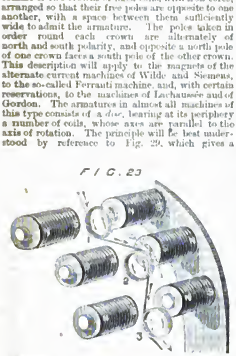
By Prof. S. P. Thompson, B.A., D.Sc.

(*Continued from page 518.*)

Alternate-current Dynamos.

BUT by far the most important of the dynamos of this second class are those usually known as *alternate current machines*. This type of dynamo was originally created by Wilde, in 1867. The field-magnets consist of two crowns of fixed coils, with iron cores, arranged so that their free poles are opposite to one another, with a space between them sufficiently wide to admit the armature. The poles taken in order round each crown are alternately of north and south polarity, and opposite a north pole of one crown faces a south pole of the other crown. This description will apply to the magnets of the alternate current machines of Wilde and Siemens, to the so-called Ferranti machine, and, with certain reservations, to the machines of Lachaussée and of Gordon. The armatures in almost all machines of this type consists of a *disc*, bearing at its periphery a number of coils, whose axes are parallel to the axis of rotation. The principle will be best understood by reference to Fig. 29, which gives a general view of the arrangement. Since the lines of force run in opposite directions between the fixed coils, which are alternately S—N, N—S, as described above, the moving coils will necessarily be traversed by alternating currents: and as the alternate coils of the armature will be traversed by currents in opposite senses, it is needful to connect them up, as shown in the figure, so that they shall not oppose one another's action.

FIG. 29.



Principle of Alternate-current Dynamos.

In Wilde's dynamo, the armature coils have iron cores, and the machine is provided with a commutator on the same principle as that used by Jacobi in his famous motor of 1838, consisting of two metal cylinders, cut like crown wheels, having the teeth of one projecting between those of the other, so that the brushes make contact against them alternately as they rotate. The brushes are, of course, fixed, so that they do not both touch the same part. This commutator Wilde usually applied to a few, or only one, of the rotating coils, and utilised the current thus obtained to magnetise the field-magnets. The main current was not so commuted, but was led away from a simple collector, consisting of two rings connected to the two ends of the armature circuit, each being pressed by one brush.

Siemens prefers to use a separate or direct current machine to excite the field-magnets of alternate-current dynamo. In the armature of the latter, the coils are wound usually without iron upon wooden cores. In some forms of the machine, the individual coils are inclosed between perforated discs of thin German silver. When currents of great strength are required, but not of great electromotive force, the coils are coupled up in parallel arc, instead of being united in series.

In a dynamo by Lachaussée, which very strikingly resembles the preceding one, there is iron in the cores of the rotating coils. But the main difference is that the rotating coils are the field magnets, excited by a separate Gramme dynamo, whilst the coils, which are fixed in two crowns on either side, act as armature coils in which currents are induced.

Gordon's dynamo, the largest yet made, is constructed on the same lines as the Lachaussée machine; but with many important improvements. In the first place, there are twice as many coils in the fixed armatures as in the rotating magnets, there being 32 on each side of the rotating disc, or, in all, 64 moving coils; while there are 64 on each of the fixed circles, or 128 stationary coils in all. The latter are of an elongated shape, wound upon a bit of iron boiler-plate, bent up to an acute V form, with cheeks of perforated German silver as flanges. The object of thus arranging the coils, so that the moving ones shall have twice the angular breadth of the fixed ones, is to prevent adjacent coils of the fixed series from acting detrimentally, by induction, upon one another. The alternate coils of the fixed series are united together in parallel arcs, so that there are two distinct circuits, in either or both of which lamps can be placed; or they can be coupled up together. Great care appears to have been taken, in the construction of this large machine, to guard against the appearance of Foucault currents, by arranging the cores, frames, and coils, so that all metal parts of any size shall be slit, or otherwise structurally divided at right angles to the direction of the induced electromotive forces.

Yet another alternate-current dynamo, identical in many respects with the Siemens alternate-current dynamo, has lately been brought out, under the name of the Ferranti machine. As in the machines of Wilde and Siemens, the electro-magnets form two crowns with opposing poles. The point of difference is the armature, which, like that of Siemens, has no iron cores in its coils; but which, unlike that of Siemens, is not made up of coils wound round cores, but consists of zigzags of strip copper folded upon one another. There are eight loops in the zigzag (as shown in Fig. 30) which depicts half only of the arrangement, and on each side are sixteen magnet poles; so that, as in Gordon's dynamo, the moving parts are twice the angular breadth of the fixed parts. The advantage of the armature of zigzag copper lies in its simplicity of construction. Sir W. Thomson, who is the real inventor of this armature, proposed originally that the copper strips should be wound between projecting teeth on a wooden wheel; he also proposed to use as field-magnets a form of electro-magnet of the kind known as Roberts's, and also used by Joule, in which the wires that bring the exciting current are passed up and down, in a zigzag form, between iron blocks projecting from an iron frame. I am not aware that this particular suggestion has been adopted as yet in practice.

FIG. 30.

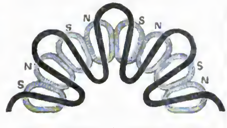


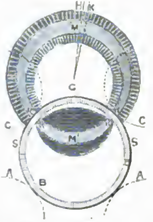
Diagram of Ferranti's Alternate-current Dynamo.

Much more might be said concerning the two machines last described—the Gordon and the Thomson dynamos—but time does not permit me to dwell longer upon them. And, indeed, I am not at all convinced that this type of machine, though at present it appears to be the fashionable one, is destined to prove of such very great value, simply because I doubt whether any dynamo that yields alternate currents can compete with continuous-current machines. For the purposes of a general system of distribution, where more than one dynamo must be available, and also for the purpose of supplying motors, alternate-current machines are quite out of the question. I will not therefore dwell longer upon them, than merely to remark that, besides the disc armatures now described, pole armatures have been employed in alternate-current machines by Gramme, Jablochkoff, and by Lontin. Hefner-Alteneck has gone a stage further, and by the device of employing a disc armature in which the number of coils differed by two, or some other even number, from those of the field, and by the employment of a multiple-bar collector with complicated cross connections, has succeeded in converting this type of dynamo into a continuous-current machine.

Thomson's "Mouse-mill" Dynamo.

One other dynamo, not belonging to the type I have been dealing with, is worthy of mention. This is Sir W. Thomson's "mouse-mill" dynamo, shown in Fig. 31, in diagram. I have noticed, *en passant*, several points in this machine—the form of its field-magnets and their coils, the internal electro-magnets, &c. The armature is a hollow cylinder, S S, made up of parallel copper bars, arranged like the bars of a mouse-mill (whence the name of the machine). These bars are insulated from each other, but are connected all together at one end. At the other, they serve as collector-bars, and deliver up the currents generated in them to the "brushes," which here are rotating discs of springy copper shown as dotted circles at C C in the figure. As the armature is a hollow barrel, with fixed electro-magnets within, it cannot be rotated on a spindle, but runs on friction rollers, AA', by one or more of which it is driven.

FIG. 31



Sir W. Thomson's "Mouse-mill" Dynamo.

Dynamos of the Third Class.

I now come to the third class of dynamos—those in which rotation of a conductor effects a continuous increase in the number of lines of force cut by the device of arranging one part of the conductor to slide on or round the magnet.

The earliest machine which has any right to be called a dynamo was, in fact, of this class. Barlow and Sturgeon had shown that a copper disc, placed between the poles of a magnet, rotates in the magnetic field when traversed by an electric current from its axis to its periphery, where there is a sliding contact. Faraday, in 1831, showed that by rotating a similar disc mechanically between the poles of a magnet continuous currents were obtained. These he drew off by collecting springs of copper or lead, one of which touched the axis whilst the other pressed against the amalgamated periphery. He was thus "able to construct a new electrical machine." "Here, therefore, was demonstrated the production of a permanent (*i.e.*, continuous) current of electricity by ordinary magnets." But Faraday did not stop short with ordinary magnets: he went on to employ the principle of separate excitement of his field-magnets. "These effects were also obtained from *electro-magnetic poles*, resulting from the use of copper helices or spirals, either alone or with iron cores. The directions of the motions were precisely the same; but the action was much greater when the iron cores were used, than without." The invention of the dynamo dates, therefore, from 1831, and Faraday was its inventor, though he left others to reap the fruits of his splendid discovery.† Such a machine, however, is impracticable, for several reasons: the peripheral friction is inadmissible on any but a small scale; moreover, the disposition of the field-magnets necessarily evokes wasteful eddy-currents in the disc, which, even if slit radially, would not be an appropriate form of armature for such a limited magnetic field.

Another method of obtaining a continuous cutting of the lines of force is where a sliding conductor travels round the pole of a magnet. Faraday even generated continuous currents by rotating a magnet with a sliding connection at its centre, from which a conductor ran round outside, and made contact with the end-pivots which supported the magnet.

A similar arrangement was devised by Mr. S. Alfred Varley, about the year 1862. He rotated an iron magnet in a vertical frame, having a mercurial connection at the centre. The current which flowed from both ends of the magnet toward the centre was, in this machine—which by the kindness of Mr. Varley, I am able to exhibit to you to-night—made to return to the machine, and to pass through coils surrounding the poles of the rotating magnet; thus anticipating the self-exciting principle of later date. Mr. Varley also proposed to use an external electro-magnet to increase the action.

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* Extracted from the Cantor Lectures, delivered before the Society of Arts.

† "Experimental Researches" § 158.—"I have rather, however, been desirous of discovering new facts and new relations dependent on magneto-electric induction, than of exalting the force of those already obtained; being assured that the latter would find their full development hereafter." Can any passage be found in the whole range of science more profoundly prophetic, or more characteristically philosophic, than these words, with which Faraday closed this section of his researches.

Quite recently, the same fundamental idea has been worked upon by Messrs. Siemens and Halske, who have produced a so-called "unipolar" machine.[*] In this remarkable dynamo there are two cylinders of copper, both slit longitudinally to obviate eddy-currents, each of which rotates round one pole of a U-shaped electro-magnet. A second electro-magnet, placed between the rotating cylinders, has protruding pole-pieces of arching form, which embrace the cylinders above and below. Each cylinder, therefore, rotates between an internal and an external pole of opposite polarity, and consequently cuts the lines of force continuously by sliding upon the internal pole. The currents from this machine are of very great strength, but of only a few volts of electromotive force. To keep down the resistance, many collecting brushes press on each end of each cylinder. This dynamo is actually at work for electroplating.

The only other dynamo of this class, of which I have seen any published notice, is one recently patented by Mr. E. L. Voice, in which a coil armature, wound upon an iron ring, is so placed that the iron ring is itself one pole of a magnet, a projecting pole-peice from the other pole being fixed near it, so that the coils fixed upon one pole glide round and cut the lines of force proceeding from the other pole. Whether this machine will be a practical one remains to be seen.

We are, however, far from having arrived at finality in the design and construction of dynamo-electric machines.

ANIMAL DOCTORS.

In a recent communication to the Biological Society, M. G. Delaunay observed that medicine, as practised by animals, is thoroughly empirical; but the same may be said of that practised by inferior human races, or, in other words, by the majority of the human species. Animals instinctively choose such food as is best suited to them. M. Delaunay maintains that the human race also shows this instinct, and blames medical men for not paying sufficient respect to the likes and dislikes of the patients, which he believes to be a guide that may be depended on. Women are more often hungry than men, and they do not like the same kinds of food; nevertheless, in asylums for aged poor, men and women are put on precisely the same regimen. Infants scarcely weaned are given a diet suitable to adults, meat and wine, which they dislike and which disagree with them. M. Delaunay investigated this question in the different asylums of Paris, and ascertained that children do not like meat before they are about five years of age. People who like salt, vinegar, &c., ought to be allowed to satisfy their tastes. Lorain always taught that with regard to food, people's likings are the best guide. A large number of animals wash themselves and bathe, as elephants, stags, birds, and ants. M. Delaunay lays down as a general rule that there is not any species of animal which voluntary runs the risk of inhaling emanations arising from their own excrement. Some animals defæcate far from their habitations; others bury their excrement; others carry to a distance the excrement of their young, In this respect they show more foresight than man, who retains for years excrement in stationary cesspools, thus originating epidemics. If we turn our attention to the question of reproduction, we shall see that all mammals suckle their young, keep them clean, wean them at the proper time, and educate them; but these maternal instincts are frequently rudimentary in women of civilised nations. In fact, man may take a lesson in hygiene from the lower animals. Animals get rid of their parasites by using dust, mud, clay, &c. Those suffering from fever restrict their diet, keep quiet, seek darkness and airy places, drink water, and sometimes even plunge into it. When a dog has lost its appetite it eats that species of grass known as dog's grass *(chiendent)*, which acts as an emetic and purgative. Cats also eat grass. Sheep and cows, when ill, seek out certain herbs. When dogs are constipated they eat fatty substances, such as oil and butter, with avidity, until they are purged. The same thing is observed in horses. An animal suffering from chronic rheumatism always keeps as far as possible in the sun. The warrior ants have regularly organised ambulances. Latreille cut the antennæ of an ant, and other ants came and covered the wounded part with a transparent fluid secreted from their mouths. If a chimpanzee be wounded, it stops the bleeding by placing its hand on the wound, or dressing it with leaves and grass. When an animal has a wounded leg or arm hanging on, it completes the amputation by means of its teeth. A dog on being stung in the muzzle by a viper was observed to plunge its head repeatedly for several days into running water. This animal eventually recovered. A sporting dog was run over by a carriage. During three weeks in winter it remained lying in a brook where its food was taken to it; the animal recovered. A terrier dog hurt its right eye; it remained lying under a counter, avoiding light and heat, although habitually it kept close to the fire. It adopted a general treatment, rest and abstinence from food. The local treatment consisted in licking the upper surface of the paw, which it applied to the wounded eye, again licking the paw when it became dry. Cats also, when hurt, treat themselves by this simple method of continuous irrigation. M. Deluanay cites the case of a cat which remained for some time lying on the bank of a river; also that of another cat which had the singular fortitude to remain for forty-eight hours under a jet of cold water. Animals suffering from traumatic fever treat themselves by the continued application of cold, which M. Delaunay considers to be more certain than any of the other methods. In view of these interesting facts, we are, he thinks forced to admit that hygiene and therapeutics, as practised by animals, may, in the interests of psychology, be studied with advantage. He could, thinks the *British Medical Journal*, go even further, and say that veterinary medicine, and perhaps human medicine, could gather from them some useful indications, precisely because they are prompted by instinct, which are efficacious in the preservation or the restoration of health.

HURRY, WORRY, AND WASTE.

We are all, says the *Lancet*, too much in a hurry about what we do. We have too many irons in the fire, too much business on hand at the same instant, and are far too energetic in our endeavours. With deliberation, calmness, and such reserve of strength as result from perfect restraint, a man may do an infinity of work without either trouble or injury. Breathless haste, eager anxiety, and an excessive expenditure of energy are the outcome of modern activity, whether in this country or on the Continent. The system of "quick returns" has been the bane of literature, almost extinguishing it and substituting in its place "journalism." The same system has revolutionised thought and science, and it is rapidly undermining the human constitution. We are impatient for results. Speeches are made with the knowledge that they will appear in print in a few hours, and that if anything is omitted the deficiency will be criticised by some watchful opponent in the Press. Every opportunity must be seized as it presents itself, or it will be lost. It follows that statesmen and politicians are kept on the strain of sustained attention, and their brains are for many hours in the twenty-four, whether in or out of Parliament, in a condition of ferment. The brains of speculators on the Stock Exchange, and even the brains of merchants in their private rooms, are equally taxed, and in the same way. All classes of the community share the turmoil. The period is one of brain-wearing impetuosity, of hurry, worry, and waste—the waste of cerebral energy and nerve force. The higher nervous centres are kept incessantly at work, and become, as it were, overheated, so that it is impossible they should quiet or cool down in the brief intervals of respite allotted to repose. Too often they do not rest even in sleep. The brain only dozes instead of sleeps, and as a result there are dreams of the recent day's work, that infallible symptom of impending mischief. The only marvel is that, looking to the utterly unphysiological character of our mental and nervous habits of work, the number of sudden failures is not greater than it is, and that we have not a larger percentage of brain-mortality to deplore.

IMPROVEMENTS IN IMITATION NIELLO.

An improved process of imitation niello has been recently patented in this country by F. Wirth, of Frankfort-on-Maine. The invention consists in producing the desired design upon the panel or plate by means of photo-engraving or photo-etching, then coating the so engraved surface with japan or other soft enamel and drying the same, then removing the surplus of the enamel by grinding or other means until the surface of the enamel is even with the surface of the metal, and finally plating the surface of the metal by electro-deposition. In order to transfer the desired artistic design to the surface of the metallic plate or panel, the design, engraving, or other work of art is first photographed and the negative or positive, as required, is placed upon a sensitised gelatine film. The light passing through the transparent parts of the negative or positive, renders the corresponding portions of the film insoluble. After sufficient exposure the film is treated in water, whereby the parts not affected by light are swollen. The film after being treated in the usual manner for electro-deposition, is placed in the copper bath and a copperplate of the required thickness deposited thereon. This plate shows the lines of the design, engraving, or other work intended to be reproduced in intaglio, or relief, according as a negative or positive was employed. In place of the photo-engraving process just described, the engraved plate may be produced by photo-etching or by any other approved method. The photo-engraved or photo-etched plate is then covered with a japan or any suitable soft enamel, and after throughly drying and hardening it, the surplus is removed from the surface of the plate by grinding or other means, until the surface of the metal appears and the enamelled portions are even therewith.

The surface of the enamelled plate is then electroplated, the whole producing a very striking and artistic effect, as the enamelled portions, representing the original design, appear on a ground of gold or silver. The plate so obtained is now applied to the purpose for which it is intended, forming a panel for artistic furniture, plaques, and other articles.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

The sixty-third annual general meeting of the Society was held at Burlington House on Friday, Feb. 9, Prof. E. J. Stone, President, in the chair.

The President announced the death of Prof. H. Smith, and the Earl of Crawford, moved that an expression of the deep sorrow which this Society feels at the death of Prof. Smith should be conveyed by the President in the name of the Society to Prof. Smith's sister. The resolution having been seconded by the Astronomer Royal, was put to the meeting and carried unanimously.

The President, on presenting the medal of the Society to Lord Crawford, for transmission to Dr. Gould, said: Your Council has awarded the Gold Medal of the Society to Benjamin Apthorp Gould for his "Uranometria Argentina." Dr. Gould is an astronomer who has held a leading position amongst the cultivators of our science for many years, and a reference to the "Royal Society's Lists of Scientific Papers" will find him credited with no less than fifty-five papers. These papers treat of almost all branches of our science, and some of them, such as the "Reduction of D'Agelet's Observations," are works of considerable extent and of great value. These works cannot have been without their influence in guiding the decision of your Council in the award of the medal; but it has been upon Dr. Gould's direction of the work of the Cordoba Observatory that attention has been chiefly directed. The astronomical results contained in the "Uranometria Argentina" constitute but a small and, in my opinion, not the most valuable, portion of those which have been obtained by Dr. Gould since he assumed the direction of the Cordoba Observatory; but although the observations for the southern zones are understood to have been completed, and one volume of results has already been published, your Council have thought it undesirable to await the complete publication of these results before marking in the most emphatic manner in their power their high appreciation of the skill and energy with which Dr. Gould has utilised the resources placed at his disposal by the liberality of the Government of the Argentine Republic. The work, for which the medal has been chiefly awarded, may be considered an extension of Argelander's scale of magnitudes to all the stars which can be seen by a good eye without instrumental aid between 10° North Declination and the South Pole, together with a series of charts, exhibiting on a stereographic projection, the positions of all these stars to the sixth magnitude, and a proposed revision of the boundaries of the southern constellations. The work is of a class which is not usually undertaken at our principal observatories, for it requires neither an elaborate instrumental equipment nor that technical skill on the part of the observers which can only be acquired by long continued practice; but Dr. Gould, on his arrival with four assistants at Cordoba, in the September of 1870, found that the instruments which had been ordered from Europe for the observatory had not been received; and the disorganisation of scientific matters on the Continent from the war then in progress, rendered it probable that there might be some considerable delay before these instruments could be delivered. Under these circumstances, Dr. Gould, encouraged by the experience which he had gained, and by the success which had attended a somewhat similar effort on a smaller scale, made during the mounting of the Transit circle at the Albany Observatory, in 1858, determined to undertake the work for which your medal is this day awarded. In the absence of any standard of absolute brightness, the determination of stellar magnitudes can only be relative, and the scale in which they are expressed must be an ordinary one. The second Herschel, while at the Cape, determined the light received from the principal southern stars in terms of the combined light of α^1 and α^2 Centauri as a unit, and he pointed out that by a slight modification of the scale in general use, it would be possible to make that scale a photometric one, and the amount of light received inversely proportional to the square of the number which expressed the magnitude. But although some such modification as that proposed by Herschel would be a decided improvement, if the ground were not already occupied, yet our conventional system of magnitudes, as practically exhibited with some approach to scientific precision in the "Uranometria Nova," has received such general acceptance from astronomers that probably Dr. Gould was well advised in adopting it for his Southern Uranometria. To secure consistency between the estimations of magnitude by the different observers, and the practical adoption of Argelander's scale and its extension to stars of the seventh magnitude, Dr. Gould selected from the "Uranometria Nova," 1,800 stars between the parallels of 5° and 15° North Declination, which culminated at nearly the same altitudes at Bonn and at Cordoba. The magnitudes of these stars were estimated by all the four observers to whom the work at Cordoba was to be entrusted, and the results obtained were carefully compared with the magnitudes of the "Uranometria Nova," and, I presume, in cases of discordances reconsidered. It was found that the estimations of the four observers were in perfect accord, to tenths of a magnitude, in the case of 722 of these stars; in the other cases the discordances did not usually exceed the tenth of a magnitude, and never exceeded two-tenths except in cases where there were peculiarities of colour, or the presence of some companion star to disturb the estimations. Dr. Gould determined to adopt as his standards of magnitude only those stars upon which the agreement of the four observers was perfect. But to facilitate the comparisons of the southern stars with these standards, stars in two regions south of Declination 55° were selected, and carefully compared by all the four observers with the standards in the principal type belt, and thus a secondary set of standards, more conveniently situated for direct comparison with the southern stars, was established. The work was then distributed among the four observers, and appears to have been completed about the end of the year 1873. It will give some indication of the magnitude of the work when I mention that the number of estimations made for the formation of the "Uranometria Argentina" exceeded 46,000. These estimations of stellar magnitude must be considered as the corpus of the work for which your medal has been awarded, but Dr. Gould has carefully discussed the results and compared them with nearly all the materials which were available for the purpose; and in particular he has compared his estimations of the magnitude of the brighter stars with results obtained from a discussion of the photometric observations of the second Herschel and of Seidel. The results of this comparison are generally satisfactory, although there appear some slight indications of a change of scale within the range of the four magnitudes compared with Herschel's measures. The comparison of the Cordoba magnitudes with those of Lacaille, Herschel, and other astronomers has revealed some cases of marked discordance; but as Dr. Gould has had the great advantage of having his predecessors' work before him, and has been able to refer to the stars themselves for verification and, if need be, correction of his results, it is not probable that these discordances can be due to accidental errors in the Cordoba estimations. In the notes appended to the catalogue such cases are carefully pointed out and discussed whenever sufficient materials existed for the purpose. These notes will be of great value to our southern astronomers, and are certain to lead to successful investigation in the interesting field of Stellar variation. The maps published by Dr. Gold are fourteen in number, one of which is a skeleton map showing the proposed revision of the Southern boundaries of the constellations. Each map has been directly compared with the portion of the sky to which it refers before publication, and the greatest care has been taken to reproduce, as clearly as possible, the gradations of light over the regions of the Milky Way. The position of the Northern pole of the Galactic Circle is fixed by Dr. Gould at R.A., 12h. 41m. 20s., Decl. North, 27°. 21'. for the epoch 1875·0. The maps are beautifully executed, and will well repay examination. The materials collected by Dr. Gould on the uranometria of the Southern Heavens are far more complete and accurate than any which previously existed, and he has, therefore, naturally been led to discuss their bearing on these great questions of the constitution of our Stellar universe, which offer so fascinating and inexhaustible a field for philosophical speculation. The results which Dr. Gould has obtained are in general accord, with those of previous investigators on the subject. It appears to be clearly proved that distance is one of the most important factors in producing differences of apparent brightness in the stars; but the agreement between the number of stars of different magnitudes, and the number which might be expected, if these changes of apparent brightness depended solely on distance, is not perfect over any large range of magnitudes. There appears to be a decided preponderance in the number of the brighter stars. It is possible that this preponderance may be partially due to the conventional scale of magnitudes not being a truly photometric scale; and it is necessary, before any close agreement can be expected between the number of stars of different magnitudes and those computed on the assumption of distance being the sole factor of variation, that the number of stars in a group should be sufficiently great to insure that the mean intrinsic brightness of the stars of each group should be constant—a condition which can only be secured when a considerable number of stars are included in each group, for there are certainly proved variations of intrinsic brightness amongst the stars in a higher proportion than 300 to 1. But, although Dr. Gould had these possible sources of error before his mind, he has been led, after a careful discussion of his own observations, to infer that the preponderance of the brighter stars is due to the existence of a stellar cluster consisting of some four or five hundred stars of which our own system is supposed to be a member. The position of the northern pole of the medial plane of this belt of stars has been fixed by Dr. Gould at R.A. 11h. 25m., N.P.D. 60°, while that of the Galactic circle is at R.A. 12h. 41m., N.P.D. 62° 39'. That there is a striking crowding of bright stars towards the portion of the heavens to which Dr. Gould calls attention, is an undoubted fact, and one which has previously attracted notice. It is also proved by Dr. Gould that the number of stars of the different magnitudes, which remain after the abstraction of the stars of this supposed group, agrees more closely than before with the computed number on the assumption that the changes in brightness depend solely on distance. But whether these facts are sufficient to prove our power of discriminating between the stars of this belt and that general condensation of matter which gives rise to the appearance of the Milky Way, is a point upon which I can form no very positive opinion. I think, however, that the differences between the annual parallaxes and apparent brightnesses of some of the stars of this belt show that, if it exists as an isolated cluster, it is one of vast extent and great complexity. To me, looking out from this mere speck of an earth on the space which surrounds me, and recognising the awful and almost inconceivable distances that separate me from the nearest of the stars, compelled to acknowledge, as I must, that every one of these twinkling points is as much an independent source of light and heat as our own sun, that every increase of optical power brings a large proportionate number of other stars into view, and in entire ignorance of the position of my point of view amongst these stars, I feel my inability to firmly grasp the geometrical, much less the physical, constitution of such a universe. I cannot conceive space without limit, or the possible nature of a boundary of such space. However much, therefore, my mind may revel for a time and rejoice in its almost unfettered liberty amid such speculations, yet it finds no Mount Ararat upon which to rest the sole of its foot, and it soon gladly returns to the ark of experiment and observation upon which the foundations of our science have been laid, and the superstructure, if slowly, yet securely raised. Although, therefore, from the constitution of my mind and training I am perhaps unable to do full justice to this, the speculative part of Dr. Gould's work, I can speak with the greatest confidence of the value of the observational results contained in the "Uranometria Argentina."

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[*] This sounds like a *lucus a non lucendo*, for the machine has two poles. But the name is derived from the term "unipolar induction," which Continental electricians give to the induction of currents by the process of "continuous cutting," which we are now dealing with. I do not adopt the term, as it is needlessly mystifying."

The meeting proceeded to ballot for the election of officers and council, and the following gentlemen were declared to have been elected—as President, Mr. E. J. Stone, M.A., F.R.S., Radcliffe Observer; as Vice-Presidents, Mr. J. C. Adams, M.A., LL.D., F.R.S., Lowndean Professor of Astronomy, Cambridge; Sir G. B. Airy, K.C.B., M.A., LL.D., D.C.L., F.R.S., &c.; Mr. W. H. M. Christie, M.A., F.R.S., Astronomer-Royal; Mr. J. R. Hind, F.R.S., Superintendent of the *Nautical Almanac*; as Treasurer, Mr. Francis Barrow, M.A.; as Secretaries, Mr. J. W. L. Glaisher, M.A, F.R.S., Mr. E. B. Knobel; as Foreign Secretary, Mr. W. Huggins, LL.D., D.C.L., F.R.S.; as Council, Capt. W. de W. Abney, R.E., F.R.S.; Mr. James Campbell; Mr. J. Rand Capron; Mr. Arthur Cayley, M.A., LL.D., D.C.L., F.R.S., Sadlerian Professor of Pure Mathematics, Cambridge; Mr. A. A. Common; Mr. G. H. Darwin, M.A., F.R.S.; Mr. Warren De La Rue, M.A., Ph.D., D.C.L., F.R.S.; Mr. A. M. W. Downing, M.A.; Mr. Edwin Dunkin, F.R.S.; Mr. George Knott, LL.B.; Rev. Charles Pritchard, M.A., F.R.S., Savilian Professor of Astronomy, Oxford; and Mr. A. Cowper Ranyard, M.A.

SCIENTIFIC NEWS.

THE death is announced of Henry J. S. Smith, M.A., F.R.S., F.R.A.S., Savilian professor of Geometry at Oxford, a chair he had held for the last twenty-one years. The deceased gentleman was one of the most accomplished of mathematicians, and one of the leading men of the University. He was also a public man, taking a part in all questions of interest to the commonwealth; it is in fact believed that his fatal illness was brought on by exposure while speaking at a meeting of agricultural labourers a fortnight ago at Oxford. Prof. Smith, who was chairman of the Meteorological Committee, was in his fifty-sixth year.

By arrangement with the authorities of the Smithsonian Institution, Harvard College Observatory, Cambridge, Mass., will in future be the United States centre for the receipt and distribution of telegrams of astronomical discoveries.

Dr. Peters, of Lichfield Observatory, Clinton, N.Y., has completed his series of celestial charts, twenty in number, containing from 2,500 to 3,500 stars on each, or roundly about 60,000. The area covered is the belt extending 30 degrees on each side of the equator.

M. Palisa, the director of Pola Observatory, is the Austrian representative of the Eclipse expedition to the Caroline Islands. M. Janssen will be the head of the French expedition, and the Academy of Sciences has agreed to defray the expenses of a naturalist. The members of the English Government expedition are Messrs. H. A. Lawrence and C. Ray Woods, who will accompany the American observers.

Count Hans Wilczek and Baron Erlanger are the presidents of the Vienna Electric Exhibition which is to open on August 1. The Society of Telegraph Engineers and of Electricians have been appointed English agents for the exhibition, which is a private speculation under the favour of the Austrian Government.

A new telephone, invented by a Mr. St. George, is stated to have been tried the other day between London and one of the outports. It is cheaper than those in use and superior, inasmuch as it gets rid of the difficulty of induction —at least, so it is said. Experiments have been made through 70 miles of wire, no "return" being needed.

Amongst the prizes offered by the Society of Arts is the Howard of £100, which is this year to be an essay on the utilisation of electricity for motive power. Preference will be given to the essay which, besides setting forth the theory of the subject, contains records with detailed results of actual working or experiment. The Council reserve the right to withhold the prize if the essays are deemed unworthy of it.

Dr. W. H. Stone will deliver the first of three lectures on Singing, Speaking, and Stammering at the Royal Institution, on Saturday next. On February 20th Professor R. S. Ball will give the first of four lectures on the Supreme Discoveries in Astronomy.

Dr. A. Milnes Marshall has been giving a series of public lectures on the Darwinian theory, at Owens College, where he is professor of zoology. His object was to act as an exponent rather than an advocate of the theory, and accordingly he took Darwin's books for his facts, and explained what the great naturalist really taught. He closed his first lecture by referring to the extremely commonplace nature of the evidence on which the Darwinian theory is based.

The Essex Field Club is about to investigate the Deneholes at Hangman's Wood near Grays—those curious excavations being still a puzzle.

At Wood's Hole, Mass., the well-known fishing station of the United States Commissioners, an aquarium is to be built to be devoted to biological researches. Preparations are also being made for the artificial propagation of cod, mackerel, halibut, and other fish at the rate of many millions of each annually.

The Speedwell Club exhibition of bicycles and velocipedes, held at the Bingley Hall, Birmingham, this week, is the best of its kind; for while about 80 firms are represented with 400 machines, the arrangements are such that the exhibition is a reality and not a mere shop. The machines are stacked in the hall, and the spacious galleries giving a run of 200 yards are available for trying the machines—an important feature in any exhibibition of velocipedes.

The early history of windmills in France is discussed by M. G. Tissandier in a recent number of *La Nature*. Their origin is rather obscure. The Latins probably did not know of them. Vitruvius makes no mention of them, though he speaks of water-mills. In the Norman texts the first references to windmills appear towards the end of the twelfth century. They were then called Turkish mills—from which it has been supposed that it was through the Crusades that a knowledge of them was brought from the East. In a curious manuscript in the Bibliothèque Nationale (1395) the Baron d'Anglure describes sixteen windmills he had seen at Rhodes, all near each other on one road, and several having six vanes. The same mills are referred to by Seigneur de Caumont, in the fifteenth century. The mills of Eupatoria, in the Crimea (of which M. Tissandier gives a picture), afford an idea of these Eastern mills: "all on one road and quite near each other." Some are like the French windmills, but most have eight vanes. They look very picturesque from the Black Sea. In the sixteenth century several windmills were built of stone, and one such may still be seen in Morbihan, near Auray. There is a stone windmill at Chesterton, in this country, dating from 1678. The present French wooden windmills are very like those of the fifteenth and fourteenth centuries. Both in France and in Holland, the country of windmills, these picturesque constructions are being gradually replaced by steam-engines.

Apropos of the general prevalence of adulteration, the following little fable has appeared in the *Gazette Medicale de l'Algerie*:—Four flies, united by friendship, lived in a certain house. They awoke one morning with a good appetite. The first applied himself to a dish of milk; but, ere long, he died in convulsions, produced by the chalk that was in the milk. The second found a sausage, of which he partook heartily: but the sausage having been coloured with aniline, the little creature was presently poisoned. A like fate befell the third fly, who had eaten flour containing a quantity of alum. Filled with despair at the sight of his comrades, and sick of life, the fourth fly betook himself to a fly-paper in a plate, resolved to commit suicide. He sucked up the liquid greedily, counting on a quick release; but, wonderful to relate, instead of dying, he found himself uncommonly refreshed and vigorous. Even the fly-paper had been adulterated!

The venous blood of a horse that recently died of rabies, at Dinan, was examined by M. Barille, with a magnifying power of 1,200 diameters and an immersion objective. It was found to contain an innumerable quantity of small organisms (vibrions and bacteria), endowed with motion. The corpuscles, especially the white ones, were profoundly altered; these (white) were much more numerous than usual. Further, there were a number of ovoid corpuscles, about two-thirds or three-fifths of the size of the blood corpuscles, with one to three budding appendices. Hallier has described this vegetal ferment of rabid blood, and he calls the fungus *Lyssophyton*. Lastly, the blood contained a great deal of hemoglobin.

Several examples of explosive medicaments have been recently noted by M. Kaeuffer. Preparing a pomade composed of chloride of lime, flowers of sulphur, and other substances, he observed small detonations, and the whole mass deflagrated. On another occasion, spirit of turpentine having been poured into a bottle in which was some sulphuric acid, the bottle burst. Trituration of pure hypophosphite of lime or soda may alone cause explosion; and pilules of oxide of silver may explode. In America a mixture of tincture of iodine with ammonia is often prescribed. This necessarily forms iodide of nitrogen. If explosion rarely occurs, it is because the trituration is generally done with water. A druggist should refuse a prescription for which he has to mix tincture of iodine with an ammoniacal liniment.

An alarum may be arranged (M. Candeze has lately shown) in a simple way, with an electric bell and an ordinary clock. One of the conducting wires is connected with any metallic piece within the clock, the other to a vertical metal rod supported in front of the clock. By means of coiled copper wire, a short horizontal rod is supported on the vertical one, so that it can be slid up or down to any position. Its end next the clock-face is bent at a right angle, and it allows of passage of the longer hand, but makes contact with the hour hand when it comes to the hour at which the rod has been set. The bell then rings. If the apparatus be lightly made, it does not interfere with the regularity of the clock, especially if the person aroused rises to remove it.

It has been observed lately by Herr Traube that not only palladium containing hydrogen, but palladium without hydrogen, oxidises carbonic oxide in presence of water and oxygen to carbonic acid. Hydrogen peroxide is also produced. Platinum behaves similarly. Further, if platinum in form of plate or wire be shaken with hydrogen, air, and water, hydrogen peroxide is produced in abundance. He hopes soon to be able to throw some light on this remarkable formation of hydrogen peroxide, and the puzzling catalytic action of platinum and palladium.

Experiments recently made by Srs. Bartoli and Papasogli prove that oxidation of carbon in the cold state generates an electromotive force, while the produce of the oxidation are organic products. In solutions of soda of potash (sp. gr. 1·10) gas-carbon and charcoal behave as negative elements to chemically pure gold or platinum. The electromotive force after 24 hours was = 0·06 to 0·10 Daniell. With saturated solutions of carbonate of potash or soda, the electro-motive force was 0·1 to 0·17 D. A much greater force is had with hypochlorite alkalies. Some days after immersion, there was a force of 0·4 to nearly 0·5 D. When the positive element in the combination indicated was separated by a porous partition from the carbon-oxidising liquid, a pretty constant electro-motor was obtained, capable of working an electric bell for months.

The French Academy of Sciences has lately lost M. Sedillot, one of its members in the section of medicine and surgery. This gentleman was especially distinguished in military surgery, and imparted lustre to the School of Medicine at Strasburg. His skill was largely brought out during the war of 1870.

The system of electric lighting with Swan lamps, recently adopted on board the French ironclad *le Redoubtable*, deserves notice. There are four Gramme machines (of the type of 500 Carcel burners, so-called), each driven by a Brotherhood engine. The steam is supplied to each motor by an auxiliary boiler, at a pressure of four atmospheres. Each machine feeds a circuit containing 51 lamps. The first circuit, called the *circuit de rade*, is meant to work in the roadstead; the second, or *circuit de mer*, at sea. The machine-chamber, lit in the roadstead by 12 lamps in the first circuit, is lit at sea by 37 lamps in the second. The third and fourth circuits are called *circuits de nuit* (night circuits). One of these lights part of the ship where light is indispensable at night; the other chiefly lights officers' cabins, and supplements the lighting by the first night circuit. This second night circuit affords, as required, lights for the course (*feux de route*), and signal lights; the former being six in number, and equivalent to eighteen of the ordinary lamps used in lighting the ship; the signal lights are ten in number, and equivalent to thirty ordinary lamps. With two commutators, one set is exchanged for the other in either case. The signalling system we cannot here linger to describe.

A remarkable proof has lately been given by by M. Janssen of the great purity and dryness of the atmoshere on the high desert plateaux of Algeria. At Mecheria, a military station there, at which he spent a month, devoting his attention specially to the atmosphere of Venus, he was able to see the satellites of Jupiter with the naked eye; and to apply an 8in. telescope, magnifying 150 times, to the study of the lunar craters illuminated merely by earthshine, the moon being four days old. Thus favourably placed, and using highly dispersive and perfect spectroscopic apparatus, he is obliged to confess, that, relying on spectrum analysis alone, there must be more reserve than has been shown, about affirming the presence of aqueous vapour in the atmosphere of Venus. Any optical evidence of it in the spectrum is very slight.

The death is announced of the celebrated physicist and optician, Johann Benedict Listing.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE NEBULA IN ORION—THE GREAT COMET OF 1882—TELESCOPE AND MICROSCOPE—SEPARATING POWER OF A TELESCOPE—THE ZODIAC OF DENDERAH — SUN-DIAL — COMETS' TAILS — LINEAR DIAMETER OF FOCAL IMAGE IN A TELESCOPE—PERIODS AND DISTANCES, &c., OF COMETS—PERIOD OF β LYRÆ—THE SATELLITES OF MARS.

[21064.]—Most astronomers who have at any time occupied themselves with the observation of that marvellous object the Great Nebula in Orion, and its contained stars, must be familiar with the work of the late G. P. Bond, published in 1867, with the Sturgis fund, in the Annals of the Harvard College Observatory. It may well be held to have represented the sum of our knowledge of this mysterious region at the date of its publication. Since then, however, Professor E. S. Holden has produced two monographs upon this subject, which must be indispensable to every student of the object, or objects, to which they relate. They have appeared as appendices to the Washington Observations. The first one I noticed at the time of its appearance (in letter 20308) on p. 474 of your last volume; the second now lies before me. Its exact title is a "Monograph of the Central Parts of the Nebula of Orion (R.A., 5h. 28m. 24·0s.; N.P.D. 95° 29′ 10·9″, 1860·0)," and an admirable example it presents of painstaking research, and careful observation. One noteworthy feature in this fine volume is the chronological series of representations of the nebula, beginning with that of Huyghens in 1656, and terminating with an autotype enlargement of the wonderful photograph of this region, taken by the late lamented Dr. Henry Draper. These observations are all discussed seriatim and compared, and are supplemented by a valuable series of measurements, micrometric and photometric, made at Washington. An elaborate chart renders reference to any specified portion of the nebula easy. As the result of his exhaustive discussion, Professor Holden comes to the conclusion that notable changes have occurred in various parts of the nebula, principally in their brightness, but that its figure is substantially the same as it was in 1758 (with a possible exception in the case of an alteration in the form of its apex about 1770). He further considers that an actual physical connection between the stars of the Trapezium has been definitely established.

It is, doubtless, my own stupidity which prevents me from quite seeing off-hand the drift of the new perplexity of "C. A. B." (query 49355, p. 508); and I have been far too busy lately to enter into the details of the elements of the Great Comet of last year. If, however, my querist will wait for another fortnight, I will try and look the whole subject up, and see for myself how far the observed positions of the comet corresponded—or failed to correspond—with the published elements of its orbit. In connection with Mr. Penrose's remarks, see paragraph one in the "Scientific News" on p. 495.

If "Mac" (query 49371, p. 509) will reflect for an instant, he will see that a Huyghenian, or a Ramsden eyepiece is nothing in the world but a microscope, used to magnify the Lunar (or any other) image at the focal point of a telescope. If he means to inquire, did anyone ever use a compound achromatic microscope as an eyepiece? then the answer is, Certainly *not*. There would be utterly useless loss of light, and other grave inconveniences; added to which, the limit of available magnifying power of any telescope, reflecting or refracting, may soon be reached or exceeded by the simple two-lens ocular.

"Cepheus" (query 49437, p. 510) should be able just to divide, with a good object-glass, 6th magnitude stars whose components are separated by the intervals set against the various apertures in the table on p. 744 of Chambers's "Descriptive Astronomy." For example—Against the aperture 4·5in., Chambers puts 1·01". If, then, my querist be the possessor of a telescope of 4½in. in aperture, it ought, if it is a good one, to divide stars at that distance apart. Separating power is strictly a function of aperture; hence, an object-glass must be faulty if it fails to divide stars within its theoretical limit.

"Spica" (query 49439, p. 510) will find the Zodiac of Denderah figured on p. 102 of Blake's "Astronomical Myths," translated from Flammarion, and published by Macmillan and Co.

I must really demur to the statement made by "L. L. L." in letter 21055 (p. 525) that the "particulars of construction of a sun-dial" were only "partially given by 'F.R.A.S.,'" inasmuch as the explicit directions which I furnished in letter 20800 (p. 316)—a very trivial typographical error being corrected—will enable anyone to construct a dial capable of indicating time within the limits of the division of the scale employed, my own, lying before me as I wrote, being divided to intervals of five minutes, or reading to one-third of the quantity given by my critic's table of angles. Moreover, a dialling-scale enables a dial to be constructed from it, for *any* latitude whatever by the aid of a common pair of compasses. Whereas the operose method advocated in letter 21055 involves the calculation of the angles afresh for every change of latitude, and the laying them down, when found, with a protractor.

In reply to "An Engineer's Son" (query 49475, p. 533), I would say (1) that it is difficult to speak with certainty as to the plane in which a comet's tail is curved, as it is always seen in projection; but I know of no evidence tending to prove that the curvature is not in the plane of the orbit. With regard to the Great Comet of 1882, when it was first seen it had a straight tail; but the earth was then not far from the plane of the comet's orbit, and however curved the tail might have been, if the curvature were in the plane of such orbit, it would be seen from a point near that plane as straight. As the earth receded from the node of the comet's orbit, the curvature of the tail became more apparent; but the earth has at no time been more than some 38° above that orbit's plane. In connection with this matter, I would refer my querist to the remarks made by Mr. A. Cowper Ranyard at the December meeting of the Royal Astronomical Society, as reported by you on p. 334. (2) As to the law according to which the repulsive force varies, I prefer to say that we know literally nothing. (3) I am ignorant to what drawing or description of the comet by Lieut. Thomson "An Engineer's Son" refers.

As "J. C. L." (query 49497, p. 533) asks for an example to illustrate the method of obtaining the diameter in parts of an inch of the focal image of a celestial body in a telescope, I may as well present him with the working of the first one I gave in the letter 20800 (p. 315) to which he refers. Suppose, then, that the Sun's diameter is exactly 32′, what will be the linear diameter of its image as formed by an object-glass of 50in. focal length? Premising, as I said before (loc. cit.), that the chord of an arc = 2 sin. ½ that arc; then chord of 32′ = 2 sin. ½ 32′, or 2 sin. 16′. Now sin. 16′ = 7·6678445; which we must of course multiply by radius to convert it into inches. Thus:—

$$\begin{array}{rl} \text{sin. } 16' = & 7{\cdot}6678445 \\ 50 \text{ (inches) log.} = & 1{\cdot}6989700 \\ \hline \cdot 23271 \text{ log.} & \bar{1}{\cdot}3668145 \end{array}$$

Therefore, if 16′ measure ·23271in., it is quite obvious that 32′ must measure ·23271 × 2, or ·46542in.

Mr. Cornish, who puts such a string of questions in query 49514 (p. 534), may be informed that the period of Halley's comet is, roughly, 76 years; but that until the necessarily most operose and laborious calculations are made it is not known yet whether it will return in 1911 or 1912. Further, that considering that Méchain discovered a series of comets (1781, June 28th; Oct. 9th, of the same year; March 11th, 1785; Jan. 17th, 1786; April 10th, 1787; Jan. 9th, 1790, and so on), "Méchain's comet" is, just to say, a vague form of expression. The calculated period of d'Arrest's comet is 6·39 years, but it has not been seen since its return to perihelion in 1857. The period of Faye's comet is 7·413 years. It was last observed here in the autumn (Sept., Oct., and Nov.) of 1880. Winnecke's comet has a period of 5·55 years. It was not seen at its last date of perihelion in Sept. 1882. De Vico's comet has seemingly gone into space. It has never been seen since 1841. Brorsen's comet has a period of 5·561 years. Its last return to perihelion was on March 30, 1879. The period of Encke's comet is 3·3035 years. I fancy that it was not observed at its last return to perihelion in November 1881, as I can find no record of such observation. D'Arrest's comet, when in perihelion, is 108,060,400 miles from the Sun, and in aphelion is 528,295,000 miles from him. The perihelion distance of Winnecke's comet is 72,040,240 miles; its aphelion distance 507,976,000 miles. The period of the variable star β Lyræ is 12 days 21h. 50m. I know nothing of the other two your correspondent mentions. The satellites of Mars are called Deimos and Phobos.

A Fellow of the Royal Astronomical Society.

θ AURIGÆ.

[21065.]—O Σ has only one determination of the magnitude of the small close companion of θ Aurigæ (O Σ 545)—viz., 7·8 (that is about 7½ mag) at the beginning of April, 1870, when the small star was discovered at Pulkova, having been overlooked previously to that date both at Pulkova and Dorpat. This determination is certainly much too small, as Mr. Webb observes (letter 21031, p. 521). Burnham rated it as 10·5m. Σ with the Dearborn refractor in 1878, adding that "the close pair is a beautiful object with even a 6in. aperture," and the same observer remarks elsewhere, "as a 6in. aperture shows the small star perfectly, it is a little strange that it should have been so long overlooked." It has been measured by De also, but as I am writing this away from all references except some MS. notes on this star, I am unable at the moment to refer to his observations, but he probably assumed O Σ's determination. I examined θ with my 6½in. Calver, power 164, on March 10th, 1875, but failed to detect O Σ's companion, of the existence of which I was not at the time aware. H's comes at 293·3° 45·5′ (1879) I rated at 12½m. in H's scale (O Σ gives 11·0 and De 10·0, both in Σ's scale), and I found two other *comites*; one, a very faint object, at about 50″ ± in the direction of 170° ±, and a second, somewhat brighter at about the same distance in the direction of 340° ±. H's second comes at 349·6° 127·1″ (1880) was about 9½ mag., and there was a distant 14½ mag. at 270° ± and 150° ±. I was rather astonished lately by seeing the close pair of θ Aurigæ given as a test for a 3in. telescope in a weekly contemporary, with an elaborate drawing, showing its appearance as seen in such an instrument; 5 Aurigæ was also, if I remember rightly, asserted to have been seen with a telescope of the same aperture. Dawes's formula for separating power is certainly stated by him to apply to 6-mag. stars; but he makes the rather extraordinary statement a little further on that "the separability of all magnitudes is nearly the same, provided the state of the air is such as to bear well the increase of power."

February 10th. **H. S.**

THE APPEARANCE OF STAR-DISCS IN TELESCOPES.

[21066.]—Anyone desirous of seeing exactly what a star-disc is in a perfect telescope can easily manage it with the following simple contrivance:—Get two thin pieces of metal and make a small round hole in each, say, the $\frac{1}{50}$ of an inch. Hold one of these to the flame of the gas or lamp, and look through the other at it. A star-disc with diffraction rings at once becomes visible, as perfect as in the telescope on the steadiest night. This little device will show anyone exactly what they ought to see.

E. Holmes.

THE GREAT COMET.

[21067.]—In my short note about the comet, (21035) I omitted to mention an interesting appearance, which I had noted as early as January 5th, and saw again on February 5th, viz:—that the streak of nebulous light constituting the nucleus was composed of a number of luminous points in a straight line. This was very apparent in the clear sky of the latter evening, when at about 6h. the comet was transiting a 10½mag. star, which was so exactly in the place of the principal nucleus, that I thought for a moment the comet had developed a stellar head. At 10h. the star was left far behind.

I see that this division of the heads is confirmed by Mr. Common with his large reflector. I am somewhat surprised that I have noted independently this phenomenon with my 10in. aperture and 110, which should have required a high power with the 3ft. reflector of Mr. Common.

Champion Hill, S.E. **Herbert Ingall.**

JUPITER.

[21068.]—As no sketch of Jupiter has this year appeared in your valuable journal, I venture to send you one.

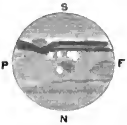
The great double south belt is bent sharply to the north just opposite to what I take to be the ghost of the red spot.

Just north of this belt is a light strip which at its following end seems to expand into three large white spots. On the equator, just north of the preceding spot is a very bright white spot, followed, and partly surrounded by a dark shade.

Time, 7.30 p.m., on February 5th, 1883. Definition moderate.

As Mr. Denning has not favoured us lately with his list of transits, I cannot say whether either of these is the great equatorial spot.

On the same evening, when watching the immersion of III., I fancied that the edge of the planet near the satellite was considerably flattened. The satellite was not half its breadth on the disc at 11 p.m., or two minutes after booked time. Can anybody corroborate this? **David Smart.**



THREE-SCALE MICROMETER FOR ALTAZIMUTH TELESCOPES.

[21069.]—This is a new micrometer, which was designed especially for lunar work, but which admits of being used for other purposes also. Its chief recommendations are that it is very cheap; admits of sufficient accuracy; and requires neither equatorial mounting, nor clock of any kind.

It consists of three equal and parallel scales of equal parts, placed in the focus of the eyepiece, the one I have used being a photograph on glass, the circle being ½in. diameter. The division of the scales should be numbered in such a way that the observer may easily and quickly read off the place at which an object transits the scale as it is carried along by the earth's rotation.

To use it to measure the distance between two objects: bring the object into the field of the telescope, then turn round the eyepiece until the two objects cross one of the scales at the same time—i.e., the scales must be placed parallel to the line joining the objects. Then move the telescope a little until they are just out of the field on the "following" side, and let it stand still. The motion of the earth will now bring the objects into the field as they pass the scale C. Note where on the scale the object No. 1 passed it. Next note where object No. 2 passes scale B; and then again where No. 1 crosses scale A. Now, add half the difference of the first and third reading to the lesser of the two, and the difference between the resulting sum and the second reading will be the distance between the objects.

If one object be due north of the other, the distance will be found at once by making one run along the line D, and reading where the other crosses A, B, or C.

If one is due east of the other, another auxiliary point or object must be chosen north or south of the two. Calling this auxiliary object C (Fig. 2), and the objects whose distance is to be measured A and B, first measure A C, C D, and C B; then A D = square root of $(AC^2 + CD^2)$, and D B = square root of $(DC^2 + CB^2)$, which may be easily found either by logarithms or by common arithmetic.

FIG. 1.

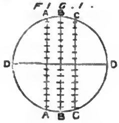


FIG. 2.

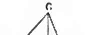
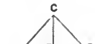


FIG. 3.



If A B makes only a small angle with the parallel of declination in which they appear to move, use Fig. 3, measuring, as before, to get A F; then measure B F, and A B is the square root of $(AF^2 + BF^2)$.

If the means are at hand of counting seconds accurately, of course, the distance of the objects apart in R.A. can be easily found by time; but, by the method described above, a little care and a little common arithmetic will make the observer, with this micrometer, independent of clocks and equatorial mountings. **W. J. B. R.**

THE TELESCOPE, &c.

[21070.]—In reply to "A. S. L." (letter 21009), the aberration of a mirror must be reckoned from the standard parabola. If from that curve we move inwards to the sphere, positive error arises, and increases as we pass from it to the ellipse. With regard to the small convex mirror, it is affected by negative error in passing from the hyperbola to the sphere. Now this negative spherical aberration may be less than, equal to, or in excess of the opposite error of the large speculum, according to the ratio of their foci. In a previous letter I have shown that for two purely spherical surfaces this ratio must not exceed 4·5. But it will be obvious that if the convexity of the smaller mirror is increased, and its focus thereby shortened, it will have a greater negative error, and will need an approximate ellipse for the curve of the large speculnm. Hence, if the small mirror be about one-sixth or one-seventh of the focal length of the large one, I believe a large ellipse and a small sphere will not be far out in balance of aberrations. Perhaps Mr. Calver, in his next letter, will kindly tell us whether this is so in practice.

I cannot see what useful purpose it can be to anyone to guess at the identity of a correspondent merely from the opinions he may express in a letter to these columns. Such a guess must in ninety-nine cases out of a hundred be entirely erroneous. I have the honour to be one of the very, very few who know who it is that has adopted the *incognito* of "Prismatique"; and can assure Mr. Hanneford that he might just as well hazard a shot at the identity of our able and valued "F.R.A.S.," as at that of "Prismatiqne." He would be about as likely to be right in the one case as in the other.

With regard to the battle of the glasses, I am glad to see the editorial note appended to Mr. Calver's letter. Each instrument will hold its place, no matter what rival makers may say. But apart from this matter, I may perhaps be allowed space for a few comments on letter 20987. Here I find Mr. Henry Wray entering your columns in so startling a manner, that, like Nicodemus, I cannot refrain from asking, "How can these things be?" Let me qnote a few of his words—"In most cases those who make reflectors do so because they *cannot* make refractors, and that those who use reflectors do so because they are *cheap*." We can only conclnde from this—first, that it is a much easier task to make a good reflector than a good refractor; and secondly, that the reflector is only a makeshift which would be most unmercifully smashed, if its unfortunate owner could only afford to purchase a big refractor. On this second point I must say nothing: I shall then avoid trespassing on forbidden ground. But with reference to the constructive difficulty, I hold a different opinion to Mr. Wray. Suppose Mr. Calver, instead of writing a calm, thoughtful, and instructive letter, had retorted, "Those who make *refractors* do so because they *cannot* make reflectors." Might he not have said so, and supported his assertion by quite as many facts as could be brought forth by a maker of refractors? How many of the old opticians could produce with certainty a *perfect* parabola? I think Short is generally credited with being the most skilful in this respect, and he set so high a value on this knowledge that it is said he divulged the secret to no one. My impression is that it is only in very recent times, that the improvements and simplifications in methods of working optical surfaces have rendered the production of reflectors a commercial success. How many specula did Herschel, Lassell, Draper, and others find it necessary to work, before they got a satisfactory result? I have the pleasure of having made the literal acquaintance of several who can make good specula; and from each and all I learn that the production of a first-class reflecting surface is a work demanding much care, thoughtful perseverance, and acquired skill, in knowing what to do, and how to do it. I do not under-rate the task of producing a first-class o.g. There are more surfaces to figure, though they are less in area; but I fail to see that any greater skill is needed to produce a refractor than a reflector.

I now come to the concluding paragraph in Mr. H. Wray's letter. Relative to the production of crown and flint discs of large diameter, "of uniform density throughout," he says, "this is one of the things yet to be done." This sentence, coming from an eminent maker of refractors, is, to me, incomprehensible. I take np Chance's "Tariff," from which I learn that T. Cooke and Sons have worked a pair of their 25in. discs; and that Alvan Clark and Sons have worked two pairs 26¼in. diameter. Next, from the "Tarif" of M. Feil, I learn that he has made a pair of 28in. for the Vienna Observatory (worked by Howard Grubb), a pair of 29in. for the Paris Observatory (worked by M. Martin), a pair of 31½in. for the Pulkova Observatory (worked by Alvan Clark), a pair of 30in. for the Nice Observatory (worked by MM. Henry), besides several pairs slightly smaller, including Lord Campbell's objective, 20in. in diameter, made by Adam Hilger; and that, in 1881, he has the discs for an "Objectif, 0m 96 [about 38in.], en fabrication, et destiné a l'Observatoire de Californie." Now, are all these big discs wanting in homogeneity? If so, why are they made? I have always been led to think that a disc, not uniform in density, was useless for optical purposes.

I am sure very many besides myself will be glad to see Mr. Wray's name among the list of correspondents to these pages. If my comments on his first letter seem unfavourable, they are so from no other desire than that of eliciting information.

Feb. 5th. **Orderic Vital.**

SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[21071.]—I am sorry to trespass further on your space, but I am anxious to sum up the results of this capital discussion. The peculiar advantages of the English Mechanic are shown in letters of this nature, by which more real information on the matter in hand is obtained than from any amount of "reading np" on the subject.

I take my own instrument as the illustration—12½in. mirror, 9ft. 3in. focus, flat at 12in. from the focus. The cone of rays from the moon reflected from the mirror measures at the flat 2³⁄₁₆in. dia., and the stellar cone 1⅜in.

The 2¼in. flat will consequently take in all the rays, with a proper margin to spare, of the cone from the moon, or from any image whose field is 32′ angular dia. The 1⅜in. flat will take in all star images, and up to a field, actually, 19′—practically, or with the best results, 12′ to 16′. Beyond this, when observing the moon, the flat acts as a stop, gradually decreasing in size till, on the extreme edge of the moon, the outside of the cone, the stop is equivalent to 9in.

There is, however, more light than with a 9in. stop, as it is only reduced to this at the circumference, and all the details of the moon's surface are observed with all the advantage of the small flat, more light and better definition.

We have, therefore, the result that the 1⅜in. gives more light on small images, when it is wanted, and less on large bright ones, when it is not of so much consequence. The 2¼in., on the contrary, gives more light when it is *not* wanted, and less when it is.

The only objects on which, *generally*, the larger flat is required are for comets and large fields, where you wish for the whole effect at once. The field of view is not affected by the size of the flat.

Will Mr. Vallance look at the moon when full, or nearly so, with his 15in. mirror and 14in. disc, with 1⅜in. flat, and tell us exactly what he sees?

Fordingbridge. **T. Westlake.**

[21072.]—In answer to Mr. Calver (21040) I really do not recollect any challenge of Mr. Bell's. There is a question in his letter (21007) of "how I prove my theory that the longer the focus, the larger the flat," and I think if he will refer to my former letter (20900) in Jan. 5, I say, if this were correct, that is, if it were necessary to have a flat large enough to reflect the image of sun or moon, then for a mirror of very long focus and small aperture, the flat would be required as large as the mirror. I think no one will deny this; and I think this proves the principle to be wrong.

Now for the question of "A. S. L." (21039). By what authority I state that the stops in the refractor are placed without any reference to the size of the focal image?

I have refracting telescopes made by Tulley, Adams, Troughton, Murrell, and others; and in all of them, when they are focussed on a distant object, if the eyepiece is removed and the eye put in its place, all light is cut off by stops except that from the object-glass alone; and if I saw more than that which would show me any portion of the tube inside the object-glass, I should consider it improperly stopped. This must be the case if more than the light of the object-glass for parallel rays is admitted, and therefore I conclude that no allowance is made for size of image of sun or moon.

I feel somewhat consoled for my condemnation by Mr. Calver when I find he is equally positive as to the errors of refractor makers of old; and I would ask him whose telescopes he has seen that show more of the object-glass than those I have? I should like very much to learn the opinion of an optician, such as Lancaster or Wray, as I believe only amateurs have given their opinions as to size of flats, &c., as yet.

Philip Vallance.

REFRACTORS, REFLECTORS, AND ASTRONOMICAL WORK.

[21073.]—Although in the heading to my letter I speak of "refractors and reflectors," I have no desire to rush into this rather acrimonious, and apparently useless, controversy. But I do desire to point out that it appears to me that in the discussion of this question *too little* has been said of the adaptability of the two kinds of instruments for different kinds of work. For my own part, I have little personal experience in the matter, and raise the question from an abstract point of view. I think that *too much* is made of splitting close double stars. To many, it would seem, the whole pleasure and profit of astronomical work consists in the dividing of doubles. Now, *merely* to divide a close double, or *see* a faint *comes*, what good is to be gained from either achievement? It does not add much to the general stock of knowledge, to have it recorded that Mr. A.—whose eyesight is keen—has split a star which Mr. B.—whose eyesight, perhaps, is not so good—could not see double, though his telescope was ¼in. larger than that employed by Mr. A. What I want to point out is this: that there are *many* branches of astronomical work, and that contributors to this discussion would do well were they to say a little *more* about the comparative performance of refractors and reflectors in matters *other* than the picking np of faint *comites*. There are branches of astronomical work, I say, *as* interesting, and far more instructive, than that double-star note which seems to bewitch all its votaries.

First, as to *Variable Stars*.—Many of the more important variables require for their study no telescope, only a good opera-glass, field-glass, or eye. For my own part, I know that my observations have been made mainly by the aid of a little field-glass, which cost 2s. 6d. Properly used, this instrument is, for the brighter stars, as good as my opera-glass. I hope Prof. Pickering's appeal for more assistance in this field will meet with a hearty response in this country. Mr. Espin, in his paper in "Ours" for April 28th last, says that, "the amonnt of valuable contribntions to astronomy in the country is steadily on the decrease." He ought to know. If it be so, it is a melancholy thing that the country which has given to the world more great amateur astronomers than any other—the country of Dawes, Lassell, Birt, and Webb, to name no more—should abandon the post of leader.

Second, the *Colours of Stars*.—Here is a most important, but almost completely neglected, field of study. The causes of the variations in the assigned colours of individual stars, which are so often noticed, deserves—indeed, demands—careful and complete investigation. How much is due to personal differences in the eyesight and training of the different observers? How much is due to actual variations in the star? These are the questions. Who is attempting to solve them? I think that much of the variation in the colour assigned arises from the circumstance that every observer refers the colours to a standard of his own. If a number of stars were examined by observers whose eyes were free from fault, and a standard list of variously-tinted stars drawn up, each observer would have a guide to the character of his own eye, and might be enabled to ascertain how, and in what degree, any peculiarity of vision he might possess affected his observations. As affording a means of tracking sources of error, such a list might be invaluable.

Third, *Selenography*. Here is another neglected branch. Plenty of workers there are; but there should, and might, be many more. The pages of the *Astronomical Register* show what there is to do. Much of it, no doubt, requires an instrument of a high class. But so many fine telescopes are there in England, that this circumstance ought to create no difficulty. By the way, Mr. Muschamp Perry has a magnificent instrument, and frequently laments in "our" columns the unsuitableness of our weather for the finest work. (*En passant*, if English skies *are* as bad as they are represented to be, how has it come about that so much of the *best* astronomical work has been done in England?) Does Mr. Perry never turn his instrument upon the moon or the planets; or does he—to omit the negative from a sentence of Mr. Webb's—think "the sole, the chief, attraction of the sidereal heavens *does* lie in the juxtaposition of two stars, possibly merely accidental, and frequently beyond the reach of any but the most powerful instrument."

Fourth, the *Planets*.—Here, also, is plenty of room for work.

Fifth. There are in the heavens many clusters and aggregations of stars, which, even to a casual inspection, have an appearance strangely suggestive of mutual connection. The discovery, examination, and treatment of these groupings might give us the key to more than one mysterious problem. All who know Mr. Proctor's magnificent researches into the distribution of stars and nebulæ in space, must know how important that great astronomer has deemed similar aggregations. It would be well to inquire, in how far *community of colour* obtains among the members of those whirls and streams. I have a fancy that it does so to a great extent.

Sixthly (and I will *make* it lastly), there is the *Search for Telescopic Comets*.—Mr. Denning appealed for assistance in this matter last April; but I have seen no more about it. The possible reward of such investigation ought to dispel any tedium which may surround it.

It will be seen that what I urge upon possessors of telescopes is, that they should take up work involving questions relating to the physical constitution of the heavenly bodies. It is of no use our doing imperfectly what others far better equipped have done, or are doing, better. The detection of a million double stars would bring us no new knowledge. The discovery, even, of a hundred thousand binaries, would only show us that they were more numerous than we had imagined. It *is* possible, that *were* so many doubles and binaries known, their distribution might involve an important generalisation; but it is not, I apprehend, to this end that our numerous double-star hunters and splitters are directing their labours.

But an important consideration is this: that double stars are permanent objects, whilst the appearances upon which our chances of gathering information concerning the physical structure of the heavenly bodies depend are phenomenal. Had there been more workers in the field of selenography, that entire failure to observe that portion of the moon in which Hyginus is situated, which happened during the year prior to the detection of N., could hardly have taken place. And how valuable would even *one* good observation made in the interval be. In this department of astronomy lies the best chance of and the greatest promise for future work. Not until we have a record, perfect as human perseverance can produce, of the moon's surface, can we attain certainty in investigations concerning a lunar atmosphere and lunar changes. Not until we have attained *full* information as to every peculiarity in the changes of light in *every* variable; full information as to their colour and changes of colour; as to their periods, and the varying irregularities which mark them; as to their spectra, and changes in their spectra, can we hope to penetrate the secrets of the most mysterious bodies in the universe.

To come back to where I started, What have experienced observers to say concerning the relative merits of refractors and reflectors in such work as the above?

S. Maitland Baird Gemmill.

Glasgow, Feb. 5.

TO MR. VALLANCE.

[21074.]—MAY I conclude from his letter that he now sees and acknowledges his mistake about the necessity for providing the flat large enough for moon's image? I thought the clear way it was shown by "F.R.A.S.," "A. S. L.," Mr. Westlake, Mr. Bell, and myself, *ought* to convince him.

I have said nothing about *his* flat, and, for all I know, it may be too large. I have only been concerned in showing Mr. V. that I was not wrong, as he said, in supplying them larger than was required for stars. Perhaps he is quite right when he says I shall not find a 12¼in. by an old maker with a 2¼in. flat.

I should hardly think Herschel made the mistake of putting a 1in. to a 10in. mirror of 10ft. focus. It might have been the act of some "lesser light." It is about half the size proper. The 6¼in. he speaks of should have 1¼in. instead of ¾in. Mr. Vallance says it does not matter about cutting off the aperture, and thereby the light, because there is too much light with large mirrors when observing the moon. This is also an erroneous argument, and ignores the vastly superior *defining* power of large aperture over small. Apart from light, is it not far wiser, if there is too much light, to reduce it by proper means, with a moon shade, or, better still, with a graduated sliding wedge of neutral tint? There are other objects requiring the large flat, and for which we can't have too much light, such as clusters, nebulæ, &c.: aperture and light for these objects, and also for photography, is the grand thing, and it is the height of inconsistency to waste it by using a flat only large enough for stars.

Mr. Vallance asks me to reply to several questions—it is not an easy thing to follow his reasoning. He says as his tube "is only the size of his mirror, can any but *parallel* rays get to the mirror when directed to the moon"? &c. I answer, None, nor would there be if he had *no* tube at all. According to his views, refractors should have a long tube in front of the o.g., so as to exclude, as in his reflector, all but parallel rays from getting to the object lens.

He seems to think that a telescope acts like a camera lens, and if it were not for the tube the mirror would take in rays from a great angle, and from objects to which we *do not* point it, and he thinks (in fact, says so) that if it were not for his tube his mirror would take in *converging* rays from the moon. Is Mr. V. serious?

He concludes, "And until I am shown [the difficulty is for him to see when he *is* shown] how converging rays from sun or moon or any object can get to my mirror, I shall be content with a flat that will reflect all the parallel rays into the eyepiece." This looks as if, after all, he is of the same opinion. As long as the moon to us remains of the same angle, or at the same distance, none but parallel rays can possibly "get to his mirror," and he may remove his tube and his results will be all the same.

Mr. Vallance is a very old correspondent, and has sent us many clever and useful contributions on telescope matters, and I hope he will continue to do so; but, with much respect and deference to him, I must say that somehow his mind is in a state of confusion and misunderstanding over this matter of the proper size of flat. **G. Calver.**

WHAT SHALL WE EAT AND DRINK?

[21075.]—IN a few years I shall enter my seventy-first year, and as Dr. Allinson has determined to attain that age, his words being, "I am going to live till I am seventy," I shall be happy to offer a few hints which, being the result of *experience*, may help him on his road to that desirable (?) end.

In the first place, I have not been a vegetarian. I once tried the system for three months to see if I could save expense; but at the end of that time I felt like unto Job's comforter, Elihu, the son of Barachel the Buzite, of the kindred of Ram, when he said—"Behold, my belly is as wine which hath no vent; it is ready to burst like new bottles," and I returned to my ordinary food with thankfulness. Secondly, for more than half a century I have smoked tobacco; the greatest enjoyment of my life has been my pipe and my books. I have not taken much nor regular exercise, nor have I had a bath every morning. Neither have I abstained from beer, wine, spirits, &c., but simply partaken, always in *moderation*, of the bounties of nature added to by the ingenuity of man. I had nearly forgotten an important item—I have always abhorred and avoided physic. Some dry toast and weak tea for a day or two has been my remedy for indigestion. So it will be seen that I have managed to attain my present age in spite of medical theories, and, though a smoker and not a water drinker, I, like the little jackdaw of Rheims, have been "never the worse" for my predilections. I am indebted to Dr. Edmunds for reviving a pleasant recollection. Hot water is always suggestive to me of "Gil Blas" and Dr. Sangrado. I can always grin when I think of *their* practice.

I do not think that the general stock of good sense has received any addition from the medico-theoretical effusions that have appeared lately, of which it may be said that "what is good is not new, and what is new is not good." However, the old man has had his say, and one result of his experience is, that it is best both spiritually and bodily to "take no thought for what ye shall eat or what ye shall drink," but that with "moderation" (in every sense) no normally healthy person need restrain his fancy or appetite in food.

F. F. C.

[21076.]—"HOUSEKEEPER's" letter, which has been on your book for more than a month, remains without a reply from Dr. Allinson, although the essential points of it have been emphasised by subsequent writers. Dr. A. asserts and re-asserts the proposition, that, tea combines with the meat you eat, and the product is leather, and he says, Look into a tan-pit, and there you have my authority. In my earlier days I had a good deal to do with leather, and unfortunately during the last five years have been under the constant supervision of my doctor, and have consulted and corresponded with not a few eminent men both here, in the provinces, and in Paris. My experience, so far as it goes, tends to this: that there is nothing so dangerous as a doctor firmly tethered to a theory, however "eminent" he may be. He will confidently advise, as a certain cure, an operation which has never yet been tried, and has since failed, or change your whole mode of living, under any circumstances. His reasoning is at least as good as Holloway's pills, Eno's fruit salt, or Cockle's pills, the pedestal on which Colonel Burnaby stands.

But let us look into the tan-pit—and then into your stomachs. I have always understood that oak-bark was the agent strongest in tannin known to commence, and that it was put into the tan-pit with *raw* hides; but that, such was the weak affinity of the tannin for the gelatine, that it required some three months to produce good leather. Now as to the stomach. I am told by the purveyor where I used to dine, that a saddle of mutton will provide ten dinners, and give to each person ten ounces of solid meat, and I am also told that there are about ten grains of tannin in two pounds of tea. Supposing the two pounds of tea to be brewed, and given to the ten persons to drink, while eating their saddle of mutton, it would give an immense quantity of tea, and one grain of tannin to each. I defy them to swallow the quantity of tea in the time if they tried.

Dr. Allinson's assertion, therefore, amounts to this: that a grain or two of tannin combines at once with ten ounces of roast (not raw) meat, although it has been masticated in saliva, and afterwards submitted to the gastric juice, and turns it, there and then, into leather—into the self-same product which it takes, I believe 10 grains of tannin three months to effect when applied to 10 ounces of raw hide in the tan-pit. To my surprise he re-asserts this, (Feb. 2, p. 50, 3rd col.) and now condescends to quote Kirke's "Physiology" as his authority. But the quotation from Kirke proves exactly the contrary of his assertion, and a second year's student, at whom he sneers, could have told him this, I think. Kirke says it requires tannic acid, that is to say, tannin in one of its most concentrated forms, and exhibited in great excess of the gelatine, in order to detect the smallest quantity of gelatine in water. Dr. Allinson's assertion is that the smallest quantity of tannin, in a highly diluted state, will at once resolve ten ounces of meat into tanno-gelatine, and that too in the presence of other agents of a most powerful character.

There has been a good deal of inquiry about sciatica in the "E. M." of late. My experience of the last three months may possibly interest many, and I hope benefit some of your readers. An accident, some five years ago, laid me at the mercy of results so serious, that my pulse had to be reduced to 55 per minute, and an essential part of the treatment was, of course, a low diet; still I was always allowed three ounces of meat per day. I drank very little, and that, principally, milk and water; often going for a whole day or more, without any liquid whatever. I had not much difficulty in bearing this treatment, having always been temperate, in the old-fashioned sense of the word. I was in bed thirteen successive months, and have kept a strict watch on my diet all these five years, in fact lived rather too low for my family to be pleased with. Not by any means a vegetarian, I have always allowed part of my vegetables to pass through the alembic of a sheep or an ox. In November last I was attacked by sciatica, lumbago, and general neuralgia of the left side, from the shoulder down to the sole of the foot, of an excruciatingly painful character. Two months' treatment with drugs, blisters, plasters, &c. only seemed to increase the misery. At last on one culminating occasion, after losing 36 hours' sleep, having had to rest sometimes standing upon one leg, and doubled up, with my elbows on the table, afraid to move, almost exhausted, I was persuaded to eat a chop at breakfast. In half an hour afterwards the pain had materially abated and could be easily borne; at dinner the same day I took more meat and a glass of port wine, and at supper again more meat with a little brandy-and-water, and I slept in my bed after that from 11 p.m. to 8 a.m. with one short break, waking up next morning tolerably free from pain. This happened on the 5th of January, and I have pursued ever since, in principle, the same regimen, but gradually modifying it, and during the past week I have been able to travel three times to town. All this time, my old malady, which is only arrested, and cannot be cured, has to be watched.

I am as great an advocate of temperance as Drs. Edmunds and Allinson, but do not think any one can ask me to place such cogent experiences and facts aside in favour of their theories and assertions. My present diet is meat twice a day, tea twice; I have dropped the wine at dinner, and drink soda-water and milk, but still take one ounce (measured) of brandy in soda-water at supper. If I have meat at breakfast, I do not take it to supper also. I am taking no medicine. I have always had great faith in the power of diet—but not in the vegetarian and the "devil in solution" form of it.

Dr. Edmunds, some short time ago, recommended a "salutaris water" drink, flavoured with lemon, for the use of glass-workers. Did he ever *see* them at work on a hard pot-setting, in a large glass-bottle manufactory?

J. D.

[21077.]—Dr. ALLINSON says "tea is worse than coffee, because it contains thein, a stronger alkaloid than caffein." Schorlemmer (whose authority few chemists would dispute) says, in his "Chemistry of the Carbon Compounds," "Caffein, thein, or methyl-theobromin, $C_8H_{10}N_4O_2$ occurs in the coffee-berries (1 per cent.) and the leaves of the coffee-tree (in tea 2 to 5 per cent., &c.). It is prepared from raw *coffee-berries or from tea* by a process similar to that by which theobromin is obtained from cacao nuts." "E. C. T." and "Anglo Dane" will see from this quotation that Dr. Allinson is mistaken, and that caffein and thein are identical in composition. **Otter.**

[21078.]—IN letter 21048, Dr. Allinson states (as a test experiment, I suppose) that if a man takes four or five meals per day, including plenty of animal food, a moderate allowance of alcoholic drinks, no exercise, and smokes freely, he will be ill in about five days.

Well, facts are stubborn things. How does he account for my being perfectly healthy and my brain not at all "clogged" after living for the past ten years in the following manner:—I am a watchmaker, going to my work at 8.30 a.m., and leaving it at 7 p.m. I take four meals per day, meat for breakfast, meat for dinner, bread-and-butter for tea, and bread-and-cheese for supper, and a pint or a pint and a half of beer during the day. The shop in which I work is 15ft. by 10ft., and I scarcely ever get any outdoor exercise. Such is the usual routine of a working watchmaker's existence, and still I am alive. I really begin to think I must be something very much out of the common. I also smoke freely. **Watchmaker.**

FOOD AND LONGEVITY.

[21079.]—The oracle has spoken, but its utterances seem nearly as edifying as those of Delphi. Does Dr. Allinson really imagine he has told us anything in his letter 21048, p. 523? It simply amounts to saying, "Gorge yourself with food which requires good digestive powers and abundant exercise to work it off; do not take that exercise, but do everything that every sensible person knows is wrong, and you will not enjoy good health. Eat moderately, exercise freely, and generally adopt those conditions which universal experience has taught conduce to health, and you will have a good chance of continuing in good health." But surely such a regimen as this will not justify any man in asserting that upon it he will never be ill, and will live to seventy or eighty. It does not even touch the question of vegetarianism; for I would undertake to make a man quite ill enough to satisfy any moderate desire in that way, on a free diet of, say, split-peas, turnips, and crab-apples, as a selection of "fruits, roots, and grains," throwing in a supply of warm water *ad libitum*. Eat as much as you can of these, "keep much indoors, in hot, close, rooms," take no exercise or baths, and I will back it to be as effectual as beefsteaks and oyster-sauce.

I have written a good many articles, and I refuse to accept Dr. Allinson's directions. If I sit to write "in the early morn, when the stomach is empty," I should desire the subject to be a critique of the cutting-up order, in which little thought was wanted. If I wanted to write something in the scientific line I should wait till about 4 in the afternoon, having dined moderately before 2, and with the interlude of a cup of tea between 5 and 6, with a slice or two of bread-and-butter, should go on till 9 o'clock. In that time I should do twice as much work, and of better quality, than if I began before breakfast. The early part of the day I should devote to reasonable outdoor exercise, or mechanical work, turning over in my mind meanwhile the subject I meant to treat.

I did not quite finish what I began to say (21043, p. 522), as to the evils which attend the abuse of alcoholic liquors. I meant to say that these evils do not in themselves justify the abandonment of their use. It may be that on a broader view they are only incidents of civilisation; they may be regarded as the killed and wounded in a battle—sad incidents, evils in themselves, yet not to be regarded as the main point. I thoroughly believe that it is a perversion of facts to charge all the poverty, crime, and death to drink: the cause is deeper seated; the drink is but a secondary cause, a pathway along which motion is imparted from other agencies, of which the alcoholic abuse is really an effect.

All honour to those who seek to diminish the action, even though they may be attacking symptoms rather than the disease. But I refuse to put my conscience and my reasonable liberty at the disposal of anyone else. Besides, there is no end to all this. If we listened to the tales of cranky medical people, life would be a perfect burden. What with the dreadful effects of alcohol, tea, coffee, meat, sewer-gas, &c., the marvel is that this world has any men and women upon it. With all these fearful causes of death and disease, the English people somehow not only exist, but increase and multiply at a very reasonable rate, and do their work in the world. And I will say another thing: I know both the Chinese and Hindoos by personal acquaintance, and I will back the omnivorous and spirit-drinking (to say nothing of opium which is far more seriously evil) Chinaman against the vegetarian teetotal Hindoo any day and at any work.

Sigma.

DIET AND INTELLECT.

[21080.]—The quotations I now bring forward are from Graham's "Science of Human Life," and the numbers refer to paragraphs there.

(1154.) Dr. Lamb affirms "not only are the special senses improved by the disuse of flesh, but this improvement pervades every organ and influences every function of every part of the system."

(1156.) Theophrastus says that "eating much and feeding upon flesh makes the mind more dull, and drives it to the extremes of madness." Dr. Lamb says "it was proverbial amongst the ancients that the athletæ were the most stupid of men; and Diogenes the Cynic asserted that it was wholly owing to their excessive use of the flesh of swine and oxen."

(1157.) "The Calmucks, and, indeed, all other portions of the human family that subsist principally upon flesh, are remarkable for their mental stupidity, sluggishness, and indocility."

(1158.) Sir John Sinclair, in his "Code of Health," says that "vegetable food has a happy influence on the powers of the mind, and tends to preserve delicacy of feeling and liveliness of imagination and an acuteness of judgment seldom enjoyed by those who make free use of animal food. The celebrated Franklin ascertained that a vegetable diet, promoting clearness of ideas and quickness of perception, is to be preferred by those who labour with the mind. In proof of the assertion (continues Sir John) that a vegetable diet promotes clearness of ideas and quickness of thought, and that a transition from vegetable to animal food produces injurious effects, a friend of mine states that he has more than once selected from his tenants' children, in Ireland, a boy remarkable for that smartness of intelligence so common in the Irish youth while in the capacity of errand boys on the farm or helpers in the stables, and before they became pampered with better food than their parents' cabins afforded. The lads, at first, were lively and intelligent, and displayed a degree of shrewdness exceeding what is generally met with from the youth of a more elevated walk in England. But he invariably found that in proportion as those boys became accustomed to animal food, and (according to common notions) were better fed, they relaxed in activity, and became *dull and stupid*; and he is confident that the change in the disposition was the effect of the change of diet, and was not owing to corruption of mind from intercourse with the other servants. In fact, they lost all vivacity of manner. . . . He is therefore inclined to think that the character of the people does not depend so much upon climate and soil as upon food."

(1165.) "In the Orphan Asylum of Albany, New York, from 80 to 130 children were, in the close of 1833, changed from a diet which included flesh or flesh-soup once a day, to a pure vegetable diet regulated by physiological principles. Three years after this change was made, the principal teachers of the institution thus speak of it." (Refer to Note A.) "Miss Grimwood and Miss Clark also state that the change in the temper and disposition of the children since they have adopted their new regimen is very great; they have become less turbulent, and irritable, and peevish, and discontented, and far more manageable, and gentle, and peaceable, and kind to each other; and this, say the superintendents, is not the result of a want of spirit and energy, but of a healthy state of the whole system—a general serenity, an absence of morbid irritation."

"The effect of the new regimen on the intellectual powers of the children (says Miss Clark), has been too obvious and too striking to be doubted. There has been a great increase in their mental activity and power; the quickness and acumen of their perception, the vigour of their apprehension, the discriminating energy of their comprehension, and the power of their retention, daily astonishes me."

(1166.) This paragraph speaks of Greek children and their aptitude for learning. Dr. Korke, their teacher, says:—"He had never in any country found children equal to these for clearness, sprightliness, and power of intellect; for aptitude to learn and ability to retain. Dr. Korke attributes this extraordinary ability in his pupils mainly to their habits of living, which were extremely simple; coarse unbolted wheat-meal bread, with figs, raisins, pomegranates, olives, and other fruit, with water, constituted their diet."

(1167.) Speaks of young negroes in one of the West Indian islands; he says:—"With all these little field negroes, which lived on corn-meal, yams, peas, &c., there was the utmost avidity, as well as aptitude, to learn. But the little negroes of the same age in the house, living on what came from their master's table—animal food, &c.—are wholly different; they are totally disinclined to receive instruction, and are slow to learn, like our white fed children of the North."

Thus we have a few quotations, showing how children may be made "dull and stupid," or "clever and bright." I hope in my next to show how to make them "always ailing," or in "universal good health."

T. R. Allinson, L.R.C.P.

DR. ALLINSON'S DIETETIC REMARKS.

[21081.]—Dr. Allinson, in letter 21048, takes distinctly lower and more reasonable grounds than heretofore. Nevertheless his statement that animal food makes people dull and heavy, is not borne out by facts. We can easily test his assertion on a large scale, by referring to the dietary scale of the nations of the earth; and we certainly find the nations who live on the larger proportion of animal food are superior — not inferior — in intellectual powers and products, as they are also in courage and strength. The dominant races of the earth are, and always have been, meat-eaters. The smallest reference to the animal world will also show that it is the exclusively vegetable feeders who are the heavy-bodied, heavy-minded, and slow, while meat-eating animals are slim, active, and keen. If not the result of long ages of meat-eating, this is at any rate its regular concomitant. Intellectual work cannot be so well done after a heavy meal of any kind—not merely after a meat dinner, as Dr. A. says. Nature enjoins rest after a heavy meal; but who has recommended heavy meals? It is the intellectual worker who needs his food in the concentrated form of flesh.

Dr. A. has given us a sure recipe, not *receipt*, as he writes, for being always ill; but what is wanted from him is the converse: how by food to be always well. Dr. A. has felt it necessary to supplement his diet by other well known aids to health, which, however, he reserves for the vegetarian, and asks the meat-eater to eat too much, to drink and smoke freely, do without exercise and fresh air, and be as dirty as he can. Suppose the vegetarian tries all this dirt, smoke, drink, and close confinement—will he not develop illness very soon? Dr. A. is hardly fair here; he knows it is these other factors that make health or sickness, and neither the meat nor the vegetables as such. But he also knows that all the care a man can take will not insure continuous health until seventy or eighty. Some, if not all, are born with the seeds of various disorders inherent in their constitutions. However, he has qualified his *never* to *rarely* be ill, now.

His next paragraph is partially well-worn truisms. Surely it does not need vegetarian diet to enable a man to discover that a hungry man is generally disposed to be worse-tempered than a full man, but either meat or vegetables will restore his equanimity. If Dr. A. could show that a vegetable dinner had a greater effect in this way, than meat in addition, he would have scored a point. He tells us his letter was written about five hours after a vegetarian dinner, and that he missed his tea to (I presume) leave his faculties clear for the mental strain he endured in the process. I also presume he intends us to notice the admirable results of this sustenance, delay, and abstention. Well, I am not struck with the result. His premises are unsound, his deductions illogical and unwarranted, his illustrations irrelevant, and his conclusions unsound. Meat would not have caused any deterioration at all. He says he has been a vegetarian a year, and can take a deal of exercise without fatigue. He is a young man, and most young men can do the same. Can he do more *hard* labour than before? If he can, he is an exceptional case; and unless he can also show that the same result follows with men generally, he does not make out a case for an exclusive vegetable diet.

I take it *citrate* of potash is a mistake for *nitrate*; but I shall have to have a vegetable meal before I can see what its recovery as carbonate from urine has to do with the use of alcohol. Does any one drink alcohol, however? If not, it is useless to discuss its evil results. Beers, wines, and dilute spirits are the drinks in ordinary use, and not alcohol. I need not tell Dr. A. that the effect of dilution is considerable, as the air we breathe furnishes a convenient proof. I am glad to see he has abated his pretensions, and have no doubt, as he grows older, he will abate still more of the presumptuous confidence which led him to assert his certain freedom from illness and attainment of the age of seventy or eighty at least.

Edwin Holmes.

[We are inundated this week with letters from correspondents anxious to assure Dr. Allinson that they have for years followed the system of diet he prescribes on p. 524 to be followed in order to be "always ill," and that they thrive vigorously. We have inserted one or two letters, and can only congratulate the writers of the others on their constitutions! We have, for the time, at least, given as much space as we can spare to the subject.—Ed.]

SUNDIALS.

[21082.]—Can any reader of the English Mechanic say what has become of the very curious seven-faced dial, which some years since stood on top of a pillar in that odoriferous locality in London, to which it gave its name? It was a remarkable example of the "antient art of dialling."

I had, some years since, to divide a dial for a friend's garden in the South of Ireland; it was on a thick octagon block of slate, about 18in. diameter. I glued on a sheet of drawing paper, and on it drew the lines, after the most approved problem of the "Antient Art," and in order to test their accuracy, I calculated the chords of the angle of each half-hour, using a beautifully divided scale, by Bate, of the Poultry. I found that although I had used every possible care in the points, intersections, measurements, &c., in working out the geometric construction, the calculated angles laid down by their chords, not by a protractor, very much surpassed it in accuracy. In laying down angles, where considerable accuracy is required, I always prefer doing so, by calculating the sine or tangent to a fixed radius, to using the protractor.

February 10. **Robt. J. Lecky.**

USEFUL FORMULA IN THE CONSTRUCTION OF A HORIZONTAL SUN-DIAL IN ANY LATITUDE.

[21083.]—Log. tan. D. = log. tan. H.A. + log. sine lat. where D = angular distance between the hour line required and the noon line, and H.A. = hour angle, which is of course 15° for each hour—*i.e.*—

the H.A. of 1 o'clock = 15°
" " 2 " = 30°
" " 3 " = 45°

and so on.

Example: What angle does 5 o'clock line make with the noon line on a horizontal dial in Latitude 55°?

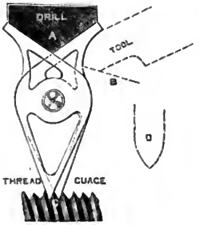
Log. tan. D. = log. tan. 75° + log. sine 55°
= 10·57 + 9·91
= 10·48
D. = 72°

It will in practice be found only necessary to work it out to the ¼ hours.

Edward M. Nelson.

GEOMETRIC DRILL AND TOOL GAUGE.

[21084.]—The inclosed sketch shows a "full size" geometric drill and tool gauge. It is designed by me for use in workshops or among fitters, turners, amateurs, and apprentices. The sketch explains itself. As the points C are opened in the direction of B, a tool gauge presents itself, which graduates to several sizes in the same manner. The points at A are opened or closed to any size drill. Suppose the points A are pushed beyond their respective distances, it would form another shaped tool D. This will be found a very useful instrument for facilitating the grinding of the above-named tools. It will also be found very useful as a bevel for filing small articles to. It is made entirely of steel, and is worthy of a place along with calipers, &c. They are well made and cheap. For other particulars see "Sixpenny Sale Column" in a week or so.



J. S. Fisher.

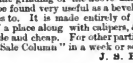
MANDREL NOSES AND CONICAL FITTINGS.—II.

[21085.]—In continuation of this subject, I wish to observe that there is a slight hitch about the plan of which I sent an illustration last week; but it only regards the small drill-chuck shown in position, and I have not yet found the best solution of it. The solid part of the cone which enters furthest not being divided by the saw-kerfs, will not yield to pressure or admit of being forced further in, and we must, therefore, reduce this part or continue it into the parallel hole.

I now come to my second proposal, which is so audacious, that I bring it forward with trembling!

I believe it has always been found impossible to make lathe-chucks run with absolute truth, unless they are made upon their own mandrel, and they have never been made interchangeable, so as to run equally well upon several lathes. My object is to enable chucks to be made to run with perfect truth, without being made upon their own mandrels, and, also, to make them run equally well upon similar lathes. This, I think, might be accomplished by adopting the cone-fitting for the *outside* of the mandrel-nose, as well as for within, and the form I propose would be something like Fig. 4.

FIG. 4.



Here the screw is rather short, and, being simply used to draw the cones together, it need not fit well. The angle of the cones to be as acute as it can be made without causing the chucks to jam—say, about 70°, about the same as that of the lathe centres. Then, I would have standard sizes for cones and screws of all mandrels and chucks, and ring and plug gauges of the inside and outside cones; and, I believe, we should then find that chucks made to these gauges would run truly upon all lathes made to the same gauges; our lathe-makers might send us a new chuck without depriving us of our headstocks. The American chucks might come over ready-fitted, and the failure of a mandrel would not involve the re-backing of a whole set of chucks.

By adopting the conical fittings we obviate all risk of chucks becoming untrue by the wear of the threads, causing them to screw up further round, and the small internal chucks could be fitted by amateurs, who have no screwing tools, all the fitting for these being a cone with a groove in it leaving a small flange, the opposite quarters of which are removed. Against these advantages I am bound to say the system is only available for mandrels put in from the front, and not those with a back centre.

F. A. M.

SIMPLE PROCESSES IN QUANTITATIVE ANALYSIS.

[21086.]—Would you allow me to make a protest respecting these papers?

There can be no doubt but that they are written in good spirit; but wherein lies their value it is difficult for me to conceive. To chemists they are of no use, whilst to beginners they are misleading.

Take, for example, the analysis of iron pyrites.

As "St. R." has shown, and which is an undoubted fact, that in the estimation of sulphur, if the evaporation be continued to dryness, loss of sulphur as sulphuric acid will be the result. Then, again, "Esthos's" pyrites contains, according to the analysis, neither arsenic or lead. My experience is that these are always present, especially so when the pyrites contains copper.

On these elements depends in great part the value of the pyrites for manufacturing purposes. In a complete analysis the amount of gold and silver should never be neglected.

I should like to suggest that in place of these papers your many chemical correspondents be invited, each to write a paper on his special branch of analysis or assaying. From these we should get some information of real practical value.

Those connected with copper assaying to give the methods used and precautions taken in estimating copper in the various ores and metallurgical products, together with the impurities that copper assayers have to be always estimating, such as arsenic, &c.

Other *branches* of assaying or analysis, including iron and steel manganese, alkalies, phosphates in ores and manures, &c., could be taken up, each writing of his own special branch. Such papers as these would be of real use, and acceptable to all our readers.

M. M. S.

THE RECENT ACCIDENTS AT EDGWARE; NEAR BRADFORD; AND CONTINUOUS BRAKES.

[21087.]—Major Marindin's report upon the accident which took place at the Edgware Station, on the Great Northern Railway, upon the 29th of December, has been published. It will be remembered that the 1.36 p.m. passenger train from Finchley overran the platform at Edgware, and came into violent collision with the buffer-stops. The stops were broken up, the engine (No. 511) coming to rest with its leading and driving-wheels deep in the soil behind where the stops had stood. Six passengers and the guard were injured.

The train was fitted throughout with Smith's non-automatic vacuum brake. The evidence shows that this brake had been in good working order at Mill Hill and other stations, and then, that when it was required to stop at Edgware, it *failed to act*, and thus caused the accident, this failure being entirely due to the hose-pipes coming uncoupled. The Great Northern Company has no rules to forbid drivers trusting to the continuous brake when running into terminal stations; therefore we cannot blame this driver for depending upon his vacuum brake.

Major Marindin remarks: "It should be observed, that if the brake had been an automatic one, the effect of the coupling coming asunder would have been the application of the brake, and the consequent prevention of the accident."

So many accidents and failures have resulted from the use of Smith's vacuum brake, that it is to be hoped the Directors of the Great Northern Railway will again consider the subject of providing their trains with a safe appliance.

The report upon the collision which occurred upon the Lancashire and Yorkshire Railway, near Bradford, on the 11th of January, has also been published. The 6.20 p.m. train, from Manchester to Bradford, fitted throughout with Fay's non-automatic brake, was running between Low Moor and Bradford, when the coupling between the engine (No. 266) and the first carriage parted, and after running for about 1,200 yards, the carriages overtook the engine, and struck it with considerable force; the leading carriage was thrown off the rails, and four passengers and the driver and fireman were injured.

Major Marindin remarks: "This collision is one of a class which would not occur if automatic continuous brakes were generally adopted."

Clement E. Stretton.

Glen Magna, February 10.

THE BLACKWELL ACCIDENT.

[21088.]—On the 19th of January a collision took place at Blackwell station on the Midland Railway, between a coal-train and an engine which was standing awaiting a signal to proceed to Hasland; unfortunately, the driver of the latter engine was killed, and a verdict of *manslaughter* has been returned against the signalman.

The signalman no doubt made a mistake; but there are circumstances connected with the case which appear to me of great importance. It appears that a young man was in the signal-box learning to work the telegraph, and that just at an important moment the signalman was called off to attend to the single-needle speaking instrument, and the "young man" took the "*be ready*" signal on the *block system* for the mineral train. The jury add to their verdict a very important remark: "They wished to express their decided disapproval of a signalman being called upon to perform the secondary duty of attending to telegraph messages whilst trains were on the line and in the neighbourhood of his box." The duties of a signalman are so important that his undivided attention is required. Of course it is necessary that "young men" should learn the telegraph, but most certainly they should not be taught in a busy and complicated signal-box. Many accidents and mistakes have, to my knowledge, taken place through signalmen having to attend to *messages*, and neglect the working of the signals and block instruments.

It must also be pointed out that if the mechanical union of the interlocking and block systems (for instance, the Sykes'), had been in use, the fatal mistake could not have been made.

We must remember that an "innocent mistake is not manslaughter." I therefore trust that this poor man will be acquitted at the trial. It appears to me that if a company calls upon a servant to do more work than he can perform in the time, we cannot be much surprised if an accident is the result.

Blackwell, Feb. 9. **Clement E. Stretton.**

STANDARD WIRE-GAUGE.

[21089.]—I have only just noticed that "Lestar" (20940), Jan. 12th, asks me to send Sir Joseph Whitworth's proposed decimal wire-gauge, so I at once send you a copy and regret that it has escaped my observation till now.

The sizes commence with the $\frac{1}{1000}$th of an inch and go up to half an inch, and are numbered the reverse way to the usual custom, the smallest size being No. 1.

Each number expresses the size in thousandths of an inch.

I should like to hear "Lestar's" opinion on the gauge.

A. A. Myall.

[It is unnecessary to occupy space with the table, for the numbers of the gauge correspond with the thicknesses in 1000ths of an inch; thus Nos. 1 to 20 are complete, and correspond with thicknesses of ·001 to ·020. From 20 to 40 the numbers advance by 2, and are represented in thickness by ·020 to ·040; from 40 to 100 the increment is 5, then advancing by 10 to 120, by 15 to 180, and by 20 to 300. From 300 to 500 the increment is 25. Thus the number in each case really states the diameter of the wire in thousandths of an inch, and the only thing to remember is the procession of the numbers.—Ed.]

BRAKE QUESTION.

[21090.]—Seeing a letter signed "Automatic Vacuum" (21063, p. 527), allow me to say that, as a passenger driver of many years' standing on the Midland Railway, with a perfect knowledge of the vacuum and Westinghouse air-brakes, having worked both, I am sorry to see it stated that we drivers have no idea what is meant by "atmospheric pressure," when it is the first thing we consider when starting with a train, as to the advisability of taking an assistant engine.

Who is there to instruct drivers in the working parts of the vacuum brake? We learn more from pamphlets issued by the Westinghouse Company than it is possible to get under our own company. When the inspector comes with the question, Have you ever seen the inside of the vacuum cylinders?

we reply in the negative. He then produces a miniature cylinder, similar in construction to a pepper-box which you buy for a penny, goes through a series of evolutions, trying to instruct us in its workings. Why not have proper brake fittings at each loco. station to instruct drivers, as, unless we are of a searching disposition, it is impossible to get at its workings?

I would tell "Automatic Vacuum" that we know what "atmospheric pressure" and "back pressure" mean; and those drivers who have worked and understand the Westinghouse brake, say that it is an impossibility for the vacuum brake to come anywhere near it; for how many of us know, that whilst running we could scarcely keep up to 10in. or 12in. of vacuum, and after we have been standing at a station we have no difficulty in getting and maintaining 20in. until we commence running again, and frequently we run as close to a station or signal, before we touch our brake, as possible, as directly we touch our valve-lever, we have to lose such a quantity of steam to release our brake again, that we wait until the last moment before we apply the brake.

We are most of us aware of the risk there is in packing the piston-rods, as, before the brake is properly applied, it begins to leak off again.

Air-Pressure.

DIRECT-ACTION TRICYCLES.

[21091.]—As an amateur mechanic of 25 years' experience, and one who takes a great interest in tricycles, I cannot refrain from saying a few words to the riders of these machines, especially when I see in the pages of the English Mechanic such sensible and straightforward remarks made by various correspondents.

It seems strange, indeed, to me to think that in all the tricycles which have been designed for a long time past, that the constructors seem to have tried not to make them simple, but complicated; and I am surprised at the majority of people taking so readily to such a mass of gearing, &c., as is contained in some of them.

The main feature—namely, driving an axle carrying two wheels—would, one would think, suggest at a glance the most simple plan of pushing it round at once with the foot without the intervention of either cogs or chain, which nobody in his senses would expect to see about a locomotive engine; and yet the idea of the machine is somewhat similar, supposing the part occupied by the cylinders to be the part from which the power of a man was to start, the connecting rods answering to his legs in their action.

Of course, the idea of connecting the pedal shaft to the wheels by a chain or cog is to get the centre of gravity as low as possible, to insure safety from the machine falling sideways; but this need not occur at all, even with direct-driving machines, if only ordinary care is taken and the machine made of a good width, which is quite consistent with lightness if properly constructed.

To give your readers an instance of what can be done with a machine which is driven direct, there has lately been seen in the midst of our crowded city a child, only six years of age, driving a "Royal National Tricycle," having 30in. wheels, which seemed to the numbers of people who flocked to see it to be driven with the greatest ease. The machine, I may say, was almost large enough to carry the father of the youngster, and yet it went over the stone sets very easily indeed. The man told me that it had never fallen over yet, and it has been in use about three months, and did not take more than a few minutes to learn. Several men who were riding tricycles and bicycles expressed their surprise at the speed at which he travelled, especially when he got to any portion of the road that was smooth and level.

We have a gentleman living close to the writer who also has a direct-driven machine; but it is different in construction, though very similar in outward appearance, and I have seen him pass the 'busses and tramcars with the greatest facility.

Another decided advantage about the direct-driven tricycles is the fact that the brake power is supplied by the feet, which completely control the revolution of the axle, and render it an impossibility for the machine to run away, at the same time saving the wear and tear of the tires caused by the friction of a spoon brake applied to the wheels in the ordinary manner.

An objection frequently urged by people against three-wheeled machines is that their great width prevents them from being easily taken into a house as a bicycle can be; but they seem to overlook the fact that they are machines just as much to be kept outside as an ordinary gig or carriage, and if made of good material and well painted, they will not sustain any injury by being stowed away in a stable or coach-house, There is a tricycle owned by a gentleman in our city which frequently is to be seen standing for hours in the rain, and it has been in use now some four years. The rider of this machine, soon after he purchased it, gave it three or four coats of good black paint, and it seems as if it is going to last for years.

I should very much like to see these machines more generally used, for, besides the amusement afforded by them on a pleasant day in taking you out into the country at no expense, save a little oil, they are capable of rendering a great service in carrying luggage, a parcel of books, or anything else, such as a portmanteau or carpet bag.

Some people say that they cost a deal of money at first; but they do not think of the amount spent in the course of a year in cab and 'bus fares, which with many people is a considerable item, and often enough the amount spent in this manner in one year would pay for two or three tricycles, besides the advantage you have of choosing your own time of starting and route you desire to take.

I am living in hopes of seeing these machines far more generally used than at present, and I feel convinced that the principle of direct-driving by means of the foot applied to the crank, the same as a bicycle, will before long, be fully appreciated as indeed it is now, by practical men. I see no limit to the speed at which the machines driven direct can be used except the speed at which a man can lift his legs up and down, and about one-third of the revolutions are required if the driving is done direct, without either chains or cogs. The quickest machine in our city is one of this class, and I have the pleasure of knowing the owner very well, and it is quite a treat to see him going along perfectly independent of everything else that has wheels on it. I have purchased one of this make for my son, and though quite a child he is capable of keeping alongside the tram-cars without any particular exertion, and I have frequently seen him overtake boys of twice his age on much heavier machines driven by chains. It is the only machine that I should think of using myself, feeling perfectly sure that everything is under my own control, and knowing that a cost of a little oil every week will save me many hours, besides furnishing me with the means of going to numbers of places in the country to which access is not available by rail or tram.

Manchester. **C. Calvert.**

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[21092.]—Medical Galvanism (49354).—The case is one that can only be advised upon after personal examination. Galvanism is not likely to be useful.

Truss (49367).—Avoid wearing waterproof to confine the perspiration when in active exercise, and have no brass, or copper, or other dissimilar metal attached to the steel spring. There is a truss, whose spring is covered with india-rubber, and which would probably not rust. Inquire of surgical instrument-maker. If in London, Coxeter, near University College, or Pratt, of Oxford-street, would show you patterns. Could you not take the spring out, and varnish or lacquer it?

Gout (49414).—I don't think I can help you further than by referring you to my recent letter on gout in the "E. M."

Psoriasis Palmaria (49428).—Minute doses of arsenic often cure this. Take five drops of "solution of chloride of arsenic B.P." (which you can get of any druggist) twice a day in water after meals.

Itch (49459).—If your son has suffered from "scabies" for twelve months, he has not been properly treated. Itch—or scabies, if you wish to use a technical term—is the irritation due to the boring operations of a microscopic insect which multiplies very rapidly, and burrows into the skin as rabbits burrow into the earth. These burrows often fester, and produce further mischief in the way of inflammation of the skin. The way to prevent rabbits from destroying your turf would be to exterminate the rabbits, and the way to cure the itch is to exterminate the itch-insects. This is effected by such chemical substances as will poison the insects without damaging the skin. To get this poison to the insects it is necessary to cleanse the skin from scabs by soaking for a half-hour in a warm bath with a handful of washing-soda in the water. Then, having softened and cleansed the skin, apply the poison so as to get it fairly soaked into the skin, but not by violent rubbing or otherwise so as to inflame the skin. The best simple remedy is "sulphur ointment," and this should be rubbed into the skin directly after drying it. The ointment must be applied freely all over the affected parts, because if one or two nests are left, they multiply so rapidly as soon to recover their ground, and furnish any number of emigrants for the bodies of those with whom you come in contact. Rub the ointment in every night for four nights, and again on the seventh night. If your disease is itch, you will be cured when you have followed these directions. It is well also to take 30 grains of precipitated sulphur night and morning in milk for the week. Itch is not at all dependent upon conditions of the constitution. But are you sure that the disease is the itch? You say you have "tried different remedies, internal and external, for over twelve months, but cannot get rid of it." I infer that you have not had the advice of any properly-qualified medical man, and if so, you should consult a competent medical man, and get a clear diagnosis.

Drinks Again.—At page 523, "Housekeeper" complains that "Dr. Edmunds has not dealt with the three queries I put regarding Dr. Allinson's statement about &c., &c., &c." I have nothing to do with Dr. Allinson's statements, and, of course, leave that gentleman to answer for himself. His *first* letter I read, and I recommended "Housekeeper" also to read it. I have no time to enter into a dispute upon vague topics with writers who do not sign their names, and of whom one tells us that rheumatism is produced by Chancery suits, and another that brandy pulls children through fever, that dipsomaniacs do not take yellow fever, and that tobacco-smoking saves one from marsh fever.

Vegetarianism.—I gave full consideration to this subject some years ago, and read a paper upon it before the Medical Society of London—a paper which was discussed so fully that the Society adjourned the discussion of it to a second meeting. On this occasion, my friend Professor Newman, and other eminent vegetarians, kindly attended the meeting, at my request, in order to relate their experiences, and exhibit themselves to the Society. Sir Joseph Fayrer and others recited medical experiences in India and elsewhere, which went much in favour of the general conclusion that we rely too much upon flesh food; in fact, that many English people poison themselves with nitrogen. But I am bound to say that none of us could get so far as Dr. Alinson seems to have done, or could concur with his very positive conclusions. What my own judgment upon vegetarianism is, has already been fully set out in the last volume of the English Mechanic.

Alcohol.—I think that the mistakes made by the medical profession by brandy practice in the generation just ending have been infinitely more mischievous than the mistakes made in a previous generation by the practice of bleeding, starving, and mercurialising. The bleeding system made an end of those whom it killed, and it disgusted those whom it did not kill—so much so, that people took to old women and homœopaths rather than go back to the doctors. But the brandy practice demoralised those whom it did not kill, made a large number of them drunkards, gave a false prestige to the use of alcohol, and, in fact, manufactured dipsomaniacs whose progeny is now growing up to adulterate the national stock. Of course, our medical men had equally excellent intentions and equally conscientious convictions, whether they bled us or brandied us; but "Housekeeper" is mistaken in saying that medical men made "this monstrous mistake in the infancy of their science." The early part of this century had men who were able to hold their own with any clinical men of the present day, and the mistake made recently by medical men in prescribing alcohol is every bit as monstrous and infinitely more mischievous than that made by the generation of bleeders which preceded them. I have never said that "alcohol is in no degree curative"; on the contrary, I have said that it has its medical uses, just as opium, chloroform, and other narcotics have valuable spheres of action, each one peculiar to itself, but I have said that I see no ground for assuming that diminishing the amount of the dose alters the nature of the effect. I hold that alcohol in small doses produces a narcotic effect to a small extent, just as in large doses it produces a narcotic effect to a large extent, and I asked one querist to show me his grounds for holding a different opinion; but his only reply was, "I believe there is not a single stimulant which is not also a depressant; and the reverse, with a few exceptions, holds good." Now, the value of this writer's "belief" depends upon the character of his mental organisation, and as I have no means of measuring that, I can follow his "argument" no further. But in point of fact, the key to the supposititious stimulant effects of small doses of alcohol is given by "Dandie Dinmont" himself, where he says, "It is in the fact that a glass of ale makes the exhausted man feel a different being that one of the greatest dangers lies." Does this mean anything but that the supposed stimulant effects of a single glass of ale are, in fact, only the delusive effect of a small dose of narcotic? If not, what does "Dandie Dinmont" mean by this sentence? "Housekeeper" asks: "If you like a thing, why should you not indulge your fancy?" This is the argument of a short-sighted sensualist, not that of a philosophical epicure. If a man's ideal of "enjoying himself" is to sit down to a leg of pork and a pot of stout, and finish up with strong cigars while he lolls before the fire and roasts his liver till bedtime, I can show no reason why he should not indulge his fancy. As to the Temperance Hospital, it is quite true that the cases there have done very well, and if my correspondents will call on me there on Monday or

Thursday at 2.30 o'clock, I shall have much pleasure in showing them the cases. What "temperance orators" have said about our results I know not; but this I know, that they are quite prepared to compare results with those at other hospitals, where the surgeons still believe that alcohol helps patients to recover. Just now there are under my own care in the beds of the hospital an exsection of the knee-joint healing up by by direct union in a few days with the most perfect result. There are also two cases in which the shaft of the tibia has been taken out of the leg; one of these was done only last Monday, and to-day I saw the patient perfectly well, with the vast grave-like chasm in his leg already beginning to heal. There are also other cases under my colleagues and myself which abundantly illustrate the way in which patients recover without alcohol.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48467.]—**Egg Preserving.**—The way I always preserve my eggs is as follows:—One bushel of quicklime slaked down, so that after it has stood a day or two to cool it will be of about the consistence of rather thick cream. If it has got too dry put more water then, also two pounds of salt to the bushel of lime. Put a layer of lime at the bottom of the tub, and then a layer of eggs, packing them closely together, and fill up the tub in this manner. Be careful not to let the outside eggs touch the tub, but put some lime round the sides. If you are going to put away a quantity use the egg-cases, and pile them up one above the other, one case will then keep the under eggs in their place, or you will find them rise up considerably, being lighter than the lime. I find upon a close reckoning that I must have preserved seventeen thousand this year, and it is a remarkable thing that I do not believe I found two dozen bad eggs among all the lot. I put them away at the end of April and commencement of May, as the eggs are then very fine and cheap, and commenced using the middle of October. I am now using the bottom case of the last pile, and find them almost as good as when I put them away. This is an enormous saving. The reason my eggs set so hard in the lime was because there was not sufficient water in it, having left my foreman to superintend the preserving of them instead of looking after it myself. They will keep two years.—CONFECTIONER.

[48655.]—**Model Locomotive Coupling-Rods.**—Bore the holes in the coupling-rods from $\frac{1}{16}$ to $\frac{1}{8}$in. (according to scale of model) larger than the crank-pins; countersink slightly at both sides, and rivet in pieces of brass rod turned to fit the holes tightly. Then bore holes in the brass to fit crank-pins, and file off nearly flush to connecting-rods. If your coupling-rods are not made solid ended, make them so by brazing or soldering them solid before drilling. The slot-holes can be cut with a fine fret-saw after drilling a hole at each end of slot. But a much easier plan in a model is to put in only a round pin instead of a cotter.—FIZOERS.

[48664.]—**Laws of Moving Bodies (U.Q.)**—The formula applies for any time, whether short or long. In the case supposed, $\frac{1}{2} m (V^2 - v^2) =$ 546ft.-lb. approximately. This has to be done as work by the spring in half a second, and if we assume the acceleration to be uniform, the mean speed of the wheel during this time is 17·5ft. per second, and the distance passed over in half a second, therefore, 8·75ft. Consequently, 546 / 8·75 = 62·4lb. approximately is the mean pressure exerted by the spring. Of course, the spring must be more or less compressed to give this pressure, and this will of necessity allow the wheel to lag behind. In a Silver's governor, however, the resistance to the spring is complicated by the fan-blades, and could hardly be calculated.—FIZOERS.

[48677.]—**Sharpening Gimlets.**—The querist should take a plug top file (round) and break off the end not cut, and pass it up or down the hollow of the gimlet till he gets a cutting edge, then try it through something thin. If it splits the thin piece of wood, file or grind off some of the outside at the back. If the worm has been made blunt against iron, go carefully round it with a fine saw file, taking care not to make a gap at the end of worm through the cutting edge, or you will spoil the job. If this simple operation be done with care, you can sharpen and keep them almost equal to new.—A COUNTRY CHIP.

[48680.]—**Horizontal Slot Drilling - machines.**—One way is to lead the strap or gut band over a pair of loose pulleys carried on a weighted lever, which allows of sufficient motion to take up the slack. The straining pulleys may be placed in various positions; in some machines they are overhead, above the centre of the bed of the machine. In other machines the work is moved back and forwards, while the drill is stationary.—FIZOERS.

[48696.]—**Saddles.**—To J. S. SADLER.—The kind of saddle I want to make is a light riding-saddle for a pony 13 hands. J. S. will much oblige if he will give approximate cost of materials, dimensions, and full particulars.—SADDLER.

[48714.]—**Hydraulics (U.Q.)**—The query is not very clear, but if "S. E. O." means what is the discharge as long as the tank is kept fully supplied, of a pipe 304ft. long and 2in. bore, with a head of 304 feet, it is between 150 and 153 gallons per minute. If the tank be allowed to empty itself through the pipe, the discharge would be but little altered; but it would be, and probably in any practical case, is, made much less than the above by a twirl or whirlpool forming over the pipe's mouth in the tank, which draws air down the pipe. The effect of this could not be calculated.—FIZOERS.

[48723.] — **Washing Flannels.** — "Allison, Laundry Proprietor," makes a great mistake in using a hydro-extractor for drying flannels, and I speak advisedly on this subject and from actual demonstration (through spoiled blankets) of the very injurious effect it has on woollens, which, if you wish to preserve their softness, should never be rubbed nor wrung—nor handled more than is absolutely necessary. Pressure of any kind is not needed. Wool is not fibrous, as cotton and flax threads are; it is because of being fibrous that impure particles, commonly called "the dirt," penetrate into their substance, and this "dirt" has to be rubbed or pressed out, else the clothes will not be clean. But flannel articles are totally different. Wool threads are like human hairs, therefore impurities can never penetrate them—the "dirt" comes away by shaking them in the suds or in water. But, as every thread of sheep's wool is armed with little spines or thorns which grip their next neighbours and thus keep close together, if you press them together you have a solid mass—more or less solid according to the pressure-force used—till the piece of flannel, blanket, or whatever it may be, comes to be almost like a piece of thick felt, and this very undesirable state is produced in as great a degree by once being in a hydro-extractor as would result from half a dozen common wringings by women's hands. A blue-water rinse is the very nicest finish for flannels, white and coloured alike. Lift the articles out of this rinse and hang them, thickest part uppermost, full length, on a line either out of doors on a fine breezy day, or in the drying-closet, and they will dry, by dripping, in a far shorter time than is supposed, and they will not shrink in the least. I always finish small articles with a cool iron; when three-quarters dry—that is, when feeling dry to the hand, but have still damp enough for the warm iron to bring it out—the larger articles I fold smoothly, wrap in an old sheet and put under pressure (say my own bed) for a few days. I have blankets in use since 1841, neither shrunk nor felted.—OLD HOUSEKEEPER.

[48754.]—**Musical Box (U.Q.)**—The jarring complained of is evidently caused by some portion of the mechanism being loose, or otherwise the box does not stand firm on the table on which it is placed. It is a very easy matter to find out from which of these two causes it proceeds. If from the former, it will be advisable to take it to a person who understands its construction, and is able to put it right. It is difficult to advise, apart from a personal inspection of the musical-box in question. —G. FRYER.

[48777.]—**Lifting Power of Gas in Water.** —The answer to this question depends simply on the difference between the weight of a cubic foot of water and a cubic foot of the gases in question. A cubic foot of water weighs 437,500 grains, or 62lb. 8oz. A cubic foot of air weighs 537 grains. If we multiply this by ·0693, the specific gravity of hydrogen, we obtain 37 grains as the weight of a cubic foot of hydrogen, and in the same way multiplying 537 by 1·524, we get 818 grains, the weight of a cubic foot of carbonic acid, and so on. By subtracting these values from the weight of a cubic foot of water, we find the following results:—Lifting-power of one cubic foot of air = 62lb. 6oz. 337gr.; hydrogen = 62lb. 7oz. 400gr.; carbonic acid = 62lb. 6oz. 57gr.; the differences between them being obviously too small to be of any *practical* importance. I may mention that I was once consulted by a person about to patent an invention for preventing ships from sinking by the use of hydrogen gas, from the firm conviction that because hydrogen is $14\frac{1}{2}$ times lighter than air, therefore it would have $14\frac{1}{2}$ times its buoyant power in water!—COMMA.

[48915.]—**Jack-in-the-Box Gearing.**—I cannot make the gear out from the part engraving referred to, but I believe it is what is now to be seen in many tricycles—known as Starley's differential gear. In that we have a mitre-wheel rigidly geared on each part of the axle, and a pinion is placed between the two in such a manner that it drives both, but leaves one free to revolve more rapidly than the other. The pinion-wheel is really carried on what may be termed one of the spokes of the chain or driving-wheel, and as it is free to revolve at right angles to the plane of revolution of the tricycle wheels, one can turn slower than the other. Your correspondent will find a clear description of that gear in No. 763, p. 221; and perhaps it will not be too much trouble for Mr. Tolman to say whether that is the gear he meant by "Jack-in-the-box."—T. P.

[48965.]—**Grease (U.Q.)**—Perhaps the following recipe will be of use to you. To one part of finely-ground black-lead, add four parts of lard. Camphor may be added if thought advisable.—W. HENLEY RICHMOND.

[48993.]—**Yellow and Red Timber.**—In reply to "Timber Merchant," I do not find that on pp. 458, I quoted him as having used the words "yellow pine" and "yellow deal." I understood him to mean that yellow deal and red pine were identical. Secondly, in the quotation "what the Swedish and Russian shippers, &c.," I see that I have not exactly represented what I meant. I wish to substitute for "Swedish and Russian shippers," "the timber merchants and their travellers from Hull." I have about 16 years' experience in the building trade in and about Lancashire. Nearly all the yellow deals used in this district come viâ Hull; they are invariably alluded to by travellers as red wood; are so described by the merchants in their invoices, and by architects in their specifications. In this district I have met but few builders who drew much if any distinction between yellow deal and red pine. Thirdly, in reference to red pine timber and red pine deal, I gave my opinion on pp. 504. Further, I am asked to say "in what way fir timber varies from yellow deal." I have this morning just had a small fir log $9\frac{1}{4}$in. square deeped, for the purpose of comparing it with a yellow deal. To me there seems to be as much difference in the two woods as there is between English oak and wainscot. The colour and size of the knots, the colour, hardness, and distance apart of the hard grain in the annular rings, and the nature of the soft grain, all appear very different to me. Further, it is always considered that fir timber is a good deal tougher than yellow deal. I should, from experience, have no hesitation in asserting that it is as three to two; indeed, my employer, who, by the way, is one of the largest and most experienced builders in London, is always calling my attention to the importance of having slating-battens, tiling-laths, and such like cut from fir, as he says it gives so much greater satisfaction than it would in yellow deal. I may say, that I have no knowledge, whatever, of how the botanists have classified the timber, and I have no time, and if I had, I have no disposition to acquire knowledge the use of which, in the circle in which I move, would cause me to be put down as a conceited fool. I should like to ask "Timber Merchant" how many people have been in his yard who wanted some Pinus sylvestris?—W. J.

[49018.] — **Manufacture of Cork Carpet (U.Q.)**—If "L. D." will advertise his address, I shall be glad to inform him of the way linoleum is manufactured at Staines. But he must be aware that he is asking for a very valuable trade secret.—J. POULSON.

[49024.]—**Stains or Dyes for Wood.**—Since writing the reply on p. 438, while looking through some back volumes, I came upon a letter containing a number of recipes for various stains (chemical) for wood. It is on p. 586, Vol. XXV. The permanganate of potash is there recommended for brown stains on light woods, and is said to be the best of all. Perhaps "Dandie Dinmont," if he has tried, will send word as to the result.—S. M.

[49053.]—**Oil-Sheet Dressing.**—You must use the best double boiled oil and put driers in, not litharge. Under any circumstances black "paints" of this kind are always troublesome. Go over the sheets that have turned greasy with a sponge and turps (or benzoline), and when they have dried give them another coat of the double boiled oil, &c., above mentioned.—S. M.

[49055.]—**German Silver.**—A good German silver is made of copper 2, nickel 1, zinc 1; but there are all sorts of alloys coming under that head, and known by the name of "maillechort" in France, "argentan" or "packfong" in Sheffield and Birmingham. I believe that the best way of annealing is to bury the metal or the manufactured article in charcoal-dust, and let the process go on slowly and occupy a long time. The exact proportions of the component metals vary with the purpose for which the alloy is intended, and large manufacturers have special mixtures, which they consider trade secrets. If a German silver for rolling is required take copper 6, nickel 2·5, zinc 2, and 0·3 of lead; or copper 3, nickel 1, zinc 1. There is an alloy which is sometimes added to the alloys just mentioned, and consists of copper 5, nickel 4, antimony, tin, lead, zinc, and iron, 1 each. That is complicated enough, and will give an idea of how the changes may be rung.—S. M.

[49077.]—**Pyrometers.**—To Mr. Lancaster.—Many thanks for your kind offer. I must try and manage with the range of degrees you mention (400 to 1,000 F.), if you will please give me the instructions how to make the instrument. Could I make another that would measure the lower degrees, from 400 F. down, or buy one, if not expensive? I wish to measure the melting points of various bodies.—T. West.

[49079.]—**Oil-proof Steam-joints.**—You do not say what joints you mean; but if you cannot afford asbestos washers, use tow or blotting-paper soaked in grease.—T. P.

[49098.]—**Water-Tank.**—Best plan, so far as can be judged from the description, would be to coat the cement with a skin of thin hydraulic cement.—Essar.

[49102.]—**Steam-Boiler.**—No one can tell the safe working pressure of so small an affair, as everything depends on the workmanship. Fill the boiler chock-full of water, and load the valve to 200lb., apply heat, and if the valve lifts before the boiler shows any signs of leak elsewhere, you may work at 50lb.—Essar.

[49164.]—**Metal-Bending Rollers.**—I should certainly advise you to retain the cog-wheels (even then you will find the rollers liable to slip), as by so doing you double the biting surface of the machine on the sheet-metal you are bending. If you observe the driving-wheels of a locomotive engine, you will find they are connected together by a rod; this is to increase the biting surface of the engine on the rails. Your own plan is the best, as by this you can hold the sheet between the rollers, whereas in your friend's the bite is dependent on the stiffness of the sheet, which in no case would be sufficient. In fitting up, you must be careful that the two connected rollers agree—that is to say, revolve exactly at the same speed, being, of course, of the same diameter, as, if the surface of one goes faster than that of the other, it would materially increase the power required to drive. I once saw a tire-bending machine made similar to your friend's suggestion, and it did not answer—the bite of the one roller not being sufficient to move the tire; it was afterwards connected to the next roller, by my advice, by cogs, and then answered perfectly.—T. West.

[49186.]—**Goods Lost at Sea.**—If the buyer pays freight he is answerable for their loss. If sender pays freight then he is answerable for their safe delivery, unless there is an agreement to the contrary.—W. G.

[49218.]—**Plain Malt Spirit.**—Just a line to say that I would have your readers believe nothing but what is true: hence I should like to know what is incorrect in the reply to which "Rera" takes exception. May I also ask him if it is the fact that the distiller who uses malt only, sends the spirit out just as it comes over without rectifying it, that is, redistilling it?—Nun. Dor.

[49223.]—**Ventilation.**—The following is the best way that I have found to ventilate any room with an outside wall. Have an opening made in centre of ceiling about a foot square, have a pipe, or I may call it long box, about 4in. square, carried between the ceiling and deafening to outside wall. The opening in ceiling may be covered up by perforated zinc or anything ornamental, the outside with an ordinary ventilator that can be shut at pleasure.—Auld Reekie.

[49236.]—**Screw Propulsion.**—To "R. A. S."—Questions of this kind are usually settled by data derived from experience; but of course in a case like this we have none, and therefore must trust to the usual empirical rules holding to such limits:—1. The best sections for canoes will be circular in cross-section at least for the submerged part, and parabolic in plan. Very likely cigar-shaped would be best in every respect. 2. A single screw would be require to be about 8in. diam. and 12in. pitch, and to make about 500 revolutions per minute; if twin screws are used, each should be about 6in. diam., 9in. pitch, and driven at 700 revolutions per minute. 3. The screws must, if possible, be submerged, for if not the waste of power would be excessive; it is difficult to say to what extent. 4. If "R. A. S." will look at answer 49409, he will see that his canoes are too short to be driven profitably at the speed he proposes. I should also add that I am of opinion that the power required, even for the dimensions given, is more than a man can exert for a length of time, therefore its speed is likely to be less than five miles per hour. I saw, some years ago, a twin canoe driven by paddle-wheels by two men; it was much larger than the one proposed, but its speed was not above four miles per hour.—Shipwright.

[49246.]—**Steam Cock.**—I am sorry to hear you have not succeeded with ground glass. I have never failed with it. For ground glass, oil is best; for bath brick, use water. I think you did not get the glass ground fine enough. It ought to be as fine as rice flour. I may add that it requires practice to grind a cock properly.—Labor Omnia Vincit.

[49279.]—**Indicator Diagram.**—To "Labor Omnia Vincit" and "W. J." Thanks for notice; am sorry I cannot obtain scale. The atmo. line, as I understand it, would be the bottom line, the engine being non-condensing.—B. N.

[49288.]—**Electro-Plating Pewter.**—The simplest way to make a copper solution from which to deposit upon pewter is as follows:—For every gallon of water take 3oz. sulphate of copper, dissolve, add liquid ammonia till the precipitate first formed is redissolved, then add solution of cyanide of potassium till the blue colour disappears, use cold, and work with sufficient battery power to give off gas at the cathode or article being plated.—Kœnig.

[49294.]—**Low-Pressure Air-Reservoir.**—I still think that a reducing valve would answer your purpose; but I could advise you better if I had a full description of your apparatus.—Labor Omnia Vincit.

[49301.]—**Organ Stops.**—To "Uranium."—Many thanks. When mentioning the "flauto-traverso," I had in mind wood cylindrical pipes, (sometimes double length in treble) with circular mouths. The Temple Church organ contains one. The tone is, I believe, of an orchestral character, but can it be much different from that of small-scale metal harmonic pipes? The triangular pipe you mention is a favourite in America, under the name of "Hohlpfeiffe 4ft.," and is described as bright, pervading, and brilliant. The "Clarionet-flute" is described in a well-known pamphlet—"Organ Voicing and Tuning"—as an agreeable contrast with the harmonic flute, and composed of metal from tenor C 2ft. with low mouths and large holes in the wooden stoppers. This would be, perhaps, a "chirrupy" flute, and so have few admirers; but useful for imitative effects. Specimens in Crystal Palace and Holborn Town Hall organs, also several by Robson, in each case 8ft. tone. Would "Uranium" kindly say a word or two about the tone of "tuba mirabilis" and "harmonic trumpet:" are they voiced for a clang tint? Has not low wind-pressure something to do with badness in gambas and reeds and sameness of tone in other stops?—C. H. D., Guernsey.

[49324.]—**Joshua and the Sun, &c.**—The omission in Heb. xi. of reference to that subject had occurred to me; but neither "Sigma" nor "F.R.A.S." has dealt with the reference in Hab. iii., 11th verse, or the parallel case in Isaiah, xxviii., 8th verse; and Sutcliffe, in his Commentary, quotes a Chinese record of a very long day which occurred at a period coeval with Joshua. Let us hear more about the matter.—Lamplighter.

[49336.]—**Bichromate Battery.**—Mr. Blackwell informs us that the crystals in this battery are chrome alum, and further, that chrome alum is a double sulphate of potassium and chromium. Now, as an earnest seeker after truth, I would like to know what becomes of the zinc which disappears when the battery is used, and I would like to ask Mr. Blackwell the meaning of the word "alum." I think it means a compound containing sulphate of aluminum, and that chrome alum is a double sulphate of aluminum and chromium. Thus we have iron alum, potash alum, ammonia alum, &c., all containing sulphate of aluminum.—Os.

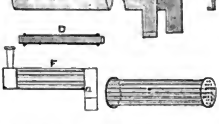
[49343.]—**Crystoleum Pictures.**—Permit me to express the hope that some correspondent will give full details of this interesting and beautiful art, by which a simple photograph can be invested with all the beauty and rich effect of the finest ivory miniature paintings of our forefathers' times. I recently had the pleasure of seeing a photograph rendered into a crystoleum picture, and was astonished to hear the process adopted was a singularly simple one. I could get but few details, so can impart no information of any value beyond the fact that the photograph is glued or cemented, face downwards, upon clean glass, and then all the paper is removed by suitable rubbers made of a pad covered with fine sand or emery-paper. The greatest care has to be exercised in the work, as no portion of the photographic film must be removed. After this, suitable varnishes are applied, and on a second glass, backed up against the first, with a small space left between, oil paints are applied for the flesh tints, little details being painted upon the photograph itself.—Alfojoe.

[49344.]—**Violin Queries.**—"Fiddler" apparently takes it for granted that when a violinist plays with "tempered" instruments he accomodates himself to the pitch of the said instruments. I do not, however, believe that this is the case to any appreciable extent, but that Mr. Fryer's view (No. 932) is the correct one. The difference between a violinist playing in the true scale and in the tempered scale with a pianoforte, is such that not one in a thousand (or say a million) at the present day would be able to appreciate it. The time may come, and some say that that time is now approaching, when instruments which do not give the true scale, or a much nearer approach to it than the tempered scale is, will not be tolerated. At present all that appears to be desired by cultivated ears is a general approximation to the true scale. A word or two to those who think the violin such a perfect instrument of pitch. Did you ever hear the first violinists of a good orchestra in some of the very high passages of Wagner's operas? If so, you will often have noticed a decided beat, showing that there were some at least of the presumably good players there who did not play in tune. I have even heard first-rate soloists playing decidedly out of tune in the highest positions. With regard to "F.'s" harmonic query, it may be possible to produce harmonics, not in the same scale as the string on which they are produced—i.e., taking its fundamental note as the tonic; but "F.'s" example is not a case in point. Placing the finger on the point where C is produced on the G string, you cut off one-fourth of the whole length of the string (the vibrations in G and C being as 3 to 4), and thus divide the string into nodes one-fourth of its length. You must thus produce exactly the double octave of G—i.e., the first G on the E string. "F." must have made some mistake in his experiment. At any rate, I have tried it, and obtained the result calculated above. Surely "F." does not compare the frivolous and *ad captandum* works of such writers as Tartini, to the high-souled compositions of Beethoven. Has "F." ever heard Beethoven's "Kreutzer Sonata," performed by Herr Joachim? With regard to a remark of mine which, I am glad to see, gave "F." an opportunity of indulging his risible faculties, I did not say that middle C was the highest note a male voice could reach; I merely referred to this C as being in the higher part of a man's voice, to distinguish it from the C which is written in the second space of the bass stave. Mr. Fryer entirely misunderstood my second query, as he himself admits; but there is no space to refer to it at present. However, I do not now consider the matter of much importance.—Voltameter.

[49345.]—**Hoist.**—Unfortunately, I cannot refer to Vols. XXXII. and XXXIII. But if the goods you wish to use the hoist for will bear ordinary handling, you could have a hoist fixed to raise by power and lower by brake for about £20. An exact estimate cannot be given without seeing the warehouse or having full particulars.—Labor Omnia Vincit.

[49357.]—**Ventilation of Room.**—"Pi-Squared" has asked a very difficult question to answer satisfactorily. Any opening into a room when the door is shut and a fire on, draught will be drawn down the opening to feed the fire; if from the outside will be very uncomfortable in cold weather. The most effectual plan I ever tried was a tube into the chimney from an Argand burner same size as glass chimney of burner, which is not very unsightly.—W. G.

[49358.]—**Locomotive Boiler.**—Go to any copper-warehouse and obtain a piece of 5½in. tube the strength and length you require, also a length of tube for your fire-tubes; you must also get two circular pieces of copper, so that when their edges are turned over square, as at C, they will just fit tight into your large tube (these will be your tube-plates), drill them both of the same template. Cut your tubes the required length, reduce their ends as at D, so as they fit the holes in tube-plates, put them all in the same as at E; be sure in having the edges of tube plate both inside; having bound them in that position it will be an easy matter to braze them over any brazing-hearth. After you have succeeded in brazing them, slip them all into your large tube, as at F, and braze them round, which you will have no difficulty in doing; then saw about half-way through the large tube at dotted line in A, which will be at (*a*) in F, then saw down at right angles to the cut you have already made, and open out the same as B, which will be your firebox. Of course you will want a firebox front, also one at the smoke-box end; but these need not be brazed, but made a tight fit so as to hold themselves in; but I am bound to say I don't think you will be able to get much pressure on your boiler unless you make your firebox larger than you intend doing. Be sure and have your holes in boiler for safety valve, &c., before brazing tubes in.—Thos. Clarke.

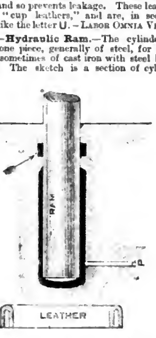


[49362.]—**Converting Flute into Flageolet.**—I tried this some time ago, but found that although a piccolo flute made a fair flageolet—a concert flute would not do well. The tone being poor, thin, and wanting character, the low notes almost impossible, and the instrument out of tune—end blowing changes the relations required between length, bore, and holes, &c. But do as I did: make a mouthpiece to fasten on the flute like the lips, and then you can play it fairly like a flageolet. But I must say that, excepting the Boehm Gyssens flageolet, the instrument is not worth learning, except for a quadrille band.—Vulcanite.

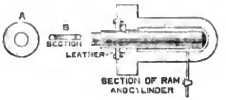
[49362.]—**Converting Flute into Flageolet.**—Many years ago I had a flageolet mouthpiece attached to a flute by Bainbridge, then living in Holborn. The flute was held in the usual position, a new joint being added in place of the old one, into which you blew through a small tube projecting from the side. If "Flageolet" were to apply to Messrs. Rudall and Carte, of Berners-street, I have no doubt he would obtain the information he requires.—F. F. C.

[49366.]—**Hydraulic Ram.**—The cylinders for hydraulic presses are usually cast in iron or steel, in one piece. The leather packing used is specially made for the purpose, and when put in place the pressure of the water tends to force the leather outwards, and so prevents leakage. These leathers are called "cup leathers," and are, in section, something like the letter U.—Labor Omnia Vincit.

[49366.]—**Hydraulic Ram.**—The cylinder is cast all in one piece, generally of steel, for large work, and sometimes of cast iron with steel hoops shrunk on. The sketch is a section of cylinder showing method of fixing the leathers. These are specially prepared and forced in the cavity shown in the direction of arrow. P is intended for supply-pipe.—Patternmaker.



[49366.]—**Hydraulic Ram.**—The cylinder is invariably cast in one piece—never in halves. The leather is of the best quality and soaked in water for thirty hours to make it quite soft. It is cut to the shape of A and pressed so as to make a ring of U section as B. The plunger is not a tight fit in the gland. The sketch C will explain the means of taking a packing out and putting in a new one. The water pressing in the ring B tends to open it, thereby making a perfectly tight packing; when the pressure is off, the leather ring closes slightly and allows the plunger to move back freely.—H. L. Crate.



[49374.]—**Boiler.**—Querist does not give sufficient information. Does he want 16,000lb. of steam at 90lb. pressure, available at a moment's notice, or is that quantity required in any longer period of time?—Labor Omnia Vincit.

[49375.]—**Saw Hammering.**—Best book I know is Holtzapffel's "Turning and Mechanical Manipulation."—J. S.

[49379.]—**Cylinder Cover.**—If you have no forcing-off screws in the cover, the best and quickest way will be to get some steel wedges made, 1½in. wide, ¼in. thick at the head, and brought down to a knife-edge. I usually make them out of an old flat smooth file, and keep a set by me. Then, whilst the cylinder is warm, drive in your wedges, four will do, and drive gradually all round; the cover will come off nicely with ordinary care.—Labor Omnia Vincit.

[49390.]—**Automatic Cut-off Motion.**—I do not think you could have anything better for the purpose than a "wing" throttle-valve. An automatic cut-off is very well in its way; but it is not quick enough for an engine working as you describe. For your 18in. cyl. I should have a 4in. throttle-valve.—Labor Omnia Vincit.

[49400.]—**To Fasten Glass.**—"R. M." will find either of the following, if mixed with care, will be of use to him:—1. Equal parts of wheat-flour, finely-powdered glass, and chalk; add half as much brickdust, scraped lint, and white of eggs; mix to a proper consistency with water. This will resist heat. 2. To ½-pint of milk put a sufficient quantity of vinegar to curdle it, separate the curd from the whey, and mix the whey with the whites of four eggs, baking the whole well together. When mixed, add a little quicklime, through a sieve, until it acquires the consistency of a paste. This cement dries quickly, and resists the action of fire and water. You will require cramps to bind it well together, and place it in a dry room for about two days. Unless you have proper tools, this will be a ticklish job. An experienced hand would do it for you cheap.—Patternmaker.

[49404.]—**Barley - Sugar.**—1lb. Martineau's cubes (for I find these boil well) and a teacupful of cold water; let it boil till about three parts done, and then drop in a very little cream of tartar or lemon-juice. Continue to boil it, get a piece of stick and dip into the syrup, and then immediately immerse it in a cup of cold water to see if the syrup is done. If it is that which is on the stick will be hard and brittle after being in the water about a half-minute. I should think brown raw sugar would answer your purpose just as well, and it is very easy to boil.—Confectioner.

[49404.]—**Barley-Sugar.**—F. Search, Epsom, will find "sugar-cake" both better and more convenient than barley-sugar for feeding his bees. I have not found any difficulty in making a good clear barley-sugar; but preferred its granulating somewhat upon cooling, being less deliquescent in that state, and not so liable to run down amongst the bees and daub them. With pretty long boiling, and the addition of the vinegar just before the syrup is of the proper consistency for pouring out, the result will generally be a clear cake. I would advise F. Search to try "sugar-cake," 8lb. of loaf sugar to 1 pint of water; boil down to proper consistency, adding no vinegar; pour the syrup into shallow trays of cartridge-paper, 5in. by 4in. being a convenient size; when cold, these tablets should be slightly opaque and non-deliquescent. Place one of these trays the sugar side downwards on the bars of the hive, and replace the quilt; it will be taken up slowly and without the least excitement. Whatever has been said as to the undesirability of winter-feeding, I have had, and now have, a sugar-cake under the quilts of each of my twenty-three hives.—G. F.

[49409.]—**Froude on Resistance of Fluids.**—To "Swindonia."—You should first find the resistance of your submerged body; thus resistance in pounds = wetted surface × (velocity feet per second / 1·688)² × coeff.

Coeff. for varnished surface = ·01
" " bright copper = ·007
" " common iron plate = ·02

Then the effective horse-power = resistance in lbs. + speed in ft. per second ÷ ·550, and 2½ to 3 times the E.H.P. will give the indicated horse-power required when applied through a screw or paddle-wheel in the ordinary manner. Second. The speed does not increase in the same ratio as the horse-power, the horse-power varying as the cube of the speed, as will be seen from the foregoing (i.e.) if 100 h.p. drive a vessel 10 knots, we should require $15^3 \div 10^3 \times 100 = 337{\cdot}5$ h.p. to obtain 15 knots, and this law only holds so long as the vessel is not driven at a higher speed than the one for which she is suitable, according to her length; if this is exceeded, the power will vary as the fourth or fifth power of the speed. Third. In ship-shaped bodies sufficiently long for the speed at which they are driven (i.e.), speed in knots per hour not exceeding $1{\cdot}03 \sqrt{\text{length in feet of vessel}}$; it is usual to allow 30 to 40 per cent. for the additional resistance due to eddy and wave-making at the surface. As regards going to great depths, I should not like to venture an opinion; but from experience I know there is no perceptible increase of resistance at from 10ft. to 20ft. Such a point as this is best settled by experiment, with suitable models of the proposed body.—Shipwright.

[49417.]—**Patent Knotting.**—"Petro" can make Patent Knotting, same as brown hard varnish, and colour with Spanish brown, &c., or with more common materials, as cleanness is no object. It is hardly worth while making it, now it can be bought so cheap. I mix a little Spanish brown with brown hard, then you have a good knotting. Brown hard varnish (in London) I buy as low as 4s. 9d. per gallon; so it is now hardly worth making. If "Petro" advertises his address, I will give him address of maker. Several receipts in back numbers for varnishes.—W. Jones.

[49418.]—**Growth.**—It is well known that men grow up to 21, and in some exceptional cases even to 25 years of age. To what height men may grow depends mainly on the height of their ancestors. But many, as we know, stop short of that. I know hundreds here in London who are much shorter than their parents, although they are brought up in good circumstances, and most likely better than those were in which their parents grew up. What I am going to advise you respecting the growth of men does not rest on scientific experiments, but on my observation only. 1. Take as much pure air as you can get, because in impure air vegetation grows thin and high, and animals short and thick. 2. Keep yourself warm: hardening children by exposing them to cold stops their growth. Look at kittens and chickens when they have come to life in the spring, and have the warm summer to grow in, and compare them with those coming to life in the latter part of the summer, which never come to much; in fact, nothing grows well in the cold. 3. Don't drink, or at least do not make drink a part of your "daily bread." Drink forces life and makes you manly before you have time to grow. 4. Smoke in your leisure hours; I do not mean to say that smoking is healthy, it keeps you down—that is, it keeps you from doing many things which tend to stop your growth. 5. Eat meat with your vegetables, not vegetables with your meat; I mean eat at least four parts of vegetables to one part of meat. Eat fruit as much as possible. 6. Get a good many hours' sleep; early rising is not conducive to growth. Don't sleep in the lower part of the house. Three children, who have grown up under the above conditions (excepting the girls from smoking), prove to a certain extent my assertions. I therefore give their measurements. One girl is 23 years of age, and is 5ft. 7in., 7in. taller than her mother; the boy is 18 years, and is 5ft. 9¾in., 1¼in. taller than his father; the youngest girl is 16 years, and 5ft. 2in., 2in. taller than her mother.—J. H. Schucht.

[49419.]—**Tank.**—The motion of the sewage may be attributed to a variety of causes; but, as I understand, "two plunge-pumps" are working in it. Now, the question arises, Do these pumps feed the tank, or does the tank feed the pumps? If the latter, I would suggest that "L. C. W." should notice the motion of sewage, and observe if that corresponds with the motion of pump-rods. If so, I should say that the clacks, or suction-valves, are faulty; for, should they stick, or anything get under too large to pass, the consequence would be that the sewage would flow backwards and forwards at every stroke of pumps. When the substance had passed, the motion would cease. This, I should say, is the actual cause, according to its varied duration.—Patternmaker.

[49421.]—**Portland Cement.**—It is not necessary the clay should contain potash. There are books published on the manufacture of cement. I believe they are expensive, but cannot give the name. Portland cement cannot be manufactured on a small scale to pay. It can be bought at the works for about thirty shillings per ton, and what are considered small works, turning out 100 tons per week, would cost about £10,000. Portland cement on the Thames is made from three-parts chalk and one part clay; these are approximate quantities. The manufacture is very critical, and requires constant testing during the process of manufacture, even with the best material.—W. G.

[49423.] — **Ventilation.** — The water-gauge varies proportionately with the friction, and the friction varies proportionately with the rubbing-surface, and as the square of the velocity. Now, area of first airway = 64, and of second 40; therefore the velocity in second, as compared with first, $= \frac{64}{40}$, and the rubbing-surface $= \frac{28}{32}$. Then water-gauge in second airway $= (\frac{64}{40})^2 \div \frac{32}{28} = 2{\cdot}24$ times the water-gauge in first; or $2{\cdot}24 \times 2 = 4{\cdot}48$in.—J. H. W.

[49424.]—**Broken American Watch.**—What kind of American watch? If a Boston lever, you will find a half-headed screw near joint of dome, or inner case. By turning the straight edge of this parallel to the edge of watch, and pressing more or less gently with the finger from back, the movement will come out. To open the front, carefully insert the edge of a sharp knife, when, by turning up the *back* of it—the *back*, bear in mind—the bezel should come open quite easily. I have never yet known this plan to fail, and I may say I have taken off bezels of cheap watches which I could not, by any means in my power replace. If the end of the small hook in barrel-arbor is broken away, it will require drilling, and another putting in. Or if the hook and the mainspring are whole, press the inmost coil in by means of long-nosed pliers, of course with due care, until the arbor fits pretty tight; when all will be right. If you put in a new arbor-hook, drill in a slanting direction, and finish off with a small file.—G. D. G.

[49429.]—**Archimedean Screw-Pump.**—These pumps are very old, and a great many are in use. They are principally used for irrigation, and worked by a windmill. Messrs. Eastons and Anderson, of Erith, have a patent screw-pump, which they have fixed at several large waterworks. Labor Omnia Vincit.

[49432.]—**American Clocks.** — First take out the balance-wheel. To do this, release the "wedge" in the stud with a pair of small pliers—or tweezers, for that matter. Draw out the spring, then through the curb pins, unscrew the back steel endpiece; and the wheel is at liberty. Move the collet forward in the direction the end of spring takes, until the end of spring has advanced about ¼in. To do this, grip the collet with a pair of cutting nippers, or anything handy that will not injure the spring, and move gently. Now put it back into its place, allowing the spring to be about ¼in. further through stud than before. Let the balance have a little liberty between the two endpieces, or it will not move. If it does not sound in beat—that is, equal on each stroke of the lever—move the spring backwards or forwards, as the case may be, through the stud, until you are satisfied it is right, then "wedge" up your spring again, and see that it works flat; also that the outer coil moves nicely between the curb pins or loop. It it still loses, repeat the operation, until it is so far correct that you can make it *quite* correct with the regulator.—G. D. G.

[49432 and 49433.]—**American Clocks.**—The replies under this heading are arranged in a somewhat confusing and contradictory manner. The knowing reader will, of course, see at a glance that if the numbers are transposed the answers will be correct.—Alfojoe.

[49433.]—**American Clock.**—See if the holes at the back of pallets, through the bent brass plate, fit the projecting pin on crank closely; but sufficiently loose to allow them to oscillate freely. If they are too large, put a fresh steel pin in, or, what is more simple, yet less respectable, hammer the holes up till they *do* fit. If the swing of the pendulum is only about ¾in. or 1in., turn the crank forward so as to throw the pallets deeper in the escape-wheel, so far that the teeth just fairly pass without jarring on pallet-edges. If the swing of pendulum is still too short, the pallets either require replacing with new ones, or else they must be "codged" up, which means softening and bending, to close or open them, thus to bring about a good action. In either case, unless you are pretty handy with your tools, and do not lack "'cuteness," let a practical man have it.—G. D. G.

[49436.]—**Sizes of Nuts.**—I have great pleasure in submitting the following table of sizes to "Faber," from ¼in. to 3in.:—

Size of Bolt.	Width of Nut over Angles.	Width over Sides.	Thickness of Nut.	Size of Bolt.	Width of Nut over Angles.	Width over Sides.	Thickness of Nut.
¼	[illegible]	[illegible]	¼	1¼	[illegible]	1⅞	1¼
5/16	[illegible]	[illegible]	5/16	1⅜	[illegible]	2	1⅜
⅜	[illegible]	[illegible]	⅜	1½	[illegible]	[illegible]	1½
7/16	[illegible]	[illegible]	7/16	1⅝	[illegible]	[illegible]	1⅝
½	[illegible]	[illegible]	½	1¾	3	[illegible]	1¾
9/16	1	[illegible]	9/16	1⅞	3¼	[illegible]	1⅞
⅝	[illegible]	1	⅝	2	[illegible]	3	2
¾	[illegible]	1 3/16	¾	2¼	[illegible]	[illegible]	2¼
⅞	[illegible]	[illegible]	⅞	2½	[illegible]	[illegible]	2½
1	[illegible]	[illegible]	1	2¾	[illegible]	[illegible]	2¾
1⅛	[illegible]	[illegible]	1⅛	3	5¼	4½	3

—Patternmaker.

[49438.]—**L. and S. W. R. Engines.**—The 394 class weigh about 46 tons, the 412 class 54½ tons. Nos. 38 Vizier, 93 Cyclops, and 106 Panther, are 6-coupled goods engines, latter being one of the oldest of that kind, same as 49 Bison and 51 Elephant. Nos. 82 Sultana, 167 Atalanta, and 174 Naiad, are 6ft. 6in. passenger engines. The first named has outside valve-gear, same as 77, Wildfire and 134 Ironsides. No. 159 Castleman is a 7ft. passenger engine. Nos. 55 Medusa, and 129 Albion, are old 4-coupled "light goods" engines, wheels 5ft., cylinders outside. Medusa's 17 × 22, Albion's 16 × 24. Will give numbers of 355 and 394 classes, if no one else does, when I am able to refer to my back numbers.—W. B. P.

[49440.]—**Cod-Liver.**—Like "Helicote," the oiliness and smell of this medicine was to me most nauseous until I discovered that a small lump of rock-salt, taken into the mouth and sucked after drinking the oil, prevented its nauseating effects. I, too, found that a small portion of a red-herring was even better to conceal the taste. If "Helicote" does not find this a remedy he may give up the oil altogether, and instead, take each morning a small cupful of pure fresh sweet cream. It is, I think, better than oil, but difficult to get good and pure. —Rock-Salt.

[49440.]—**Cod-Liver Oil.**—Take a clean wineglass, pour into it about a dessertspoonful of cold water, then a teaspoonful of the oil; have near you some table-salt. Having swallowed the oil, quickly throw a small pinch of salt into the mouth, letting a little fall on the lips. Children who take it in this way soon get quite fond of it, for there is no unpleasant after-taste. If more oil is taken increase the quantity of water to about half a wineglass. When cod-liver oil is taken in wine, milk, or with sugar, it nearly always disagrees, and soon causes a distaste for it. The above was recommended to me some years since by a doctor, formerly physician to the Children's Hospital.—J. H.

[49444.]—**Band-Saw Machine.**—If "Cabinetmaker's Apprentice" has got on fairly well with his trade, he would have no difficulty in constructing the above, which, if carefully done, would turn out work equal to that done by the most costly machine. If he will advertise his address, I will send him some valuable information on the matter. —Practical.

[49445.]—**Engine.**—A pair of 5in. cyls. such as you describe might be reasonably expected to lift 10cwt. when working in single gear.—Labor Omnia Vincit.

[49446.]—**Feed-Water.**—You could utilise the waste heat from boiler-funnel in the way you describe by having an annular cylinder made of ¼in. boiler-plate, 2ft. deep, 3ft. dia., with a hole in centre same size as the uptake. Or, instead of one large hole, have a number of boiler-tubes, 2in. dia., with a smoke-box on top of heater. A boiler of the size given would have a 9in. uptake, and you could have, say, 10 2in. tubes through the heater so as to break up the hot gases as much as possible without affecting the draught. It is advisable to force the feed water through the heater into the boiler, and to fix a small safety-valve on top of heater.—Labor Omnia Vincit.

[49446.]—**Feed-Water.**—"J. H." may with great advantage fix a tank around his engine funnel for the purpose of heating his feed-water. But first he must ascertain whether the funnel is sound and watertight; if not, do not try to make it so, but go in for a new one. It will be far and away the most satisfactory, and give the least trouble, for it is, to say the least of it, rather annoying to occasionally have your fire slaked out and bars twisted. I should advise him to have the tank made of strong galvanised iron. It should be round, with the bottom tapering down to the size of the engine funnel, and should have a strong wrought iron flange riveted to it to bolt down to flange on funnel, the joint being made with the usual cement of leads, &c. If the engine is in a town or near convenient waterworks, of course he will supply the tank from the main with ball-tap, &c.; but, on the other hand, should it be in the country with no such convenience, he must, in order to get water to and from the tank without employing any other pump than the one in the engine, resort to the following ways and means:—He must place a stop-cock on the return-pipe of his feed-pump below the one already there, and between these two cocks, by means of a T, he must fix some piping of the same size as return, and connect it with the top of tank to supply the same with water. Then he must bring another pipe connected with the bottom of tank to the feed-pump and let it be joined by a T to the suction-pipe of a pump close under the first valve-box; the old suction-pipe must have a valve placed below the T. This new pipe also must have a stop-cock between tank and T. Now, we will suppose the tank is full of hot water, and he wishes to pump into boiler: all that is required is to close the original cock on return-pipe and open the one in pipe from bottom of tank, when the pump preferring the water running down hill, to lifting it through the old suction-pipe, the boiler will be supplied with water from the tank. When sufficient has been injected, close the cock on pipe from bottom of tank, also the one on bottom of return-pipe, and open the original one on ditto, and the pump will lift fresh water from well or what not, and force it up to top of tank. Of course, I am presuming that the pump is in good order, and is capable of pumping when full on, far more than is required by the boiler, as all feed-pumps should. By the above plan feed-water may be pumped at a much greater heat than when the pump has it to draw by suction. "J. H." will gain no advantage in having the tank too large. Any further hints or assistance I can give him I shall be glad to do. —W. Lissington.

[49446.]—**Feed-Water.**—Place a coil of pipe inside your boiler. Let the pipe be rather larger inside the boiler than out. You will thus save fuel and get more steam, and do away with the expense of a cistern.—J. Poulson.

[49453.]—**Carbon in place of Copper.**—Carbon gives a good deal the higher force; in fact no one who knows anything of the principles involved would think of using copper. Platinised silver is the best, and next to it carbon, which is also said to be improved by platinising.—Sigma.

[49456.]—**Aniline Dyeing.**—"London" has not used a pure blue to dye his buttons with. The aniline blue must be pure; all impure blues dry off a mauve colour. He might try a weak solution of sulphuric acid added to his present blue, or steep the buttons in the solution and then paint them over with the blue.—J. Poulson.

[49457.]—**Steam Boiler.**—I rather think that the plan of boiler-setting you have given would have the effect of reducing the draught considerably. As your boiler is small for the work, I do not think you would improve on the ordinary plan of boiler-setting, a drawing of which appeared in "ours" a short time ago. Take the draught from back of tube round the end of boiler into the two side flues to the front, then dip down under and along bottom, and so to chimney. This is called a split draught. Galloway's conical tubes inserted in furnace-tube would also assist in the quicker generation of steam.—Labor Omnia Vincit.

[49457.]—**Wanting Steam.**—There may be something wrong with the bridge: it might be too low or too high. I had great trouble with my boiler once. I could not obtain steam sufficient for my purpose until I altered the bridge. I also sent my feed water in at the bottom of the front plate of the boiler, and coiling it round the inside of the boiler several times, so that my water was delivered into the boiler boiling. I also worked the damper at the same time I worked my fire. I then found I had more steam than I wanted, and I saved fuel. "Wanting Steam" might try these suggestions before going to any greater expense. I beg to apologise to "Labor Omnia Vincit," as this query was addressed to him; but sometimes two suggestions are better than one.—J. Poulson.

[49460.]—**Chemical Atoms.**—Has "Experimenter" been asleep the last dozen years? He appears to have just woke up and begun to inquire about a subject which is now almost forgotten. If he cannot digest the H_2O notation he must be fearfully behind the age, seeing that almost every chemical book published for 8 or 10 years employs it. The system is so universally accepted that no one thinks of explaining its reasons fully. Of course, it is based on gaseous volume relation, and the relation to energy as heat. These, and the usefulness of molecular types over-ride the greater simplicity of the equivalent notation. He should look up the works of Hoffman and Wurtz and make up his mind that the change has not met with such general acceptance without very good reasons.—Sigma.

[49460.]—**Chemical Atoms.**—Has it not occurred to "Experimenter" that there are probably good and sufficient reasons for the adoption, by the great majority of chemists, of the notation to which he refers? He may study with advantage Hofmann's "Modern Chemistry," or "The New Chemistry," by Cooke, one of King and Co.'s International Scientific Series; and it is to be hoped he will afterwards avoid applying such terms as "gross monstrosities," "abominations," &c., to chemical formulæ, because he cannot understand them, as such exhibitions of bad taste are not likely to be considered flattering to their author.—Comma.

[49460.]—**Chemical Atoms.**—I think "Experimenter" will have to hunt over a great many more books on chemistry before he will find the atomic weight of O fixed at 8 instead of 16, or before he will find the two theories placed side by side, for the O 16 theory has been accepted by chemists as being much simpler than any other (if, indeed, any other theory has been propounded). H, being the lightest element, has been universally adopted as the unit of atomic weights, and as a given bulk of O is 16 times as heavy as the same bulk of H, the atomic weight of O can only be fixed at 16. HO is doubtless a simpler formula than H_2O, and one more easily remembered by dull students, but as HO (or rather H_2O_2) is hydroxyl, and H_2O is water, it is, of course, entirely wrong to substitute the one formula for the other. "Experimenter's" idea of leaving out the figures from formulæ in order to simplify them is doubtless ingenious, but it is one that I should advise him not to adopt at the May Examinations, as the examiners might object to the substitution of hydroxyl for water, and so on. "E." can know very little about graphic formulæ and atomicity if he seriously thinks N_2O_2 "an incongruous formula" and a "monstrosity." If he did, he would know that no G formula for NO can exist, N being a perissad, and O an artiad; whereas, by writing the formula N_2O_2 the G formula may be rendered, $N - O - O - N$, all the bonds of each element being thus satisfied. I wish "Experimenter" every success at the coming exam., but am afraid, unless he considerably alters his views before May, that the examiners will not consider him suitable for a science teacher.—E. G. T., Plymouth.

[49460.] — **Chemical Atoms.** — That water should be H_2O, instead of HO (as Berzelius wrote it), is very plain: firstly, as a rule, a molecule equals two volumes, thus, H_2, O_2, Cl_2, &c. = two volumes, the exceptions to this rule are mercury, arsenic, sulphur and phosphorus, so in equal volumes of diatomic elements such as H and O, there are equal number of molecules, and it can be shown by the eudiometer that two volumes of H combine with one of O to form water; therefore the formula would be $H_4 + O_2 = H_2O + H_2O$, occupying four volumes. I think that "Experimenter" did not write advisedly when he speaks of "such abominations as N_4O_2," &c., for chemistry, as other sciences, is a progressive science and liable to alterations *even* in the "well known field of inorganic chemistry." Indeed there is a French school which renounced the atomic theory entirely and based their chemical calculations on heat. Concerning the "O 16 theory," the atomic weights are found as follows: it was ascertained, by analysis, that oxygen combined with various elements in more than one degree as H_2O, CO_2, Fe_2O_3, N_2O_3, &c., and the degree which corresponded to Dulong's law of specific heat should be adopted as the atomic weight: thus the specific heats of the elements are inversly proportional to their atomic weights; or, in other words, if the specific heats are multiplied by their atomic weights the products will be all equal, or only differing slightly owing to inaccuracy of working; so if we take O as 8, then 8 × 0·2175, (the specific heat of O) = 1·7400, also take 16, (really 15·963) = 16 × 0·2175 = 3·480, taking the specific weights, (*i.e.* the product of the atomic weight and specific heat) of the other gases, we find, hydrogen 3·409, and nitrogen 3·413, and as the figure 3·480 practically corresponds to the other specific weights of the other gases, 16 is taken in preference to 8, as the atomic weight of oxygen. There are other laws by which the atomic weights are corrected, but this is the chief law. Concerning N_2O_2 see "History of Chemistry," by Thompson, Vol. II. p. 289; N_2O_2 forming two volumes of gas, and *not* four volumes, just as Fe_2Cl_6 represents a molecule, or two volumes, whereas $FeCl_3$ could not exist in a free state. A good book on this subject would be "The Atomic Theory," by Wurtz, of the International Scientific Series, published by Kegan Paul.—WALTER H. INCE.

[49467.]—**Indicator Diagram.**—This is evidently from an old engine. If the valve is as well set at the other end of cyl., then there is little to find fault with. The diagram shows the engine to be in good condition.—LABOR OMNIA VINCIT.

[49469.]—**Worm-eaten Floor.**—Wash first with a solution of carbolic acid, then work in a thin paste of plaster of Paris.—SIGMA.

[49469.]—**Worm-eaten Floor.**—For worm-eaten furniture I have found methylated spirit kill the insects. Stop up the holes with whiting and oil, or plaster made thin.—J. D.

[49469.]—**Worm-eaten Floor.**—Clean all holes out with a brush; then fill them up with patent knotting; then you may paint, varnish, or polish as you prefer; but be sure that the floor is clean, and you get all the dust out of the holes.—J. POULSON.

[49471.]—**Singapore.**—Singapore has a population of 61,752, which is chiefly made up of Chinese, Malays, and Klings. Its climate is healthy, the surface is low, undulating, and very thickly wooded. The soil is more particularly adapted for the growth of cocoa-nuts, sugar-cane, tapioca, and fruits. Its area is 224 square miles; its length 25 miles; and its breadth 14 miles. But you had better consult some work, giving full and reliable information.—W. HENLEY RICHMOND.

[49471.]—**Singapore.**—I should advise "Leo-Trieste" to think of somewhere else, as the climate is bad for Europeans; life short; will be glad to return.—ONE HAVING BEEN ON THE COAST.

[49473.]—**Patent Leather.**—J. S. Saddler asks for a very valuable trade secret. If he will advertise his address I will willingly help him.—J. POULSON.

[49476.]—**Ferns.**—I should think that your correspondent refers to a Selaginella, not a fern. This is a native of Palestine and is known as the "Resurrection Plant," or Selaginella lepidophylla. The importer says, "This plant as received is perfectly dried up as though dead, but upon being placed in a vessel of water begins to unfold, and in a short time reveals its green colour and beautiful fern-like form. It will last for years if not allowed to remain more than a day or two at a time in water. When taken out it will dry up again and after a short interval may be again expanded by being replaced in the water. If your correspondent likes to advertise his address, I will send him the name of the firm who supply it.—DR. W. H. BROWNE, Aldbrough, Hull.

[49479.]—**Chamber-Organ.**—If "G. T. B." will advertise his address, I will put him in the way of obtaining some valuable instructions in tuning his organ. It would take columns of the "E.M." to describe the art of tuning properly.—G. FRYER.

[49483.—**Massachusetts Washing.**—There is a small article sold that is placed in the copper or the boiler that does all that "Soap Bubble's" informant spoke of. If you advertise your address I will inform you where.—J. POULSON.

[49489.]—**Lead Pencils.**—These are rounded by being placed in a stop block and planed with a hollow or half round plane-iron turning them end for end at each stroke of the plane.—J. POULSON.

[49489.]—**Lead-Pencils.**—I have had no actual experience in making lead-pencils, although I have manufactured large quantities of ⅜in. round rods in an ordinary moulding machine. The essential requisites of a machine to do this kind of work are: two horizontal spindles, one above and one below the bed, driven at about 3,500, a set of four-geared feed-rollers with stepped cone, giving from 20 to 30ft. per minute, and the usual holding-down levers and springs. The cutters may be made in more than one way; but perhaps the following, although expensive in first cost, would be most satisfactory in the long-run. They are made by turning a number, say 15, of semicircular grooves in a cylinder of steel, corresponding with the size of the pencil. This cylinder is then cut through the centre longitudinally, and one edge of each half bevelled to form the cutting-edge. After being hardened and tempered, they are set upon the spindle eccentrically, so as to give clearance to the cutting-edge. The great advantage of this form of cutter is the ease and certainty with which it can be ground and set, also retaining its shape until worn out, a very remote contingency. If you found it economical to use stuff which would make 15 wide, and fed at the rate of 25ft. per minute, this machine would round about 30,000 pencils per hour. —W. J.

[49490.]—**Speed of Shaft.**—To attain this object, you must multiply the size of "pulley" on main shaft by the number of revolutions of same, divide this by the speed required, and the product will be the diameter of pulley required; the distance of shafting one from the other does not affect this in any degree, as the power is merely transmitted by the belt. Therefore, if he puts a 24in. pulley on his main shaft, running at 90, he will require a 6¼in. pulley on counter-shaft, which will give him 350 revolutions. He will now see that half the speed is attained, and to double this he will require pulleys acting 2 to 1, that is to say, a 16in. pulley on counter-shaft, driving an 8in. pulley on machine, will give him 700 revolutions. For a work on this question, and all others in connection with machinery calculations, I would refer him to "Templeton's Guide."—PATTERN-MAKER.

[49490.]—**Speed of Shafting.**—"Survey" does not give us any information as to the sizes of the pulleys in his countershaft; so I cannot say in which way they will alter the case. I should strongly advise him to employ a countershaft, for it would require over a 9ft. wheel in his main shaft to obtain the requisite number of revolutions of machine, driving direct. The distance of one shaft from another does not affect the speed in any way. The rules for calculating I always use are:—Given the diameters of drivers and driven, and revolutions of driver, to find revolutions of driven. Multiply diameter of driver, in inches, by number of revolutions, and divide by diameter of driven. The quotient will be the revolutions of driven.—W. LISSINGTON.

[49494.]—**Chemical.**—"MEDDLER" will, I think, find that the best way out of his difficulty will be to decompose the whole mixture, and then to distil off the iodine; to do this he should add sufficient sulphuric acid to the mixture, to liberate the carbonic anhydride contained in the sodic carbonate; then by adding black oxide of manganese, and more strong sulphuric acid, the iodine in the sodic iodide will be set free and may be distilled off, together with the 3oz. that "Meddler" added. The reaction may be expressed thus—

$$\underset{\text{(sodic iodide)}}{2NaI} + \underset{\text{(sodic carbonate)}}{NaCO_3} + \underset{\text{(manganese oxide)}}{MnO_2} + \underset{\text{(sulphuric acid)}}{3\,H_2SO_4}$$

$$= \underset{\text{(manganic sulphate)}}{MnSO_4} + \underset{\text{(sodic sulphate)}}{2\,Na_2SO_4} + \underset{\text{(iodine)}}{2\,I} + \underset{\text{(carbonic anhydride)}}{CO_2} + \underset{\text{(water)}}{3\,OH_2}$$

The above operation is, however, rather complex for anyone but a skilled chemical manipulator to perform, so if "Meddler" has done nothing of the kind before, I should advise him to take the mixture (if the quantity warrants it) to a manufacturing chemist, who would, no doubt, for a percentage on the iodine obtained, recover the iodine from the mixture.—E. G. T., Plymouth.

[49492.]—**Mining Queries.**—(1) The quantity of air would be reduced in the same proportion in each split; therefore the quantities would be 5,000 and 3,000. (2) The expansion of gases = $\frac{1}{491}$ for every degree Fahr. In the example given the increase of volume = 40,000 × $\frac{40}{491}$ = 3,258 cub. ft., making a total of 43,258 cub. ft. Now, the area of a 14ft. shaft = 196 circular feet; and to maintain the same velocity in the upcast as in the downcast, we have the proportion 40,000 : 196 : : 43,258 : 212 circular feet; and the square root of this = 14·56ft. dia. This answer does not allow for any gases which might be generated in the mine; nor for any obstruction there might be in the two shafts. (3) The direction of full dip is from A to C, and the amount [illegible] = 1 in 10. The strike or level-line is at right-angles to the full dip, or from B to a point midway between A and C.—J. H. W.

[49496.]—**Tramway.**—I do not see how "Hampshire" can overcome his difficulty other than by erecting a bridge over parish-road, or by tunnelling under same. To do either of these he would have to submit his plans to the local board of that parish. If they should pass the board all right, he can use what means he likes to convey his trams, without consulting them further. I should suggest an endless rope, so as to make the full trams pull the empty ones up. If he could take a trip into some of the North Staffordshire colliery districts, he could witness the action of this process in a variety of forms.—PATTERNMAKER.

[49496.]—**Tramway.**—Capt. Fairholme, R.N., writes to inform "Hampshire," that he carried out some experiments at Bristol at the locomotive factory of Messrs. Fox, Walker, and Co., on a gradient of 1—10, and found that a heavy locomotive was completely under control and could be stopped at pleasure, on that exceptionally severe gradient, with the Heberlein brake. He will be glad to afford "Hampshire" any additional information if desired; and is quite prepared to fit up any trams with these brakes if written to at 9, Gracechurch-street, London, E.C.

[49498.]—**Skrivanoff's Dry Cell.**—The size of the plates has nothing to do with the E.M.F. The parts would require renewing every few minutes if it was possible to get an electric lighting current out of the battery, which is a self-evident impossibility. It is only of use for the infinitesimal currents used for medical purposes.—SIGMA.

[49509.]—**Grinding Tough Seeds.**—An American Steel hand-mill will reduce anything to a very fine powder. They are to be had at a very small cost. You had better advertise address. I will communicate with you.—J. POULSON.

[49513.]—**Transfer Inks.**—Try mixing dry colours in turpentine and lay on with camel's-hair pencil. If it does not answer the experiment, it will not be very costly. That is the way I have seen them prepare the carpet and other patterns in Yorkshire.—J. POULSON.

[49514.]—**Comets, &c.**—(1) Halley's Comet has a period of 76·78 years, and its next perihelion passage will take place about August, 1912; Méchain's 13·66 years, perihelion passage June, 1885; D'Arrest's comet has a period of 6·441 years, and the querist will find details of its next return on page 519 of the number in which his query appears; Faye's comet, having a period of 7·44 years, will probably return to perihelion at the commencement of 1888; Winnecke's comet has a period of 5·54 years, and may be expected about the end of 1885, or the beginning of 1886; De Vico's comet takes 5·469 years to perform a revolution, and is due about the present time. Judging, however, from past experiences, it is more than probable that it will not be observed. Biela's comet (or comets) had a period of 6·617 years, but, as Chambers says "even the continued *existence* of the comet seems now open to uncertainty, startling as such a suggestion may appear." Brorsen's comet travels round the sun in 5·581 years, and may be expected in the spring of 1885. With regard to the last-mentioned comet (Encke's) its period is pretty accurately determined to be 3·296 years, and as the last perihelion passage took place in October, 1881, we may expect another about the middle of February, 1885. (2) Taking the radius of the earth's orbit as unity, we have the following perihelion distances,—Méchain's, 1·0274 (1858); D'Arrest's, 1·1696 (1857); Winnecke's, 0·7689 (1858). (3) γ Virginis seems to be variable, but the period has not yet been determined. According to Struve it must be several years at the least. α Cassiopeiæ has a period of variability of 79·1 days, β Lyræ of 12d. 21h. 47m. The fluctuations of this last named star are, however, rather remarkable. Starting from a maximum magnitude of 3·4 it diminishes to 4·3; then follows a second maximum of 3·4, and then a second minimum, this time of 4·5 magnitude. After this, the star regains its maximum, and the period is complete. This double minimum caused the first observers to assign a period equal to half the real one. (4) The outer satellite is named Deimos, the inner Phobos.—A YOUNG ASTRONOMER.

[49516.]—**Galvanometer Coils.**—To "SIGMA." The width of the galvanometer coils depends on the purpose intended. If large deflections are to be used, the wires should extend beyond the width of the needle's position, otherwise the value of the larger deflections will be very largely reduced below even that of the tangential scale. If used as a zero instrument, or for small deflections, the wire, especially of the inner layers, should be kept near the middle line. I do not think there is any definite rule as to size of coils, except that the best dimensions are those of a reasonable ellipse; that is, such as will take up the principal lines of magnetic force. The size of wire used in such space depends on the object; fine wire gives length of spark, thicker wire gives a shorter but thicker spark. The only way to find out what battery power a coil will stand is to add to it cautiously: it depends entirely on the construction of the coil, its insulation, size of wire, and capacity of condenser. The best way is to keep well within the limits of reason, because damage once done is difficult to remedy.—Sigma.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Fingers" has replied to 48964, 48714; G. Fryer 48754; W. Henley Richmond, 48965; J. Poulson, 49018.

48826. Bench Lathe, 327.
48828. Gas Engine, 327.
48833. Henry's Solution of Salts, 327.
48836. Continuous Brakes, 327.
48854. American Iron Planes, 328.
48863. Voss Multiplate Machine, 328.
48870. Symme's Theory, 328.
48871. Subsidence near Maidstone, 328.
48875. Coals, 328.
48878. Air Currents, 328.

49043. Problem, p. 415.
49045. Electric Clock, 415.
49049. Burnt Sugar, 415.
49054. Ross Battery, 415.
49056. Lathe-head, 415.
49062. Zinc Tanks, Milk, and Ammonia, 415.
49067. Oval Chuck for Wood Turning, 415.
49069. Model Electric Engine, 415.
49075. Gas Engine, 416.
49076. Making Circular Bellows, 416.
49082. Magnesian Cement and Emery, 416.
49090. The Largest Ironworks, 416.
49095. G.E.R. Locos., 416.
49098. Isle of Wight Locos., 416.
49101. Yacht Building, 416.
49104. Brewing Pan, 416.
49106. Motor for Workshop, 416.

QUERIES.

[49518.]—**Eggs and Chickens.**—There is strong division of opinion amongst us as to the above. The question being, Is the yelk transformed into the chicken which eats the white, or is the white really the chicken, which consumes the yelk? The question, as a scientific one, may interest other readers besides—Chink.

[49519.]—**Faulty Battery.**—Having constructed a battery (on the principle described in reply to query 48807, p. 435, Vol. XXXVI.) with nine cells containing about a noggin each of sulphuric acid and water 1 in 12; zinc and copper, length 4in., breadth ½in., the former being amalgamated; by placing the brass handles together sparks can be produced, and the acid appears to boil round the copper; but by taking a handle in each hand all action ceases, and the battery won't give a shock. Perhaps "W. S. W." or Mr. Lancaster will kindly state where deficiency is, and oblige—Refractory.

[49520.]—**Stain for Stone.**—I have a quantity of Cornish serpentine stone, but it isn't nicely coloured, and I should like to be informed if it can be coloured artificially, say bright red, and perhaps a little darkish green. If so, I should be very thankful for full instructions for doing it. What ingredients to use, what liquid to mix it with, and how to prepare and apply it? Should it be applied hot or cold, and should the stone be hot or cold, and must it be applied before or after polishing, and will the stained parts polish the same as the rest? I want a stain by means of which I may imitate the natural veins of good quality serpentine. It must be a stain that will not fade. Also, what is the best way to heighten the polish after finishing with crocus, so as to fine glossy surface?—Mason.

[49521.]—**How to Black Hammers.**—How can I give hand-hammers and tools a clean and permanent black? The so-called "self-black" preferred. Varnish is objectionable as giving the articles a dirty or sticky appearance. Particulars of expeditious and good methods will be gratefully received.—H. G.

[49522.]—**Collotype Printing.**—Can Mr Pumphrey or any of our friends inform me of the cause of my failure in above? I coated the plates with a first coating of albumen and gelatine, and a second of gelatine, on which I obtained the transfer or print; but on proceeding to ink the plate, using an ordinary lithographic roller and ink, the gelatine came off the plate in folds, adhering to the roller. Would the fact of my having heated the plates after the coating had set, in order to level the coat, cause it, or is the ink wrong?—Nonplussed.

[49523.]—**Borer for Lead.**—Can any correspondent inform me what is the right form of a borer to make a hole about 2in. diam. through a foot or so of solid lead? —X. Y. Z.

[49524.]—**Hypsometer.**—Would Mr. Lancaster, or other contributor favour me with particulars, dimensions, &c., of this instrument, used for taking altitudes of hills church-steeples, &c., without a knowledge of trigonometry? I should like to construct one if the details are not too complicated.—J. B. Poole.

[49525.]—**Making Air-Balls.**—I have tried melting the rubber as you (Mr. Editor) advised, but only made a sticky muddle. Will you kindly let me ask if any one will advise me how to make the above, giving the "mode of operation"? I want them to give away at a school treat.—Tom.

[49526.]—**Mining.**—A narrow board drive 600yd, and rises 2·5in. per yard, and gets a 54ft dipfault. There is a dip drift drive, dips 3in. per yard, empty tub weighs 5cwt., and carries 11cwt. of coal. Can there be a double incline made geared up with drums to suit the long and short incline, the long incline to run with 12 tubs. How many full tubs will they be able to pull up the short incline, or what would be the cheapest way to get the coal up the drift?—First Callar.

[49527.]—**Setting Lathe Heads and Slide-Rests.**—Will any reader inform me how to set lathe heads and slide-rest true with bed? The bed is a wood one, faced with iron. I cannot turn shafting true—it is always tapering. What is the cause of same?—Turner.

[49528.]—**Deal Doors.**—I want to make some deal doors (must be deal) to lay on a clay soil. I would be obliged if any one will kindly let me know which is the best kind for that work, if any difference.—Comets.

[49529.]—**Raising Water.**—The only drinking water obtainable for my household purposes is from a spring issuing from the side of a hill 300 yards distant, and fully 80ft. below house level. There is no sufficient stream near to drive or work a ram. Now would it be convenient to fix a pump at the spring to force the water up to house, as it would always necessitate someone going there to operate it? Is there any practical way of dealing with the case from the house, beyond that of fetching in pails, as now done? It has occurred to me that it might be done by means of an air-pressure pump forcing air of, say, 40lb pressure down a small pipe into a small cistern, situate at the spring, which fills with water by a valve opening inwards, when not under pressure from the air-pump; but which valve, when pressure is put on, would close (like the ram), and contents of cistern be forced to site required. If practicable, this plan seems preferable to a line of rods working a piston or pole at the spring, as less likely to be tampered with. It would also probably be less expensive. No mechanical motive-power is available in this case. Kind advice will oblige—Marienberg.

[49530.]—**Neuralgia.**—As I wish to construct such a battery as "W. S. W." describes in No. 929, would he kindly give some further details? What is to be understood by a "binding-screw," and how is the connection with zinc and copper piece made by this screw? Also how is the brass tube having a wooden handle attached to the metallic cord, and how is the sponge fitted on? As the apparatus might be largely adopted, perhaps "W. S. W." would supply some sketches, which our good friend, the Editor, would perhaps kindly permit to appear, from which the construction by non-professionals could be effected?—Marianberg.

[49531.]—**Alum-Water.**—I am residing where, formerly, alum was largely manufactured. The water is said to be impregnated with alum, and unfit for washing purposes, turning the linen grey. Will some of our friends kindly say if there is any way of neutralising the alum and making the water fit for washing purposes? Also, if there is any simple practical method of testing it, as to what extent alum is present in the water?—Marienberg.

[49532.]—**Clay Models.**—Is there any means of making clay models hard and durable, either by the use of petrifying solutions, by the admixture of suitable cements with the clay, or otherwise?—W. E. C.

[49533.]—**Organ Pneumatic Tubes.**—Will any of your readers kindly give me assistance on the following point? I have constructed a soundboard on the "Roosevelt" system—i.e., pallet to each pipe, for eight great organ stops (double to trumpet) amply blown. What size should the valves be in the tubular apparatus CC, Ten. C, mid C, and top C? And what size should the controlling groove be at the same notes? A sketch of the best way of dispersing the valves in connection with the keyboard, and any information will be thankfully received. Is there any reliable source of information on the system published?—Vacuum.

[49534.]—**Gas Supply.**—To Thomas Fletcher and Others.—Rule wanted to obtain the quantity of coal-gas at different pressures in mains, that will be discharged from pipes of different diameter at 10ft. from main? Also, what allowance must be allowed for friction at per 100ft. from it?—Oddfellow.

[49535.]—**Engraving on Brass, &c.**—Will some kind reader give me information on the above, as to the method, and also the forms of the gravers generally used for cutting name-plates, &c.?—F. W. S.

[49536.]—**Analysis of Manures.**—Will Mr. Allen kindly give the tests for ammonia (peligote) and soluble phosphates (uranium process) in manures, with full particulars of procedure, and oblige—T. S.

[49537.]—**Microscopical Mounting.**—Can any of our microscopical readers tell me what is the best varnish to use in order to fix covers on objects which are mounted in balsam and benzole? If they would shortly describe the process of mounting with balsam and benzole, particularly in dealing with objects of such a thickness as to require a shallow cell, I should feel greatly obliged, as hitherto I have been unsuccessful in my efforts in this direction, and "Davies on Mounting" does not throw much light on the matter.—Novice.

[49538.]—**Turning.**—Would one of your correspondents kindly inform an amateur what he could make out of vegetable ivory (coroso) nuts? And what is the best way of chucking them in the lathe?—Cato.

[49539.]—**Barrel Organ.**—Will anyone give instructions how to make a barrel organ with reeds? I have 35 reeds (Munroe) from G to F; can I turn these to account? Must I drive by worm and screw; or cannot it be worked by a strap driven from the bellows action worked by the feet?—J. C.

[49540.]—**Adhesive Substances.**—I want to coat two substances so that they will adhere without the application of moisture or heat when brought into contact. At the same time, neither surface must be adhesive to uncoated surfaces. Can any reader help me?—J. H.

[49541.]—**Organette.**—Our American friends have invented a tribe of automatic instruments called variously "organinas," "orguinettes," "orchestrionette," "panette." Will some kind friend tell me what are the peculiarities of those several instruments, and which is the best of them? I got one called an "orchestrionette," I was told it is superior to any of the tribe; and now I am told another, the "organette," is better. A few hints on the subject will oblige—The Organ Grinder's Monkey.

[49542.]—**Mercantile Insurance.**—Would some reader kindly recommend some easy book on Mercantile Insurance, suitable for one taking it up as a profession? —A. L. M.

[49543.]—**Horse-Power of Engine.**—Would any reader kindly give me the nominal, actual, and indicated horse-power of the following engine? Diameter of cylinder 16in., stroke 24in., steam-pressure 60lb., making 60 revolutions per minute, but working on the expansive principle, the steam being cut off at ⅓rd of the stroke? Also, explain what would be the difference if the engine were not working expansively?—A. B. G.

[49544.]—**Spectroscope.**—I should be glad if some of our contributors would give me particulars of how to construct a good cheap pocket spectroscope, for use in the Bessemer process?—Bessemer Blower.

[49545.]—**Diet in Training.**—As the question of "drinks" is engaging the attention of your readers at present, may I ask for advice as to the best system of moderate training for rowing at the University? And especially what liquids, stimulant or other, should be allowed? I hear that the old fashion of half-cooked beef-steaks, and port wine, was all wrong; and should be glad to know what the present medical opinion is on the subject?—Hortorum Cultor.

[49546.]—**Catgut.**—Would any kind reader tell me how to prevent catgut from stretching on a lathe?—C.

[49547.]—**Access to Pump.**—I should be glad if Mr. Wetherfield could tell me if I am right in claiming access to a pump, under the following circumstances? Four cottages, all one property, were put up for sale in two lots. I bought No. 1 lot, but found that the pump and well were on the boundary of lot 2. No mention was made of this at the sale, nor is the well mentioned in the deed. One of the tenants in my lot has had access to the pump for 25 years, and there is a door in the party wall, evidently put on purpose. Could the purchaser of lot No. 2 bring an action for trespass against my tenants for continuing to use the pump?—W. S.

[49548.]—**Hogs' Bristles.**—Would one of your readers give me a few hints on choosing bristles for making brushes? What different sorts are there, and what should be the price of them?—Hogos.

[49549.]—**Photo-Lithography.**—Would any reader be kind enough to tell me whether an amateur photographer could produce from his negatives pictures, in such a way as the design plates of the *Building News* are done from the original drawings; how to set about it, &c.?—Semper Fidelis.

[49550.]—**Photography.**—Would Mr. Robinson oblige an amateur by giving him formula for (1) Good silver-bath; (2) Good developer; (3) Good intensifier; (4) Good fixer for wet collodion plates—something that will not be injured by keeping?—Semper Fidelis.

[49551.]—**Hot-Water Apparatus.**—I shall be obliged to Dr. Edmunds, or any other correspondent who will explain the system by which it is alleged that water containing lime in solution can be heated for domestic purposes without incrusting the boiler or pipes. I mean that which Dr. Edmunds quoted, No. 931, page 480, January 26, 1883, as "Perkin's arrangement." My house is supplied by water from the West Kent Water Company—excellent water, but so highly charged with lime, that I have to get the kitchen high service boiler cleaned out every three or four months. Without such attention, the flow pipe, of fully one inch bore, becomes completely choked in a year, and the boiler more than half filled with a chalky deposit.—Gamma Sigma.

[49552.]—**Foul Tongue.**—Will Dr. Edmunds tell me what treatment I can adopt to cure myself of a tongue which is black or dark-brown down the centre about ½in. wide? I generally have neuralgia, or a headache at the same time, but not always, and everything tastes acid. I have consulted my medical man, and he is unable to account for it or give me any effectual remedy. I am a druggist, and I have never seen anyone with so black a tongue.—Chemicus.

[49553.]—**Battery Construction.**—I beg to thank "Sigma" for reply to query respecting positive element, and now intrude upon his kindness for furthur advice. I wish to make up 50 or 60 cells (pint size) of the following construction:—Porous cell containing rod of amalgamated zinc. Outer cell, strip of sheet platinum (or platinised silver) on a support of ebonite, and packed with a mixture of carbon and manganese solution, sal ammoniac, or chloride of zinc. (1) What is the rule for width of the platinum (or platinised silver), and if sufficient for the metal to be on one side only of the ebonite support, or should both sides be covered so as to present equal surface? (2) Should the outer cell be packed full with the carbon and manganese? (3) Which of the two solutions would be preferable, sal ammoniac, or chloride of zinc? (4) Would a battery, such as described, have greater E. M. F., and be more constant than the Leclanché, and if suitable for working a medical coil, using, say, two (each of pint size) or one quart size?—Therapeutist.

[49554.]—**Diaphragm in a Refractor.**—Would some astronomical reader kindly inform me how to regulate the position of a diaphragm in the tube of a refracting telescope? What would be the result if no diaphragm was used? I notice that in Chambers's "Descriptive Astronomy" (in the description of astronomical instruments), and in Loomis's "Practical Astronomy," no mention is made of a diaphragm. Information on the subject would oblige, but please do not refer to back numbers.—Neptune.

[49555.]—**Glass Positive.**—I have an old glass positive, from which I wish to take a paper print; but the film side is varnished with yellow varnish. How can I remove varnish? Is there any chance of spoiling positive in removing varnish?—Positiva.

[49556.]—**Perpetual Almanack.**—Will Mr. Pearson oblige by furnishing rule for finding the year in which Easter will fall upon a specified date within the possible days. I have employed a week's leisure in trying to find a rule, without success, my curiosity having been excited by the fact that Easter this year falls on March 25th, which date is a very rare one for that feast. A friend gave me this doggrel, which set me to work—

"When Our Lord falls in our Lady's lap,
England will meet with some mishap."

—HOTNOS.

[49557.]—**Sundial.**—Will any of our dialing friends favour us with the rule to find the angle of hour-line to meridian in perpendicular dials declining from south towards east or west? For horizontal dials it has been clearly explained in Vol. XVI., p. 45, &c.—W. H. R.

[49558.]—**Focussing Screen.**—Will some reader of this journal tell me how to grind the glass of a focussing screen?—LITTLE JUMBO.

[49559.]—**Ramsden Eyepiece.**—Would "Aldebaran," or some other of your astronomical contributors, kindly state what are the special advantages of the above kind of eyepiece? Would it enable me to see Cassini's division of Saturn's Ring through my simple refracting telescope (non-achromatic), 3in. o.g., 14ft. 6in. focal length. I fancy I have just been able to glimpse this division on two or three occasions with the o.g. stopped down to 2¼in., using a Huyghenian eyepiece, power about 96 diam.—E. T. JOY.

[49560.]—**Collodion.**—Can plain collodion of commerce be thickened with anything of a transparent or semi-transparent varnishing character, so as not to dull the lustre of a bright metal surface when painted on?—MECHANIC.

[49561.]—**Weaving.**—What is the English equivalent for "Cartons pour le tissage," or "Cartes de tissage"? Can anyone inform me whether a machine has recently been invented for manufacturing in 24 hours carding-combs for weaving (if that is the rendering)? As a rule, I understand the process of manufacturing such articles is a very lengthy and expensive one, and requires such minute care, that none but skilled workmen can do it. Such an invention, therefore, would be of great importance. The machine in question is supposed to be capable of making such combs for every kind of stuff, silk, linen, wool, &c. Has any such machine actually been produced, and is it working anywhere?—O.

[49562.]—**Emery Bands.**—My business requires me to use occasionally emery bands. Their principal defect is, that the glue flakes off the band. Could any reader inform me what is the best preparation to cause the emery to stick to the bands? Also, what is the best preparation to keep the adhesive substance from heating? Emery bobs or solid wheels are useless for the purpose—not being pliable enough.—GO-AHEAD.

[49563.]—"**The Dickens.**"—Can any one tell me what the derivation of the word "dickens," as used in this sense, is? I have always thought that the word was a creation due to the popularity of Charles Dickens; but my opinion has been rather shaken since I saw it stated that Shakespeare used it, though I cannot find the passage.—E. G. T.

[49564.]—**Gas-Engine.**—I have a vertical gas-engine ½ h.p., Giles and Humbult's patent. It has a trunk piston, also another top piston. I am thinking of doing away with top piston, as I think it will work with less friction and noise. Would any one give me sketch as to how I am to make my inlet-valve and exhaust?—J. H. G.

[49565.]—**Fan for Forge.**—I am about to make a fan. Could any reader oblige by giving best way to drive same, either by lever or foot, size of wheels, &c.? Also size of fan best suited for brazing iron plugs into tube 1¼in. diam.? A sketch as to how to place wheels, &c., will oblige—J. H. G.

[49566.]—**Furniture.**—Will some one kindly tell me how I can loosen the joints of furniture that have been dovetailed? I want to take it to pieces for packing for a a sea voyage.—OLD SALT.

[49567.]—**Mechanics.**—Can any correspondent give me some help towards solution of the following problem, over which I have occupied weeks without success? A bowl is formed from a hollow sphere of radius a. It is so fixed that the radii of sphere drawn to each point in the rim make an angle α with the vertical, and the radius drawn to a point, A, of the bowl make an angle β with the vertical. If a smooth uniform rod remains at rest when placed with extremity at A, and with a point in its length on the rim of the bowl, show that the length of the rod is—

$$4a \sin.\ \beta \sec.\ \tfrac{1}{2}(\alpha-\beta).$$

I have supposed two forces acting at A, end of rod—viz., one whose direction passes through centre of sphere, the other at right angles to it, a tangent to the sphere, acting in an upward direction. Curiously, I have obtained an answer to a particular case, $\alpha = 90°$, by supposing this last force to act at one time in one direction, at another time in another.—J. C.

[49568.]—**Litho Varnish.**—Will any reader tell me what thin litho. varnish (known as S.H.) is made from? I do not want to make; the information is only wanted to aid me in its use.—J. D.

[49569.]—**Legal.**—A lady travelling by rail takes a seat in a carriage wherein already is a gentleman with his children. The gentleman's portmanteau has been placed in the hat and umbrella rail just over the lady's head, and during the journey the jolting of the carriage causes the portmanteau to fall on the lady's head, damaging her bonnet, and causing her to be unable to follow her business for a few days. The gentleman says the railway porter placed the portmanteau in the hat rail, and that, in consequence, he is exonerated. The railway porter cannot be identified by me, as the gentleman commenced his journey in the carriage some miles before the lady got into it; so that the gentleman's statement that the railway porter put it there cannot be denied, although it may fairly be assumed he put it there at the gentleman's request. Would Mr. Wetherfield inform me whether I ought to sue the gentleman passenger or the Railway Co. for damages, and if the gentleman, whether the onus of proving that the railway porter placed the portmanteau in the hat rail at his own instance or by the instructions of the gentleman, rests with the gentleman, or with me, the plaintiff?—F. JOHNSON.

[49570.]—**Physical Change in Seven Years.**—If it really is a physiological fact that "every particle of our bodies change once in seven years," and not only change, but are entirely removed from us, and replaced by new ones. I should be glad to see an explanation of the following. I have a tattoo mark upon my body, done when a boy: as that was twenty-one years ago, my body must have changed about three times, or, in other words, I have cast off three old bodies, not a particle now remaining of those bodies within me. The tattoo marks are as distinct now as when first executed. How is this? This subject has been discussed in another journal before, but not clearly explained, one instance, given as an example, being that of a boulder remaining stationary at the bottom of a running stream; but surely a wide difference exists between the two cases. This subject will also affect the teaching of the final raising of a material body, the question arising, which one is to be raised? I shall be glad to be enlightened upon this matter.—W. H. MAUCHAN.

[49571.]—**Electrical Resistance.**—I understand that the conductivity of a wire increases with its softness, and also that heating a wire increases its resistance; but, as it seems to me that heating must necessarily soften a wire, I cannot reconcile the two statements. Will one of ours kindly explain?—B. H.

[49572.]—**To Mr. Allen.**—Will Mr. Allen kindly inform me what causes the mottley, or marbled appearance in ordinary blue mottled soaps?—BOTHNASA.

[49573.]—**Gums Receding from Teeth.**—Will Dr. Edmunds kindly state what is the best remedy for gums receding from the teeth? I am in the habit of occasionally chewing a small piece of rhubarb, which I find excellent for the liver when a little out of order. Can this be injurious to the gums, as I fancy the teeth feel rather loose after doing so?—JASON.

[49574.]—**Meridian Instrument.**—Will some one of ours kindly explain the purpose of, and how to use, one of the above. It is Dent's patent, and has an hour circle?—J. J. H.

[49575.]—**Sidereal Clock.**—Can an ordinary clock be converted into sidereal, by either doubling weight of, or the length of, pendulum?—J. J. H.

[49576.]—**Legal.**—A., while boarding and lodging at B.'s, purchases a sewing-machine of C., to be paid for by instalments, D. becoming security. After paying off about one-fifth of the purchase money, A. goes away from B.'s, considerably in B.'s debt; D. also changes residence. C. makes no great effort to find D., but tries to frighten B. (who is a very poor woman, and has kept the machine against what is owing her) out of the machine. Eventually, after keeping the machine some 15 months, B., believing her title clear, sells the machine through E. to F.; B. thereby recovering part only of what is owing to her by A. F., in buying, knows nothing of the circumstances of the sale. The question is, Has or has not F. clear title to the machine?—ANXIOUS.

[49577.]—**To "Os."**—Will "Os" kindly say if he has tried "Bennet's Battery" for electro-plating purposes? If so, will he give his opinion compared with Daniell's for the same purpose?—NOVICE.

[49578.]—**Electro-Plating Bath.**—Will some professional inform me the best kind of wood to use for a bath for silver solution, and the best method of constructing one to hold about 20 gallons? Also whether the joints require any special treatment?—FORK AND SPOON.

[49579.]—**Small Power Engines.**—I confess I feel at times, on seeing the advertisements in "ours" of handy little gas-engines, and of sets of castings for making same, &c., a little envious, living as I do where gas is not to be had. Will not someone take pity on country residents and tell us how to construct small power engines for hot air, which, I doubt not, would be acceptable to many.—H. R.

[49580.]—**Tool-Grinding.**—To (more especially) "T. K. W."—As an amateur, I cannot succeed as I should wish with grinding chisels, plane-irons, and drills. I have made an adaptation of the rest referred to at p. 254 of 17th Nov. last, and illustrated in Vol. XXXII., p. 212, but cannot get it to work satisfactorily. Can you explain how, with it, to get different angles, as unless the tool-holder with the thumbscrews is made to shift, I do not see how to be able to grind but at one and the same angle, some of the tools being too short to advance far out from the holder, and I do not see how to make the holder shift. Again, unless the point in the post fits very loosely, the rest will not come down on the stone; and if it is fitted loosely, there is too much side play, and the tool gets at another angle across the stone, and is not ground true.—H. R.

[49581.]—**To "Esthos."**—Will "Esthos" kindly give the calculation whereby he arrives at the result on p. 422, that 100 parts of magnesium pyro-phosphate contain 35·7 parts of magnesium oxide?—NOVICE.

[49582.]—**Dyeing Oil.**—Will some correspondent kindly tell me how I may dye a vegetable oil black, so that when applied to any substance the black may not rub off? I have tried several ingredients, but without success.—A WOULD-BE PIPER.

[49583.]—**Water Engine.**—How many gallons of water per hour would a 1h.p. water-motor require, with water pressure at 130lb. per sq. in.? Also state if ¾in. feed-pipe would do for a supply? I have been thinking about having two oscillating cylinders, 3in. bore and 9in. stroke.—A JOBBER.

[49584.]—**Pasteur's Fluid.**—Are any of ours able to tell me how the yeast is prepared which is now, I believe, generally used in place of Pasteur's fluid?—CIUDADOSO.

[49585.]—**Verge Watch.**—I should feel greatly obliged if some kind fellow-workman would advise me how to act with following:—In repairing verges very often I get one or two back through going five minutes slow the one night, and ten or so other fast; hands all tight; escape-wheel true; contrate true also; mainspring good and work free; can find no confinements; runs well when verge is out. Ought I to bush out from beginning, or how should I act?—ANXIOUS.

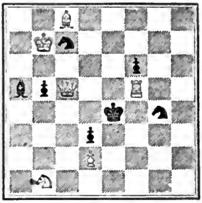
[49586.]—**Renovating Old Silver Jewellery.**—I understand how to polish old silver jewellery, but I want to know how to obtain the dull appearance seen on new goods. Can anyone tell me how to "renovate" old silver?—POOKE.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden W.C.

PROBLEM DCCCXXII.—By D. MACKAY.

Black.



White. [6+7

White to play and mate in two moves.

"ENGLISH MECHANIC" PROBLEM AND SOLUTION TOURNEYS.

I.—PROBLEM.

1st prize, £1 1s.; 2nd, "English Chess Problems"; 3rd, Gossip's "Manual" (last edition); 4th, Collins's "Problems"; 5th, "Chess Chips," by J. P. Taylor.

II.—SOLUTION.

1st prize, "English Chess Problems"; 2nd, Pierce's "Chess Problems"; 3rd, Miss Beechey's "Chess Blossoms"; 4th, Miles's "Problems and Poems."

RULES.

1. Each competitor can send in two three-movers and two two-movers, original and hitherto unpublished, on or before May 31st, 1883, to the Chess Editor, 31, Tavistock-street, Covent-garden.

2. The 1st and 5th prizes will be given for the best and second best three-er; the 2nd and 4th for the best and second best two-er; the third for the best sui-mate in two moves.

3. Solution prizes will be given in the order named, corresponding to the marks gained by solvers.

4. The principal variations must be given for full marks. Extra "marks" for discovering a "cook."

5. The usual rules respecting sealed names and motto.

6. There must be at least ten competitors in each tourney.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 819 and 820, by Dicky Sam, and R. J. Adams.

J. THURSBY.—Thanks for the problems, which we shall have pleasure in inserting shortly.

J. W. Mc. A.—Corrected version received. W. T. Pierce, J. Watkinson, and H. J. C. Andrews are thanked for games, chess cutting and problem.

DICKY SAM.—In your elaborate and ingenious solution of J. B., of Boxford's, problem, have you not overlooked the defence 1. $\frac{\quad}{\text{R at K B 3 to K Kt 3}}$?

R. J. A.—The best book is Gossip's "Manual" (last edition) price, we believe, 3s. 6d.

THE Khedive of Egypt, through the Consul for the Netherlands, has been pleased to confer upon Mr. James Hill, of the Thames-street Lock Depot, the insignia of the Order of the Medjidie.

THE Albo-Carbon Light Company, Limited, has decided to distribute, out of the profits ascertained as earned in the half-year ending 31st December last, a dividend at the rate of 15 per cent. per annum, free of Income-tax.

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade, to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 14, and unacknowledged elsewhere:—

J. B. Yonge.—J. and H. Grace.—H. Milnes.—G. W. Weeks.—T. Taafe.—Rev. F. Carre.—C. W.—Robinson Crusoe.—Suds.—James Ward.—K. C. N. S.—Puzzled One.—Brass.—Cymru.—Penmaenmawr.—A. Francois.——Laura.—W. T. W.—Working Joiner.—A Contributor.—G. Dreher.—Testycrumbs.—E. J. R.—Firer.—O. V.—F. W. K.—Omega.—F. E. R.—Jack of All Trades.—Engine Driver.—Bromsgrove.—D. B. Siddall.—S. E.—H. P.—W. L. Lancaster.

Pax. (Not that we know of, and we should imagine not. There are a few facts in "Men of the Time.")—F. C. Byng. (All necessary particulars given several times. See p. 31, Vol. XXXII., and p. 94, Vol. XXXIII.)—Economy. (For staining floors, see pp. 22, 118, 694, Vol. XXXIV.; p. 127, Vol. XXX., and the indices generally.)—Comet. (The solution should not be used for articles of copper or brass. Its use is to "quick" solder seams and ornaments of lead and its alloys. 2. For what purpose is it used?)—J. C. (The label can be registered at Stationers' Hall on presenting a copy and paying 5s. The trade-mark must be registered at the office—the Patent Office, Southampton-buildings, E.C.)—W. Wilby. (You could obtain particulars at any recruiting office, and also at the post-offices, we believe. Every recruit for the Engineers must have had some training in a trade.)—Cousier. (We do not remember the special note referred to; but there are two papers on enamelling in Vol. XIX., pp. 217, 347. See also p. 144, Vol. XVIII.; p. 44, Vol. XVII.)—N. S. Godfrey. (It is corrosive sublimate, a highly poisonous salt of mercury. Dissolve one ounce and a table-spoonful of common salt in a pint of hot water. That is sufficient for eight gallons of water, and can be kept ready for adding as required, but should be under lock and key. It is most effective applied after a shower of rain.)—J. H. G. (Apparently rheumatic gout. Consult a medical man, as personal examination is necessary before advice can be given.)—A Novice. (Perhaps you have forgotten the iron borings. However, it was fully described on p. 5, last volume, and many times since. Try again. 2. Apply the wires to the tongue—that is the simplest test.)—H. J. M. (Apply to Mr. Van Voorst, Paternoster-row, for his catalogue.)—Brighton Traveller. (We could not afford space for such a table just at present. We believe it is gaining steadily in favour on the Continent.)—Cato. (No more effect than walking if the work is steadily performed. A machine geared down would require the least exertion. It would be invidious to recommend a special make; but you have doubtless read what has been said, and must please yourself.)—Dominus. (We suspect it is simply whole wheatmeal specially ground.)—Num. (About 30 or 40lb.; but one weighing about 8lb. would keep the light going for a couple of hours.)—G. F. B. As the question is put, we suppose it must be tinman's solder; but we imagine you are alluding to the galvanised iron parts. That is a coating of zinc.)—D. B. Livie. (We can only refer you to the back volumes. There is no definite rule, and the best propeller is very much a matter of experiment for any given boat.)—W. K. (Properly speaking, there is no such thing. You must either have a cistern above the tank or a weight below it to drive the water up; or you can have one of the reversible arrangements. See p. 497, Vol. XXXI.; p. 254, Vol. XXIII.; p. 400, Vol. XVIII.; p. 20, Vol. XVII.; pp. 294, 366, Vol. XVI.; pp. 39, 172, Vol. XIV. You do not say for what purpose it is intended, and we cannot, therefore, say which would be best suited; but at all the places mentioned you will find illustrations.)—J. J. (Best white gelatine, or if the colours are high you may use clear glue.)—Markwell. (You can try isinglass dissolved in acetic acid, making the parts warm (*i.e.*, coaguline), or grated cheese 2 parts, finely-powdered quicklime 1 part, white of egg sufficient to make a paste. We believe the latter to be equally effective without the cheese, but the lime must be freshly burnt and the operation performed as quickly as possible after mixing, using the smallest possible quantity. The marble is most likely alabaster. Freshly-made plaster of Paris mixed with water would answer, but as that is not easily obtained, put a lump of lime in an iron spoon into a clear fire, and powder and use it as soon as cool.)—One who would Like to Cure his Own. (Several recipes have been recently given. There is no difference in the treatment. See indices under head Skins, Moleskins, &c. Roll the hard skin up with a damp cloth inside, and when soft rub in castor-oil, and afterwards arsenical soap.)—Ralph. (There are many devices for obtaining distilled water in back volumes. What you want is a vessel in which to evaporate water, and a worm in which to condense the vapour. The worm passes through a vessel containing cold water. Some years ago a correspondent said he used the ordinary compo.-pipe; but glass would, we think, be better. You can obtain worms in several materials at the chemical apparatus shops, or a tinman would soon make one.)—Juventus. (It is a mixture of oil of almonds and lime-water, the latter made by adding slaked lime to water, agitating and allowing to settle. A recipe given on p. 148, No. 448, has lime-water 5oz., oil of almonds 3oz. Sometimes a little glycerine is added, and, of course, a perfume.)—J. D. P. (Most of the large music-sellers publish instruction books and exercises, and more depends on the student than the book.)—G. F. C. (See list of Back Numbers, published in first number of each month. The composition is glue 1, glycerine 4, whiting to colour; but the proportions may be varied. For ink, dissolve aniline violet in spirits, and dilute to a suitable consistency.)—Astrologer. (Consult some elementary textbook of Astronomy. If you find any difficulties, your questions shall receive attention; but time is too short to waste it in "satisfying" you—at present.)—J. H. Stephens. (See pp. 303, 324, 339, 342, 364, this volume, about sharpening files. As to the second question, it is too vague; but you could see suitable engines and boilers at any engineer's.)—A Weekly Subscriber. (What do you mean by "steel bronze"?)—Poor Man. (You must sue the "Company" if you sue at all, but the great probability is you will only throw good money after bad. Their defence will be that you bought what you saw.)—Dr. W. H. Browne. (We fear present pressure upon our space prevents acceptance.)—H. P. (Your grandfather sold the property, as, no doubt, he had a perfect right to do. "Cutting off the intails," as you call it, has nothing to do with the matter, and the signature of a boy of seven years of age would have been useless in any case. Do not waste time or money in attempting to recover your lost inheritance.)—Milan. (Quite possible, if the accident to his hand did not stand in his way. Best chance in the Colonies or the United States.)—Justice. "A.'s" remedy is to sue "B." for the loss sustained; but unless he has a written agreement he has not much chance of success.)—J. H. (Four questions from examination papers at once is too much for our space.)—Enquirer. ("A." can dispose of her property as she pleases, but she should consult a solicitor in the matter, so as to be quite clear as to what is hers, and what is her second husband's. "G.'s" share goes equally to her children.)—Stylus. (You must attend before the registrar and state that payment has been offered, when the registrar will make an order for the fees.)—D. Livie. (Practicable enough, and, we should think, an improvement; but we fear so few of our readers are interested in whale-fishing that we could hardly spare the space for the sketches.)—E. A. Jones. (The plans of the proposed brick workshop must first be submitted to your district surveyor.)—Leyden. (Remove the old coat.)—Star. (Consult some astronomical textbook for the argument. It is too long.)—Brass. (Made of lac and methylated spirit, with various colouring matters. An amateur requires considerable practice. See indices.)—Abstainer. (In the case of a teetotaler, it must be indigestion.)—W. D. (You cannot use Bell's telephone for such a purpose without infringing. 2. Alarms in variety in back numbers. 3. Several recipes for so-called "fruit-salt" on pp. 97, 121, 166, Vol. XXXII.)—Chas. R. Gowers. (It probably has reference to a repeating or magazine rifle, which is to be issued for experimental purposes, we believe.)—A. Holman. (Answered last week, p. 535, middle column. Put the query to Mr. Davies direct.)—John Jones. (Pickle in sulphuric acid and water. Scrub with sand, dry, and immerse in pot of melted tin. See p. 361, No. 900.)—Tin Tack. (You must have a waterwheel and a dynamo-machine. Then when you have ascertained how much current you can get, you can determine the number of incandescent lamps. As you say the stream is swift, you may be able to get enough power; but you do not supply sufficient data to answer the question. We do not know the price of gas in your neighbourhood, but should imagine it to be cheaper than electricity.)—One Desirous of Knowledge. (If you have not the back numbers, you can easily get them. See pp. 221, No. 737, for furniture polish, and for blueing steel screws, p. 54, No. 861.)—R. M. L. (Yes, to both questions as they stand on paper, but the exercise should be moderate. No one would go without medical advice, which can be given only after personal examination.)—W. T. and J. (Such questions are answered in any textbook of quantitative analysis, and many instances will be found in back numbers.)—F. Dixon. (We do not know of such a wash. Try the old-fashioned plan of combing. 2. See several replies in back numbers. The skin is hard, because it was not properly worked to soften it. See pp. 456, 523, Vol. XXXIV.)—H. E. (There are some in the market which are easily worked, and keep in repair well; but to mention the names would be to advertise them gratuitously.)—Young Astronomer. (Nothing whatever can be said about such a telescope without testing it. Its age is not of necessity a disadvantage. The price stated is very high, unless it includes mounting. For testing power of eyepieces, see the indices.)—Blowpipe. (See pp. 562, 586, last volume, and 28, 53, this volume.)—Optical. (The lines from spiders' webs are fixed by just a touch of varnish or gold size. What is it you mean?)—Learner. (Formula in all the books and in back volumes; but it is bought so cheaply that not one photographer in a thousand thinks of making it.)—Robt. Jas. Houlton. (Why should we go to the expense of a woodcut to illustrate what you can see at most large furniture dealers?)—An Apprentice. (Don't attempt to make until you have seen one. The dimensions would depend on the work it is to do. The ribs must be curved and the canvas named will do if well painted. 2. Not if the tools belong to you; but it is advisable to study his opinion in the matter.)—Young Polisher. (Get Nos. 814, 816, and you will find something useful to you.)—B. H. L. J. (What do you mean by "zinc to carbon, carbon to zinc"; and what cell is it? The zinc of one cell should be connected to carbon of next, and so on. Send more explicit details, and then the query may be inserted.)—Wain. (If the weights are the same, the broader tired will be most difficult to draw by the extra surface impinging on the road; but the difference is small. If the weights differ, the heavier will require most power.)—P. B. (Bind guttapercha tissue over it, using several layers. The manufactured article is made by machinery, the wire passing through a vessel from which it issues coated with the guttapercha, the thickness of the coat being regulated by the dimensions of the orifice through which it is forced.)—E. K. J. (Try lampblack mixed with a spirit varnish, or with French polish, thick, and then thin with spirit. What is wanted is something to bind the pigment, so you may use turpentine if you add gold size, and drop or vegetable black. For brass, it is better to use one of the chemical stains—say, bichloride of platinum. Many recipes in back volumes.)—F. G. Edwards. (We do not understand how you are to study practical mechanics by means of a "dictionary." Cassell's, however, publish Knight's, and they also publish Prof. Perry's useful little technical manual, a notice of which is in type.)—Illuminator. (The information should have been sought in back numbers. To answer your questions briefly, to A we reply, certainly; B, copper, preferably insulated, the size depending on the quantity of current required; C, much longer distances can be covered without loss; D, the answer would be an advertisement, but one arc lamp would be enough, and two, one at each end, ought to light it splendidly. Any of the companies will give an estimate.)—Romeo. (There are a fair number in Sydney, Melbourne, and Brisbane. For addresses, see "The Indian and Colonial Mercantile Directory," published by Geo. Street and Co., 30, Cornhill.)—Anxious. (Had better buy the last three volumes. It is hard on us when a reader stops his paper for a few years, and then buys the last number and expects us to repeat for his especial benefit the very information we have been striving to place before our readers week by week almost for months and years.)—E. F. B. (We really cannot bother Mr. Wetherfield with queries as to the stamp duties on deeds. The official at Somerset House will mark the deed if the consideration is stated. 2. We do not know. 3. We have no room just now for discussing the so-called "missing links.")—W. B. (If people were all honest we should not want lawyers at all, and it would not be "absolutely necessary" to have mortgages, re-conveyances, or any other documents. Be guided by the opinion of your own solicitor—if he is a respectable one—and do not, for the sake of saving five pounds, endanger your property.)—Cheap Gas. (The Albo.-Carbon light is a patent, and you cannot make it yourself. Why you should seek to when the appliance is sold so reasonably we do not see.)—A Constant Subscriber. (Nothing but time will take away the taste and smell; but it will do no one any harm, and will gradually disappear.)—Engineer, J., Meteor, T. West, J. M. J. Jacomb. (In type.)

Thorns in an Editor's Chair.—Among the things, writes the *Tablet*, which a puzzled editor has often to ponder upon is the best means of pacifying the fiery gentlemen whose letters from time to time appear in his columns. His editorial heart is pained by the tendency he observes to wander from the point at issue, and sooner or later to drift into idle irrelevances or poor personalities. Nothing seems so well calculated to arouse the combative instinct as public letter writing; once a man is engaged in a newspaper controversy charity is cast to the winds; the meekest of men will sit down to pen venomous innuendos about the character of the critic who has ventured to differ from him about the authorship of a prayer-book or the reading of a text. Amiable old gentlemen, admirable in all the relations of life, will sit for hours together with elaborate vindictiveness hugging and nursing the prospect of impaling an antagonist, or perhaps subjecting him to a sort of literary scalping. To make an opponent cut a pitiable figure, so that his friends may think of him as a good sort of creature who has made the mistake of appearing in print, soon becomes the chief object of desire, and the truth of the matter in dispute is lightly forgotten; and so epithet is piled upon epithet until the editor in his perplexity announces that the controversy must end.

The American Self-steering Bicycle Head.—In our notice of the Stanley Show, p. 489, we omitted to mention that Messrs. Gorse and Sons, of Birmingham, exhibited several machines with their patent head. We illustrated and described this useful invention on p. 346, last volume.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 23, 1883.

PROF. HUXLEY ON SCIENCE IN EDUCATION.

AT the Liverpool Institute last Friday Prof. Huxley distributed the prizes to the successful students, and took occasion, or as he himself expressed it, felt morally bound, to deliver a speech on scientific education, because it was expected. Prof. Huxley fourteen years ago delivered an address on the same subject in the same building before the members of the Philomathic Society, and the present was, therefore, a fitting opportunity to review what he had said in the past. Prof. Huxley has long held that instruction in physical science supplies information of peculiar value, because it is of a character that cannot be otherwise obtained; and that as educational discipline it supplies in a better form than any other study can supply, a peculiar kind of logic and a peculiar method of testing the validity of our process of inquiry. At the time (fourteen years ago) increasing attention was being paid to education in physical science, and as it would no doubt go on increasing, it was obvious that the time given to teaching and training must either be increased too, or some of the other subjects of the curriculum must be removed from the table. Glancing down the lists of prize-winners at Liverpool, we find that Prof. Huxley had no light task to distribute the awards, which included University and other distinctions, certificates of the Oxford local examiners, showing that "general knowledge" had not been neglected, and quite a host of prize-winners at the Science and Art examinations. The value of science teaching as an item in general culture is well expressed in a paper by Mr. Worthington, one of the masters of Clifton school, whose words Prof. Huxley quoted. Mr. Worthington says it is not easy to exaggerate the importance of the information imparted by certain branches of science. It modifies the whole criticism of life made in maturer years—not, be it noted, because boys have acquired a knowledge of facts by learning science, but because the latter has exercised an influence as much moral as intellectual, which is shown in an increased respect for precision of statement, and for that form of veracity which consists in the acknowledgment of difficulties. It produces a real effect to find that nature cannot be imposed upon. The student of science, it may be said, experiences no difficulty in saying "I do not know," for he has discovered that there are so many matters beyond the ken of even the oldest and wisest of us, that there can be no shame even when the acknowledgment is made by a "professor." The student of science, if he goes earnestly to work, must acquire some knowledge of the right quality, and the question is how to set young students to work in the proper direction. Prof. Huxley holds that there are four points which must be attended to. (1) the proper selection of topics, (2) practical teaching, (3) practical teachers, and (4) sufficiency of school time. If these cannot be attended to by anyone who introduces physical science in a school, Prof. Huxley's advice to him is to leave it alone. As to topics, they include a general knowledge of nature and specific exercises in science; but the great point is practical science teaching, which requires more personal exertion and trouble on the part of the teacher than other branches of knowledge do, for it is absolutely necessary, in Prof. Huxley's view, that the pupils should be shown what is behind the talk—"in science the condition of knowing of your own knowledge the things you talk about is absolutely imperative." Diminish the extent of ground covered as far as you like, but unless that which is taught has a basis of actual observation and familiarity with facts, which are feebly symbolised in words, it is far better to leave it alone. As to the teacher, Prof. Huxley holds that it is a profound mistake to suppose that elementary teaching can be done by what are called "elementary" teachers—meaning by that persons who have only a smattering of the knowledge they endeavour to impart to others. Prof. Huxley says that there is nothing so difficult to do as to write a good elementary book, and there is nothing so hard as to teach properly and well people who know nothing whatever about a subject—an opinion which may be commended to the attention of those gentlemen who think they are called upon to write a textbook on some branch of science with which they have more or less acquaintance. Only those who have endeavoured to teach persons who know nothing of the subject can fully appreciate the difficulty, whereas explaining to those already grounded in the matter is comparatively easy. A teacher, then, must be a man practically acquainted with the facts he wishes to impart to others, and until lately it has been impossible to give the would-be teachers the instruction necessary to make them competent masters of even elementary things.

As to the time to be given to scientific education, that is the great difficulty at present, and it cannot be determined until it is agreed what other subjects are absolutely necessary. Prof. Huxley, however, does not avoid it, but boldly grapples with it, and condemns the so-called "literary education" which prevailed in the great majority of schools when he was a boy. He does not believe in the system which kept boys at Greek and Latin for years, learning the grammar, construing certain authors, and writing verses which, had they been English verses, would have been condemned as abominable doggrel. That kind of literary education was not literature at all; but science in a very bad and improper form—for grammar is science, not literature, and the analysis of a sentence by the help of the rules of grammar is as much a scientific operation as the analysis of a chemical compound. Prof. Huxley says there is nothing in it which appeals to the æsthetic faculties, and he asks all who have reached his age to say whether they had a conception of what art and literature meant until they learnt for themselves after leaving school. Grammar is a science; but it is taught in a most inadequate and inappropriate way, and not as a science at all. Prof. Huxley doubted whether many of his audience could give him a notion of what a nominative case really means, and of why it is necessary for a verb to have a connection with it. The whole thing, he said, involved a knowledge of logic, and of considerations which it is not possible to put fairly and fully into the mind of a young person. If a man cannot get literary culture out of the Bible, Chaucer, Shakespeare, Milton, Hobbes, and Berkeley, not to mention others, then, in Prof. Huxley's opinion, he cannot get it anywhere. He would, therefore, devote a large portion of the time of every child to a study of the models of English writing; and, if possible, he would add Latin and German—the former because it is the key to all the Romance languages, and German because it enables us to understand the language of the people from which most of us derive our descent. Drawing, Prof. Huxley considers an essential element of every child's education, because it gives the means of training attention and accuracy—two things in which mankind are more deficient than in any other mental quality whatever. He repudiates the idea that some people cannot draw, for, as he points out, writing is a form of drawing, and there is no one who cannot be taught to draw in the way he means, though it is impossible to make artists. Then he would have every child taught some art, music or painting, the elements of morals, and of political and social life; and beyond all that, let each take his special line. It is thus not a question whether one order of study should predominate, but what topics shall be selected in order to combine all the needful elements of education in such proportion as to give the mind the greatest food and the greatest support and encouragement in those faculties which enable us to appreciate truth, and to enjoy those sources of innocent happiness which are open to us, while avoiding the pitfalls which beset those who break either the natural or moral law. Knowledge, from Prof. Huxley's point of view, is divisible into two groups—matters of science and matters of art, for all things knowable belong to the province of the former, and all things feelable to the province of art—the æsthetic province; thus the business of education is to provide the young in the first place with the means and habit of observation and of procuring information, and secondly, to supply the subject matter either in the shape of science, or in the shape of art, or of both combined, and that is scientific education in its widest and best sense, for the object is not so much to cram the memory with rules and facts, exceptions and hypotheses, as to train the faculties of the young so that they will receive that development which will enable them to be happy and useful in their generation, and to furnish them with all that is most important in the capitalised experience of the human race, which is true knowledge.

REVIEWS.

Physical Optics. By R. T. GLAZEBROOK, M.A., F.R.S. London: Longmans.

THIS volume is one of the series of "text-books of science" issued by Messrs. Longmans, and though it professes to deal only with physical, as distinguished from geometrical, optics, the author has purposely avoided drawing a very decided line. Geometrical optics treats of the propagation, reflection, and refraction of rays of light according to certain definite laws, while physical optics deduces those laws as consequences of a certain hypothesis as to the nature of light, and explains phenomena which are beyond the domain of geometrical optics. Mr. Glazebrook, who, we may remind our readers, is demonstrator of physics in the Cavendish Laboratory, and Fellow and Lecturer of Trinity, Cambridge, undertook this work at the request of Prof. Stokes, and naturally makes frequent references to the writings of the Lucasian professor of mathematics, while several sections new to the textbooks are from the papers of Prof. Lord Rayleigh, and from the MS. notes of Mr. T. Dale. To give a clear explanation of the arrangements of lenses and other apparatus required in optical experiments, as well as to describe the spectroscope and the chief phenomena of spectrum analysis, involved more or less of geometrical optics; but one of the principal recommendations of the work to a very large number of students is the fact that, except in one or two sections, no deeper knowledge of mathematics than simple trigonometry has been assumed. The earlier chapters on the rectilinear propagation of waves, and on reflexion and refraction, will offer difficulties to many students, but they can take the author's hint to accept the propositions as demonstrated. The volume is freely illustrated with diagrams, and where apparatus is described the illustrations are from photographs of the instruments and appliances used in the Cavendish Laboratory. The work is well adapted to meet the wants of "advanced" students, and will be found very useful by lecturers and teachers.

Practical Mechanics. By John Perry, M.E. London: Cassell, Petter, and Galpin.

This is one of the new series of manuals of technology issued by the publishers, and is really a method of studying mechanics especially adapted to those who are already familiar with them in the way of rule and thumb. Prof. Perry has grasped the true idea of technological education, and objects to teaching a workman as if he were a schoolboy. He goes further: he would even assume that the schoolboy has acquired some experience. This work, however, is intended for workmen and apprentices; for those who are supposed to have some previous knowledge of the behaviour of materials and machinery, and who can put the facts to the test of experiment when they do not know they are true from their experience. Prof. Perry pertinently says: "I believe that the most illiterate men may be rapidly taught practical mechanics if we take the right way to teach them—approach the subject from their point of view, rather than compel them to approach it from ours." That passage gives the keynote to the method of teaching adopted by the author, who expects the reader to understand the meaning of decimals in arithmetic, to possess a box of drawing instruments, and to comprehend the fact that a letter of the alphabet, or any other symbol, may be used to represent a physical magnitude. The reader must also know the elementary principles of mechanics, not from books or lectures, but from practical experience. Here, then, is just the book which many workmen in this country can study with advantage, and which is what a manual of technology should be.

Pumps and Pumping Machinery. By Frederick Colyer, M. Inst. C. E., &c. London: E. and F. N. Spon.

This is a companion treatise to the author's work on "Hydraulic and Steam-Lifting Machinery," which, we think, will be found equally useful by the profession. The elementary facts in connection with the theory of pumps find no place in the book, which is devoted solely to practical details offered in as terse a style as possible, for the use of readers who are capable of understanding the matters described, and merely require the use of data which have been obtained from actual experiments, to decide upon the dimensions and design of the plant for a new establishment. Thus the volume contains a number of plates of pumps, engines, and machinery used in pumping, valuable data in connection with their working results, and brief notes of dimensions and general arrangements.

We have also received—*A Handbook of the Electric Lighting Act*, 1882, by A. P. Poley, B.A., and Frank Dethridge (Simpkin, Marshall and Co.); *The Electric Lighting Act*, 1882, by Clement Higgins, M.A., and E. W. W. Edwards, B.A. (W. Clowes and Sons), are both intended for the use and guidance of local authorities. The latter is the more elaborate work, and contains numerous notes and cases. It is, in fact, a treatise on the law as it relates to local authorities, companies, and their shareholders. The former is a digest of the Act, which will be useful to all members of local boards, or other bodies, who may be responsible for the introduction or rejection of the electric light into given districts.——*The Yearbook of Photography*, edited by H. Baden Pritchard, F.C.S. (Piper and Carter), is as usual full of interesting matter to photographers and to those engaged in the processes which have sprung out of the development of the art. The frontispiece is a nice portrait of Wheatstone by the Sawyer Collotype process, and there is a portrait of Mr. Woodbury, by Ives' patent process.——*Flowers of the Sky*, by Richard A. Proctor (Chatto and Windus), is a new edition, or apparently a reprint of a series of the author's essays on astronomical subjects.——*Nature Studies* and *Leisure Readings* (Wyman and Sons) are collected essays from the pages of a contemporary. By such writers as Grant Allen, Andrew Wilson, Thos. Foster, Edward Clodd, A. C. Ranyard, and Richard A. Proctor, they cannot fail to interest readers, and from the variety of subjects, must suit all sorts of people.——*The Stars in their Seasons*, by Richard A. Proctor (Wyman and Sons), is an atlas of twelve maps, exhibiting the appearance of the heavens at any hour of the night all the year round. All stars down to fifth magnitude are inserted, and the magnitudes indicated by the special form of the marks, which are white on blue ground. This work is rightly described as an easy guide to a knowledge of the stars.——*Where to Emigrate* (Wyman and Sons) is a "handy guide to all the English Colonies for intending emigrants," but it is a pity the author did not append his name, for the man who undertakes to advise "where to emigrate" incurs considerable responsibility of the moral kind. If bricklayers are "offered, at the present moment," wages varying from 20s. 10d. to 29s. 2d. per day in Manitoba and the North-West, it must be because there is so little bricklaying to do that it does not pay men to emigrate there. The guide, however, gives some trustworthy facts about the colonies themselves, and as it is accompanied by neat little maps, intending emigrants may obtain useful information from it.——*Household Boiler Explosions*, by William Ingham, M.E. (Lockwood and Co.), is a manual which should be read by all who have hot-water fittings in their houses. The plates will explain the arrangements usually adopted, and with the text, render a comprehension of the system easy. Where the "danger" comes in is clearly pointed out, and also the best means of avoiding it.——*Calvert's Mechanics' Almanack* for 1883 is the tenth year of this popular and very useful little annual. It is published by the author at Great Jackson-street, Manchester, but can be had of all booksellers, and the railway stalls—sufficient evidence of the position it has attained by its merits.——*The Engineer and Building Trades Almanack* (Abel Heywood, Manchester) is another annual which appeals to a wide circle, as it contains a variety of useful matter, a great deal of which is reproduced from our own pages.——*Platt's Essays*, by James Platt (Simpkin, Marshall, and Co.), is a larger edition of the well-known works issued by a man who has something to say and knows how to say it. The present volume contains "Business," "Money," and "Economy," and is adorned with a photo portrait of the author.——*Longman's Magazine* continues the promise of its first number. Nos. 2, 3, and 4 show that the editor judiciously mixes popular science papers with fiction and verse, and we have thus an excellent magazine at a small cost.——From the United States Commission we have the *Report of the Fisheries Commissioner for* 1879, containing besides matters relating purely to the work of the commissioner in the United States, a variety of valuable information in connection with fish and fishing. These volumes are really of value to other countries than America, and the United States Government is to be thanked for the generous manner in which it distributes them.——*Chemical Percentage Tables and Laboratory Calculation*, by C. H. Ridsdale (Crosby Lockwood and Co.), is intended to help the student to understand the calculations of the laboratory, and to save the chemist some of his less interesting labour. The book should be useful to many of our readers.——*Jas. Nasmyth, Engineer: An Autobiography*, edited by Samuel Smiles (John Murray) is, as its title indicates, a memoir of the famous inventor of the steam hammer.——*The Bell News and Ringers' Record* (Allen, Ave Maria-lane, E.C., weekly one penny), is a neatly got up periodical devoted to the interests of the lovers of the tintinnabulary art. That the interest evinced in bell-ringing is universal is clearly proved by the fact that in last week's number, independently of ringing items from all parts of England, there is a long account of the performance of six 6-scores of grandsire doubles on the bells of Christ Church Cathedral, Canterbury, New Zealand. The journal well deserves the support both of ringers and the general public, for whom it contains various interesting items.

We have also received *American Foundry Practice*, by Thos. D. West (New York: John Wiley and Sons), a work we shall notice at some length. We have already given some portions of it in the shape of articles quoted from one of our American contemporaries.

ASTRONOMICAL NOTES FOR MARCH, 1883.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination.	Sidereal Time.
	h. m. s. p.m	h. m. s.	° ′ ″	h. m. s.
1	0 12 33·30 ,,	22 48 21	7 35 59S.	22 35 47·77
6	0 11 28·33 ,,	23 6 59	5 40 48 ,,	22 55 30·53
11	0 10 13·22 ,,	23 25 27	3 43 42 ,,	23 15 13·29
16	0 8 50·00 ,,	23 43 46	1 45 30 ,,	23 34 56·05
21	0 7 20·98 ,,	0 2 0	0 13 0N.	23 54 38·81
26	0 5 48·94 ,,	0 20 11	2 11 4 ,,	0 14 21·57
31	0 4 16·83 ,,	0 38 21	4 8 0 ,,	0 34 4·33

The method of finding the Sidereal Time at Mean Noon at any other station will be found on p. 373.

At 11 p.m. on the 20th, the Sun is said technically to enter Aries, and Spring is supposed to commence. In reality, as is well known, he, at this instant, forms a rudely equilateral triangle with λ and ω Piscium. This is the theoretical date of the Equinox, which will, however, really occur in London on the 19th, when the Sun will be just 12h. above the horizon. The Zodiacal Light may now be looked for in the West, every clear night after sunset. Spots, faculæ, and prominences continue to appear upon the Sun's disc.

The Moon

Enters her Last Quarter at 5h. 26·1m. a.m. on the 2nd, and is new at 4h. 31·3m. in the early morning of the 9th. She will enter her First Quarter at 8h. 31·4m. p.m. on the 15th; be full at 6h. 4·8m. in the evening of the 23rd; and for the second time this month, enter her Last Quarter on the 31st at 8 21·3 p.m.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	21·7	5 13·4 a.m.
6	26·7	9 37·0 ,,
11	2·3	2 13·4 p.m.
16	7·3	6 54·4 ,,
21	12·3	10 47·7 ,,
26	17·3	1 38·0 a.m.
31	22·3	5 39·2 ,,

The Moon will be in conjunction with Venus at 10 p.m. on the 5th; with Mercury at 10 a.m. on the 7th; with Mars at 8 o'clock on the same evening: with Saturn at 11 a.m. on the 13th; and with Jupiter at 4 p.m. on the 15th.

Occultations of Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
12	o Arietis	6	6 51 p.m.	Dark	77	115	7 49 p.m.	Bright	304	344
20	14 Sextantis	6	12 3 ,,	Dark	66	88	1 17 a.m.	Bright	243	276
21	36 Sextantis	6	6 37 ,,	Dark	70	34	7 48 p.m.	Bright	245	215
24	50 Virginis	6	12 38 ,,	Bright	94	91	1 51 a.m.	Dark	217	227
28	41 Libræ	6	4 1 a.m.	Bright	36	44	5 1 ,,	Dark	305	323
28	ψ Ophiuchi	5	12 0 p.m.	Bright	119	87	12 54 p.m.	Dark	217	190
31	16 Sagittarii	6	2 44 a.m.	Bright	59	34	3 49 a.m.	Dark	303	286

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
2	III	Oc D	12	0	P.M.	13	II	Oc D	8	48	P.M.	22	I	Sh I	8	6	P.M.
3	*III*	*Oc R*	2	45	A.M.	13	I	Tr I	10	24	,,	22	II	Sh I	8	41	,,
4	II	Tr I	11	33	P.M.	13	III	Sh I	11	15	,,	22	II	Tr E	8	54	,,
5	*I*	*Tr I*	2	1	A.M.	13	I	Sh I	11	43	,,	22	I	Tr E	9	5	,,
5	*II*	*Sh I*	2	6	,,	13	I	Tr E	12	40	,,	22	I	Sh E	10	23	,,
5	*II*	*Tr E*	2	18	,,	14	*I*	*Sh E*	1	59	A.M.	22	II	Sh E	11	28	,,
5	I	Oc D	11	16	P.M.	14	*II*	*Ec R*	2	6	47,,	23	I	Ec R	7	36	34,,
6	*II*	*Oc D*	6	14	,,	14	*III*	*Sh E*	2	10	,,	24	III	Ec R	8	2	35,,
6	III	Sh I	7	15	,,	14	I	Oc D	7	39	P.M.	28	I	Oc D	11	32	,,
6	I	Tr I	8	30	,,	14	I	Ec R	11	11	46,,	29	I	Tr I	8	45	,,
6	I	Sh I	9	48	,,	15	*II*	*Sh I*	6	3	,,	29	II	Tr I	8	49	,,
6	III	Sh E	10	8	,,	15	*I*	*Sh I*	6	12	,,	29	I	Sh I	10	2	,,
6	I	Tr E	10	46	,,	15	*II*	*Tr E*	6	14	,,	29	I	Tr E	11	2	,,
6	II	Ec R	11	31	24,,	15	I	Tr E	7	9	,,	29	II	Sh I	11	19	,,
6	I	Sh E	12	4	,,	15	I	Sh E	8	28	,,	29	II	Tr E	11	35	,,
7	I	Ec R	9	15	57,,	15	II	Sh E	8	50	,,	29	*I*	*Sh E*	12	19	,,
8	*II*	*Sh E*	6	11	,,	20	III	Tr I	10	3	,,	30	I	Ec R	9	32	20,,
8	*I*	*Sh E*	6	33	,,	20	II	Oc D	11	24	,,	31	*I*	*Sh E*	6	47	,,
10	*IV*	*Sh I*	6	33	,,	20	I	Tr I	12	20	,,	31	*III*	*Oc R*	6	58	,,
10	IV	Sh E	7	35	,,	20	*III*	*Tr E*	12	51	,,	31	II	Ec R	8	35	14,,
12	*II*	*Tr I*	2	10	A.M.	21	*I*	*Sh I*	1	38	A.M.	31	III	Ec D	9	16	41,,
13	I	Oc D	1	10	,,	21	I	Oc D	9	35	P.M.	31	III	Ec R	12	4	49,,
13	*III*	*Tr I*	6	1	P.M.	22	*I*	*Ec R*	1	7	33 A.M.						
13	III	Tr E	8	47	,,	22	*I*	*Tr I*	6	49	P.M.						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Mercury

Is a Morning Star during the entire month. He attains his greatest elongation West (27° 13') at 5 p.m. on March 3rd. His considerable South Declination is very unfavourable for his observation, though, even at this time. His angular diameter diminishes from 7·4" on the 1st to 5·2" by the 31st.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° '	h. m.
1	21 3·6	16 47·8	10 28·1 a.m.
6	21 24·7	16 3·9	10 29·5 ,,
11	21 49·1	14 44·5	10 34·2 ,,
16	22 15·8	12 51·3	10 41·1 ,,
21	22 44·2	10 25·7	10 49·7 ,,
26	23 14·0	7 29·1	10 59·8 ,,
31	23 45·3	4 3·3	11 11·4 ,,

The path indicated by the above Ephemeris commences in Capricornus, crosses the greater part of the breadth of Aquarius, and terminates in Pisces. At 6 p.m. on the 9th Mercury will be in conjunction with δ Capricorni, but, of course, below the horizon. He will also be in conjunction with Mars, under similar conditions, at 5 p.m. on the 17th.

Venus

Is a morning Star too, and is just as badly placed for the observer as Mercury. She is, though, a conspicuous object to the naked eye, which he is not. Her angular diameter diminishes from 21·4" on the 1st, to 16·6" by the end of March.

Venus.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° '	h. m.
1	19 42·9	19 7·6	9 7·6 a.m.
6	20 5·8	18 30·4	9 10·7 ,,
11	20 28·8	17 40·6	9 14·0 ,,
16	20 51·8	16 38·4	9 17·3 ,,
21	21 14·8	15 24·2	9 20·6 ,,
26	21 37·6	13 58·8	9 23·7 ,,
31	22 0·3	12 23·1	9 26·7 ,,

Hence Venus travels from Sagittarius through Capricornus into the borders of Aquarius. She will be in conjunction with δ Capricorni (under the same circumstances as Mercury, mentioned above) at 1 a.m. on the 27th.

Mars

for the observer's purpose, remains quite invisible.

The Minor Planet

Vesta

Is now in a peculiarly favourable position for observation, and may now be detected with the naked eye on a dark night, by anyone possessing tolerably acute vision. Our Ephemeris is for intervals of 10 days.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° '	h. m.
2	10 15·8	20 49·0	11 34·2 p.m.
12	10 7·0	21 42·7	10 46·1 ,,
22	10 0·3	22 13·3	10 0·1 ,,

It will thus be seen that Vesta will travel backwards just above γ Leonis.

Jupiter

Souths in strong twilight even at the beginning of March, and must be looked for as soon as ever it is dark to be seen to any advantage; as, however, he does not set until about 3 a.m., during the early part of the month, and about 1h. 30m. at the end of it, we give our usual ephemeris of him. He is in so-called Quadrature with the Sun at 9 a.m. on the 13th. His angular diameter which is 38" on the 1st, is reduced to 34·6" by the 31st.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° '	h. m.
1	5 23·9	23 1·9	6 47·0 p.m.
6	5 25·1	23 3·7	6 28·5 ,,
11	5 26·6	23 5·7	6 10·4 ,,
16	5 28·5	23 7·8	5 52·6 ,,
21	5 30·6	23 10·0	5 35·1 ,,
26	5 33·0	23 12·3	5 17·8 ,,
31	5 35·7	23 14·6	5 0·8 ,,

Hence Jupiter will describe a short arc from west to east above ζ Tauri.

Saturn

Is an Evening Star, but is approaching the West even more rapidly than Jupiter. In fact, he Souths now in bright sunlight, and is low down in the West by the time that it is quite dark. For this reason our ephemeris of him extends only through the first third of the month. We shall not resume it until his appearance before sunrise in the early Autumn. His angular diameter decreases insensibly from 15·8" to 15·6" during the time specified. No perceptible change occurs in the opening of his ring.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° '	h. m.
1	3 15·3	16 6·7	4 38·8 p.m.
6	3 16·8	16 7·7	4 20·6 ,,
11	3 18·4	16 15·1	4 2·6 ,,

This short arc lies to the South-east of δ Arietis.

Uranus

Is now very well placed for the observer, coming as he does into opposition to the Sun at 5 a.m. on March 12th. and being above the horizon during all the working hours of the night. His angular diameter remains constant at 4" during the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° '	h. m.
1	11 31·0	4 0·8	12 53·1 p.m.
6	11 30·2	4 5·9	12 32·6 ,,
11	11 29·4	4 11·0	12 12·2 ,,
16	11 28·6	4 16·2	11 51·7 ,,
21	11 27·8	4 21·2	11 31·3 ,,
26	11 27·0	4 26·1	11 10·9 ,,
31	11 26·3	4 30·9	10 50·4 ,,

This short retrograde path is described in the sky above the 6th mag. star 89 Leonis.

Neptune

Has, for the observer's purpose, left us for the season.

Greenwich Mean Time of Southing of Eleven of the Principal Fixed Stars on the Night of March 1st, 1883.

Star.	Souths. h. m. s.
α Leporis	6 50 40·37 p.m.
α Columbæ	6 58 29·54 ,,
α Orionis	7 11 53·31 ,,
Sirius	8 2 54·25 ,,
Castor	8 49 55·80 ,,
Procyon	8 55 57·05 ,,
Pollux	9 0 55·19 ,,
α Cancri	10 14 38·96 ,,
α Hydræ	10 44 19·10 ,,
Regulus	11 24 30·75 ,,
α Ursæ Majoris	12 18 44·41 ,,

The method of ascertaining the Greenwich

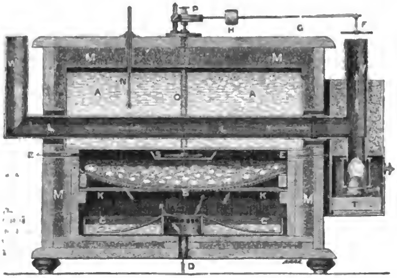
Mean Time of Southing of either of the Stars in the above List for any other Night in March, as also of finding the instant of its Local Transit at any other Station will be found on p. 375.

Shooting Stars

May be watched for from the 1st to the 4th, and again on the 16th.

HEARSON'S INCUBATOR.

HATCHING the eggs of poultry and certain game birds by means of incubators is an industry which has grown into considerable dimensions during the past ten years—perhaps because the demand is so great, and perhaps also because the means of carrying it on have been vastly improved. Our own pages bear witness to the fact that a great deal of interest is taken in the subject, and as we have previously described other incubators, we now give some particulars of Hearson's champion incubator, an apparatus which has been long enough in existence to have undergone a severe trial, and which has proved itself to be second to none. Other things being equal, it is well understood that the method of regulating the temperature is the distinguishing feature on which the relative merits of incubators depend; for it is clear that, unless the apparatus is to be very troublesome, there must be some arrangement by which the temperature can be steadily maintained at 102°—104° Fahrenheit, when required, and regulated to suit the processes going on within the eggs. When it is remembered that the operation of hatching the eggs of fowls runs over 21 days, and that a few hours' neglect on the 20th day may ruin the whole "nest," the importance of having a really trustworthy incubator can be readily appreciated. In the annexed engraving we give a longitudinal section of Hearson's champion incubator, the distinguishing feature of which is the capsule S, and the accessories by which the temperature is regulated. The capsule is a little vessel of flexible metal, exposing large surface compared to its contents. It contains about 20 drops of a liquid which boils at the highest range of temperature desired in the drawer of the incubator, and consequently, when that temperature is reached the flexible side of the capsule expands, or is puffed out, giving motion to a needle O, which acts on the lever G, and opens the damper F. In the engraving for clearness the lamp is shown with a vertical chimney and a horizontal tube leading out of it and passing through the water-tank, when it turns up to the air; in practice the tube is returned to give more heating surface, and to bring the two chimneys side by side. In ordinary working the heated gases pass through the tube L and warm the water; but when the capsule is brought into action the damper F is lifted and the heat from the flame shunted out by the chimney V. The weight H on the lever regulates the opening of the damper, which should be limited to one-eighth of an inch, and it also regulates the temperature, for the capsule commences to expand at 97-98°, and would consequently lift the damper if the weight were not shifted so far along the lever that a temperature of 104° must be reached before the damper begins to open. Whether lamp or gas is used as the source of heat the flame must always be turned to a greater height than is absolutely necessary, so that there shall always be a little heat to shunt. The other parts of the apparatus will be clearly understood by the following description:—A is the water in the tank; B, perforated metallic movable egg-tray; C, water-tray for damping the air which enters by D, and passes through a piece of coarse canvas which filters it; E, ventilating holes, to insure a full supply of fresh air; K, slips of wood for varying height of egg-tray; M, non-coudncting material; N, thermometer; P, milled head screw for adjusting the needle and lever; S, capsule; T, lamp.



THE MODERN LATHE: ITS MANUFACTURE AND USES.*

By J. H. Evans.

(*Continued from p.* 541.)

ANOTHER great advantage of possessing an eccentric cutter is that it is capable of being used for cutting squares, hexagons, octagons, &c. This is done by extending the eccentricity to cut a circle rather larger than the size of the surface required; this done, the cutter is driven at a high speed, and passed along the surface by the movement of the slide-rest. A certain amount of beautiful work may be done on the dome or sphere by turning the work in the first instance to the shape required, and then adjusting the radius of the cutter to suit it; by a variety of setting, in this way some very beautiful work is produced. Having described a few of the capabilities of this instrument, I will pass on to a brief outline of the eccentric chuck, its movement and results. In making a chuck of this description, it will be necessary that the greatest care should be exercised, for the simple reason that if it is not absolutely true in all its parts it will be impossible to do accurate work. The first thing to do will be to screw the back so that it will stand at a right angle to the bed of the lathe when the index points to zero. This done, the face must be carefully turned over and surfaced; the steel slides are then fixed to it, and the front plate fitted, equal care being given to this also. You will see, by examining this chuck, that the slide is capable of being advanced from two to three inches, and if there is the least error at starting, by the time it is moved a very short distance, the error will be so multiplied that it will be useless. And now as to the work to be done by its aid: if for patterns similar to the minor productions of the cutter, it will only require the slide to be set out the required distance, and a fixed double-angle tool in the slide-rest, and by dividing the front wheel of the chuck, a large variety of patterns may be executed.

Another pattern which is very effective is what is termed the geometric staircase. This is done by extending the slide of the chuck, and using a fixed tool in the slide-rest, which should be a square-ended chisel. It will be as well to point out that for this pattern a larger diameter must be left than is required, in consequence of a considerable part being cut away on one side, caused by the eccentricity given to the slide. As an example of this pattern may be useful, I will give the details connected with it. In the first place, the work, which will consist of a plain cylinder, must be turned on the eccentric chuck, and if sufficiently long to cause vibration, the poppet-head centre must be used to steady it; the end of the wood must be carefully faced up. It will be necessary to see that the dividing wheel in the front of the chuck is set at the starting point 96. The tool, which is fixed in the slide-rest, should be 1-10th wide, and the reader on the main screw set at zero also. Having them all at the centre, we may proceed with the first cut, having first set out the chuck or turn. The tool must then be carefully inserted until a complete circle is cut, and when this is done, the slide of the stop screw of the top slide must be fixed. The tool must be withdrawn, and the poppet centre released, the dividing wheel moved round 12 divisions, and the slide-rest moved one turn, which will be the exact width of the tool. This done, the second cut may be taken, but before doing so, the poppet centre must be replaced. It will now be seen that when this operation has been repeated eight times, that the dividing wheel has made one complete turn, and that the end of the wood has eight separate centres. It will, therefore, be necessary to release the poppet centre, and replace it for each consecutive cut. I have a few samples of this work amongst the specimens that are exhibited here, which will show the result perhaps more clearly.

We will now take a brief outline of the drilling instrument and its uses. This is made to run in a square stem in the same way as the eccentric cutter, and the drills are made of a variety of patterns; and for flutings, cutting beads, piercing fine lace patterns, it is of course indispensable. It is an instrument that requires very little explanation, and the various shaped drills will denote the pattern they produced. Very beautiful effects are to be produced by an extensive use of the division-plate and slide-rest, in conjunction with it.

The next instrument to refer to will be the vertical cutter. This is also made with a square stem, but the spindles run between two centres. There are, however, several patterns of this instrument, and the most useful is, I think, one that was invented by Dr. Stodarts. The spindle running in a collar, the frame is dispensed with, and enables the cutter to be brought closer to the collar of any work that is being turned. One of the most effective patterns to be cut with the vertical cutter is the basket pattern: of this a number of different designs may be made. The way to proceed is to take the first cut round, arranging the index point and division plate so that the points are brought up sharp. Having cut round the entire circle, taking, we will say, 12 divisions of the 96 circle, the slide-rest must be moved the exact width of the tool, the divisions advanced 3 holes, and a second cut all round, taking 12 divisions again; this must be repeated as many times as required to complete the pattern the entire length of the work. Another effect may be obtained by cutting half in each direction, this is, when the centre is reached, the divisions are taken in the reverse way, which, in other words, will be back again. By varying the division, a great many different patterns are thus produced.

We have now taken a brief view of those instruments I have named as forming a sufficient outfit to begin ornamental turning with.

Before concluding my remarks, I must refer to a very important discussion which has recently taken place in the Council of the Amateur Mechanical Society, and by means of which, certain very necessary and desirable conclusions have been arrived at.*

In acknowledging the fact that this advance is due to the action of the Council of the Amateur Mechanical Society, I may perhaps venture to say, that when scientific amateurs, such as Mr. Boord, Dr. Edmunds, Colonel Sandeman, Mr. Henry Perigal, and others, devote their attention to constructional questions, the result is always advantageous to science, and helpful to technical workers. To Dr. Edmunds, as a member of the council, is be ascribed the initiative and the zeal which has carried this matter through; and I am bound as a practical mechanician to testify to the advantages that will arise from the action thus taken by the Council of the Amateur Mechanical Society.

Having said so much, I will briefly describe the new mandrel nose. It has long been a complaint that the old pattern having a thread of 9·45 inch pitch created difficulties to amateurs in the screwing of their chucks, although, as lathe-makers, we always supply special taps for the purpose. Another objection is, that being grooved out at the base of the nose, while the centre of the mandrel is bored out, it is considerably endangered; that very part of the nose where the greatest strength is required being, in fact, made the weakest point.

Then, again, the shape of the thread from a scientific point of view has been imperfect, inasmuch as its height is greater than the length of its base, while its angle has not been precisely defined, and in practice has varied considerably. Although I have made a very large number of the old pattern, I am quite of opinion that it is time an alteration was made, and a definite scientific standard adopted. This may now be said to be done, and I have made arrangements for my new lathes to be made to it, unless especially ordered otherwise.

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* Paper read before the Society of Arts on Wednesday, Feb. 7, 1883.

* These conclusions appeared in our report on p. 474 —Ed. E.M.

The details of the new standard mandrel for ornamental lathes are as follows:—The diameter of the mandrel nose is ·9in., and its length over all is also ·9in., with a cylinder base ·15in. in length and larger than the top of the thread. The thread is ten to the inch, and its shape that already defined by Dr. Edmunds, and recommended by the Council of the Amateur Mechanical Society. The face is left perfectly square, no recess whatever being turned at the base of the nose. The mandrel nose being now larger in diameter, admits of the end being coned out slightly to receive a variety of small chucks for delicate work; the screw at the end of the mandrel, which holds the cap to its place, is also bored through, so as to allow a slender rod to be passed through from behind without unshipping anything. The cylindrical base ·15in. in length, is ·95in. in diameter, so as to allow the mouth of the chuck to pass clear over the top of the thread.

This is not the first time that the ornamental lathe is indebted for its progress to scientific amateurs. Professor Willis's tool-holder; the ellipse cutter, by Capt. Ash, with its indispensable tangent compensator, by Mr. Perigal; the geometric slide rest by Capt. Dawson; the geometric chuck by Mr. Ibbetson, and many other improvements, have emanated solely from the ideas of scientific amateurs.

In the discussion which followed, Dr. Edmunds said he believed the use of the geometric lathe, with which a great variety of beautiful work could be done, had not been fully appreciated as an educational instrument. He went on to point out that the mandrel was the all-important part, and having dwelt upon some matters which have been recently treated in these columns, he proceeded:—To this day the screw on the nose of these costly mandrels was made with a pitch of 9·45 threads to the inch instead of 10, whilst the screw at the back-centre was 13·09. The result was that if anyone wanted to know how deep his drill had gone, he had to divide an inch by 13·09, and multiply that by the number of turns of the back-centre, and then he got the result. Now, if only the screw were made with ten threads to the inch, he would simply have to read the number of turns he had given the back-centre, and would have in decimals of an inch the depth he had bored. It was the same with the other screws. In fact, they still had a whole series of screws which could not be made by change wheels, and could not be produced except by getting a copy from the particular manufacturer who sold these tools. They ought to have a screw which, in itself, possessed true scientific merit. It could be shown mathematically that there was a certain distribution of the material of the thread of a screw which would give the greatest possible strength, combined with the greatest durability under the wear and tear of frequent fixing and unfixing. Such a thread was obtained by an isosceles triangle of 50°, truncated at its apex to the extent of 7½ per cent. of its pitch. The point tool, if kept absolutely sharp, would leave a minute groove below the flattened top of the thread, and this would receive minute particles of foreign matter, and hold oil. Where the strength of the stem was important, the point of the tool might also be flattened down or rounded off some 7 per cent. of the pitch of the thread. This thread, the Council of the Amateur Mechanical Society thought, must be recommended on its merits, and as it could be made with perfect ease, it was preferable to the Whitworth screw for that reason. It could be made by a simple geometrical arrangement of the slide-rest, and calipering of the cylinder out of which it was made; whereas, the Whitworth screw, while an easy thread to cut for rough purposes by the ordinary hand tool, was exceedingly difficult to cut for scientific purposes in a screw-lathe. In rounding off 1-6th at the top, and 1-6th at the bottom, you require to continually vary the arc of the circle in relation to the pitch of the screw. The thread of 50°, truncated to the extent of 7½ per cent. of its pitch, had other advantages besides the distribution of material. The depth was always exactly equal to the pitch, and that got rid of numerous calculations. In cutting a screw of ten threads to the inch, each part of the thread was ·1in. deep; you had not to refer to any tables. If you had a cylinder of ·9in. diameter, you knew you had ·1 taken off each side from the diameter of the bolt by the incision of the groove, and an untouched stem of ·7. If, again, you had twelve threads to the inch, you took off one-twelfth on each side, and so on with any number of threads.

Mr. Smythe said the mandrel which had been shown was a most excellent one. He would advise any amateurs beginning turning to see that they had a good head to start with, and then the mandrel might have either 9·45 or 10 threads to the inch. He was a member of the Amateur Mechanical Society, but he had not yet been consulted on the advantages of the thread described by Dr. Edmunds, on which he should like to say a word. Though the top might be cut off, the bottom was so sharp that he feared the presence of little particles of dirt, which were always liable to get in, would spoil the chucks and interfere with the tools in every way. His advice to the members of the society was to wait a little longer and see if they could not improve even on what was now suggested.

Mr. Boyle believed the screw proposed by Dr. Edmunds would be found to be identical with that which had been adopted as the standard in America, on the advice of Mr. Sellers, an eminent engineer, in preference to the Whitworth. Dr. Edmunds said he believed the pitch of that screw was 60°. Mr. Boyle said it was very small; it was cut off straight at the top, and had also a corresponding cut at the bottom of the thread, the absence of which Mr. Smythe had observed upon.

Mr. H. T. Wood, secretary, said he should like to ask Dr. Edmunds whether the Amateur Mechanical Society had really made up their minds to go in the face of all experience by refusing to use what had long been the national thread, and was really becoming universal—that introduced by Sir Joseph Whitworth. In that thread, height was practically equal to the pitch, so that it really possessed the theoretical advantage claimed by Dr. Edmunds for his screw. Dr. Edmunds asked if Mr. Wood was certain about the Whitworth screw having the same depth as the pitch. Mr. Wood said it was so stated in Molesworth.[*] Dr. Edmunds said Molesworth must be wrong; the angle was 55°, which was greater than the one he had shown. If you had a triangle in a square, the height of the triangle was equal to its base, and of that triangle, the upper angle was 53° 8′, a little blunter than he recommended. Sir Joseph Whitworth's was blunter still, and he cut off 1-6th at the top, and also at the bottom, which would make the depth about 2-3rds of the pitch. With regard to the bottom of the thread, you could not use a tool absolutely sharp, however accurately it was ground, and if you took off just as much from the top of the tool as you took off the top of the thread, you had the bottom corresponding with the truncated top, and did away with the sharp V thread, which otherwise would have the objection which had been adverted to, and also the objection that it tended to weaken the bolt and render it liable to break under deflection. There was the most perfect contact which could be imagined. No one had a greater admiration for Sir Joseph Whitworth's work than he had; but scientific amateurs found a difficulty in adopting his screw, because you could not curve off the top by any definite law, but had to make a tool which was different in its cutting radius for every screw. The thread proposed gave greater power (with an equal length) than the Whitworth, and Mr. Evans, and other eminent practical men, held the opinion that the Whitworth thread was not fine enough for small screws or scientific work.

The chairman, Mr. T. W. Boord, M.P., said he was not in a position to say whether Molesworth or Dr. Edmunds was right about Whitworth's screws, but he could say that though they were admirable for the larger sizes, most people who used lathes would admit that they were not suitable for small threads. With regard to the new mandrel which had been shown, it looked a very nice tool, the diameter to him appeared rather large, but that was compensated for by the power of adapting small chucks and drills in the coned-out hollow inside. The ring at the base of the screw-thread reminded him of another device adopted in some ornamental lathes called an adapter, by means of which any ornamental chuck could be fixed with a certainty of its running true. Dr. Edmunds had referred to broken noses in lathes; but he believed there was a good deal of truth in what a friend of his said on the subject—that the fault generally lay in an imperfectly fitting chuck. He remembered on one occasion almost having an accident of this kind, through incautiously using a chasing tool, adapted for wood, to cut a thread in iron; he found the chuck would not go on the lathe, and when he took it off, it stripped a small portion of the thread, and, most probably, if he had forced it on, it would have brought the nose of the mandrel with it. As Secretary of the Amateur Mechanical Society, he must say that the resolutions quoted in the paper had not yet been passed, but were postponed to the annual meeting in May, when they would be considered by the society at large. He feared Dr. Edmunds was rather utopian in his ideas, when he spoke of ornamental chucks being passed from hand to hand; he had three lathes in his workshop, and not one of the chucks belonging to any one of them would fit either of the others.

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[*] Molesworth gives depth of thread = ·64 pitch for angular, ·475 for square threads. In Sir J. Whitworth's "papers" the actual depth is said to be "rather more than three-fifths, and less than two-thirds of the pitch."—Ed.

DYNAMO-ELECTRIC MACHINERY.—VIII.[*]

By Prof. S. P. Thompson, B.A., D.Sc.

(Continued from page 542.)

The Dynamo as a Motor.

In my first lecture I laid down the definition that dynamo-electric machinery meant "machinery for converting the energy of mechanical motion into the energy of electric currents, or *vice versa*."

An electric motor, or, as it was formerly called, an electro-magnetic engine, is one which does mechanical work at the expense of electric energy, and this is true, no matter whether the magnets which form the fixed part of the machine be permanent magnets of steel or electro-magnets. Any one, in fact, of the four kinds of dynamo can be used conversely as a motor, though, as we shall see, some more appropriately than others. But whether their field-magnets be of permanently magnetised steel or of temporarily magnetised iron, all these motors are electro-magnetic in principle: that is to say, there is some part either fixed or moving which is an electro-magnet, and which as such attracts and is attracted magnetically.

Everyone knows that a magnet will attract the opposite pole of another magnet, and will pull it round. We know also that every magnet placed in a magnetic field tends to turn round and set itself along the lines of force.

As a matter of fact, a mere coil of wire carrying a current is acted upon when placed in the magnetic field, and is pulled round as a magnet is.

On this very principle was constructed the earliest electric-motor of Ritchie, so well known in many forms as a stock piece of electric apparatus, but little better in reality than a toy.

A great step in advance was made by Jacobi, who, in 1838, constructed his multipolar machine. This motor, which Jacobi designed for his electric boat, had two strong wooden frames, in each of which a dozen electro-magnets were fixed, their poles being set alternately. Between them, upon a wooden disc, were placed another set of electro-magnets, which, by the alternate attraction and repulsion of the fixed poles were kept in rotation, the current which traversed the rotating magnets being regularly reversed at the moment of passing the poles of the fixed magnets, by means of a commutator consisting, according to Jacobi's directions, of four brass toothed wheels, having pieces of ivory or wood let in between the teeth for insulation. Jacobi's motor is, in fact, a very advanced type of dynamo, and differs very little in point of design from one of Wilde's most successful forms.

A still earlier rotating apparatus, and, like Ritchie's motor, a mere toy, was Barlow's wheel, described in 1823. This instrument, interesting as being the forerunner of Faraday's disc dynamo, is the representative of an important class of machines, namely, those which have a sliding contact merely, and need no commutator.

A fourth class of motors may be named, wherein the moving part, instead of rotating upon an axis, is caused to oscillate backwards and forwards. Professor Henry, to whom we owe so much in the early history of electro-magnetism, constructed in 1831 a motor with an oscillating beam, alternately drawn backwards and forwards by the intermittent action of an electro-magnet. Dal Negro's motor of 1833 was of this class; in it a steel rod was caused to oscillate between the poles of an electro-magnet, and caused a crank, to which it was geared, to rotate in consequence. A distinct improvement in this type of machine was introduced by Page, who employed hollow coils or bobbins as electro-magnets, which, by their alternate action, sucked down iron cores into the coils, and caused them to oscillate to and fro. Motors of this kind form an admirable illustration of one of the laws of electro-magnetics, first formulated by Gauss, but developed later by Maxwell, to the effect that a circuit acts on a magnetic pole in such a way as to make the number of magnetic lines of force that pass through the circuit a maximum.

Page's suggestion was further developed by Bourbouze, who constructed a motor which looks uncommonly like an old type of steam-engine. We have here a beam, crank, fly-wheel, connecting-rod, and even an eccentric valve-gear and a slide-valve. But, for cylinders, we have four hollow electro-magnets; for pistons we have iron cores that are alternately sucked in and repelled out; and, for slide-valve, we have a commutator, which, by dragging a pair of platinum-tipped springs over a flat surface made of three pieces of brass separated by two insulating strips of ivory, reverses at every stroke the direction of the currents in the coils of the electro-magnets. It is really a very ingenious machine, but, in point of efficiency, far behind many other electric-motors. Unfortunately, it does not do to design dynamo electric machinery on the same lines as steam-engines.

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[*] Extracted from the Cantor Lectures, delivered before the Society of Arts.

Yet, a fifth class of electric motors owes its existence to Froment, who, fixing a series of parallel iron bars upon the periphery of a drum, caused them to be attracted, one after the other, by an electro-magnet or electro-magnets, and thus procured a continuous rotation.

Lastly, of the various types of motor we may enumerate a class in which the rotating portion is inclosed in an eccentric frame of iron, so that as it rotates it gradually approaches nearer. Little motors, working on this principle of "oblique approach," were invented by Wheatstone, and have long been used for spinning Geissler tubes, and other light experimental work. More recently, Trouvé and Wiesendanger have sought to embody this principle in motors of more ambitious proportions, but without securing any great advantage.

It would be impossible, within the limits of a lecture, to deal with a tithe of all the various stages of discovery and invention, and if it were my intention to deal with the subject from the historical point of view, I might speak of many interesting and curious machines that have from time to time been tried. I might tell you how Page, after inventing his machine in 1834, succeeded, in 1852, in constructing a motor of such a size that he was able to drive a circular saw and a lathe by it. I might describe the electric-motor of Davidson, which, in 1842, enabled him to propel a carriage at the speed of four miles an hour, between Edinburgh and Glasgow. I might describe the engine built in 1849 by Soren Hjorth at Liverpool, which was of ten-horse power.

All these early attempts, however, came to nothing, for two reasons. At that time there was no economical method of generating electric currents known. At that time, moreover, the great physical law of the conservation of energy was not recognised, and its all-important bearings upon the theory of electric machinery were not available.

While voltaic batteries were the only available sources of electric currents, economical working of electric motors was hopeless. For a voltaic battery, wherein electric currents are generated by dissolving zinc in sulphuric acid, is a very expensive source of power. To say nothing of the cost of the acid, the zinc—the very fuel of the battery—costs more than twenty times as much as coal, and is a far worse fuel; for, whilst an ounce of zinc will evolve heat to an amount equivalent to 113,000 foot-pounds of work, an ounce of coal will furnish the equivalent of 695,000 foot-pounds.

The fact, however, which seemed most discouraging, and which, if rightly interpreted in accordance with the law of conservation of energy, would have been found to be (on the contrary) a most encouraging fact, was the following:—If a galvanometer was placed in the circuit with the electric-motor and the battery, it was found that when the motor was running it was impossible to force so strong a current through the wires as that which flowed when the motor was standing still. Now, there are only two causes that can stop such a current flowing in a circuit; there must be either an obstructive resistance or else a counter-electromotive force. At first, the common idea was that, when the motor was spinning round, it offered a greater resistance to the passage of the electric current than when it stood still. The genius of Jacobi enabled him, however, to discern that the observed diminution of current was really due to the fact that the motor, by the act of spinning round, began to work as a dynamo on its own account, and tended to set up a current in the circuit in the opposite direction to that which was driving it. The faster it rotated the greater was the counter-electromotive force (or "electromotive force of reaction") which was developed. In fact, the theory of the conservation of energy requires that such a reaction should exist.

We know that, in the converse case, when we are employing mechanical power to generate currents by rotating a dynamo, directly we begin to generate currents, that is to say, directly we begin to do electric *work*, it immediately becomes much harder work to turn the dynamo than is the case when no electric work is being done. In other words, there is an opposing reaction to the mechanical force which we apply in order to do electric work. An opposing reaction to a mechanical force may be termed a "counter-force." When, on the other hand, we apply (by means of a voltaic battery, for example) an electromotive force to do mechanical work, we find that here again there is an opposing reaction; and an opposing reaction to an electromotive force is a "counter-electromotive force."

The experiment of showing the existence of this counter-electromotive force is a very easy one. All one requires is a little motor, a few cells of battery, and a galvanometer. The galvanometer I shall use to-night is one which I brought out some years ago, and which has proved itself very convenient for lecture work, because it can be put into any ordinary lantern and projected on the screen (Fig. 50). I have here, as a battery, four small accumulators of the Faure-Sellon-Volckmar type, and I have connected them with a little motor, also of my own design, the current being arranged so as run through the galvanometer. I hold the spindle of the motor fast, so that it cannot rotate, and you see that the pointer of the galvanometer indicates 44°. I now release the motor; it begins to rotate, and as its speed increases, you observe the needle descend the scale to 23°, and eventually to about 15°. If I load the motor and cause it to slacken speed, the needle at once returns.

The existence of this counter-electromotive force is of the utmost importance, in considering the action of the dynamo as a motor, because upon the existence and magnitude of this counter-electromotive force depends the degree to which any given motor enables us to utilise electric energy that is supplied to it in the form of an electric current. In discussing the dynamo as a generator, I pointed out many considerations, the observance of which would tend to improve the efficiency of such generators. It is needless to say that many of these considerations, such as the avoidance of useless resistances, unnecessary iron masses in cores and the like, will also apply to motors. The freer a motor is from such objections, the more efficient will it be. But the efficiency of a motor in utilising the energy of a current depends not only on its efficiency in itself, but on another consideration—namely, the relation between the electromotive force which it itself generates when rotating, and the electromotive force—or, as some people call it, the electric pressure—at which the current is supplied to it. A motor which itself in running generates only a *low* electromotive force cannot, however well designed, be an *efficient* or economical motor when supplied with currents at a *high* electromotive force.

Now it can be shown, mathematically, that the efficiency with which a perfect motor utilises the electric energy of the current depends upon the ratio between this counter-electromotive force and the electromotive force of the current that is supplied by the battery. No motor ever succeeds in turning into useful work the whole of the currents that feed it, for it is impossible to construct machines without resistance, and whenever resistance is offered to a current, part of the energy of the current is wasted in heating the resisting wire. Let the symbol W stand for the whole electric energy of a current, and let w stand for that part of the energy which the motor takes up as useful work from the circuit.[*] All the rest of the energy of the current, or $W - w$, will be wasted in useless heating of the resistances.

But, if we want to work our motor under the conditions of greatest economy, it is clear that we must have as little heat-waste as possible; or, in symbols, w must be as nearly as possible equal to W. It can be shown, mathematically, that the ratio between the useful energy thus appropriated, and the total energy spent, is equal to the ratio between the counter-electromotive force of the motor, and the whole electromotive-force of the battery that feeds the motor. The proof will be given later. Let us call this whole electromotive force with which the battery feeds the motor E, and let us call the counter-electromotive force e. Then the rule is $w : W = e : E$; or, if we express the efficiency as a fraction, $w / W = e / E$. But we may go one stage further. If the resistances of the circuit are constant, the current c, observed when the motor is running, will be less than C, the current while the motor was standing still. But, from Ohm's law, we know that

$$c = \frac{E - e}{R}.$$

Hence

$$\frac{C - c}{C} = \frac{e}{E} = \frac{w}{W}.$$

From which it appears that we can calculate the efficiency at which the motor is working, by observing the ratio between the fall in the strength of the current and the original strength. Now, this mathematical law of efficiency has been known for twenty years, but has been strangely misapprehended. Another law, discovered by Jacobi—not a law of efficiency at all, but a law of maximum work in a given time—has usually been given instead.

(*To be continued.*)

ISLAND LIFE.

On Monday evening, Mr. A. R. Wallace, LL.D., lectured to the Birmingham and Midland Institute on "Island Life." The lecturer said that the ancient opinion concerning the surface of the earth was that it was permanent, as shown in the allusions to the "everlasting hills." The same opinion existed with regard to the forms of life upon the earth, which were thought to be equally fixed both in themselves and in their relations to the earth which they inhabited. It was now found that these were ever changing. The two great movements, organic and inorganic, were closely related, and their highest result was seen in the forms characteristic of the organisms that live upon it, and in the manner in which those organisms were distributed over its surface. By means of diagrams the lecturer pointed out the enormous disproportion between the bulk of land above the sea-level and the depth and bulk of the great oceans. It had been and was a common doctrine among men of science, that the sea and land were interchangeable—that the whole of the continents had once been deep seas, and that the ocean depths were once dry land. If the law of nature had been that continents had sunk down, and other continents had risen up in the great oceans, then, considering how very small was the area of land, and how easily it might be submerged or lost in the ocean, the probabilities were that during the long course of geological ages, continents would have altogether disappeared so as to leave very little dry land on the surface. But they knew from the complete continuity of life taught by geology that that had never taken place. They knew there had been continuity of large masses of land. That could hardly have been if there had been interchangeability of oceans and continents, as was commonly supposed. The characteristic of the ocean bottom was wonderfully suggestive of an ancient permanent structure. The islands of the globe consisted of recent continental islands, which were those situated within the 100-fathom line. They were of various geological structure, and contained the varied forms of life which existed on the continents, either identical or simply modified. Then there were the ancient continental islands, situated beyond the 100-fathom line, and within the 1,000-fathom line, also having varied geological structure, and containing generally the great types of animal life; but there were many gaps in the series, and many forms which were not allied to those of the closest Continent, but allied to those of remote Continents, and were probably separated during the early part of the Tertiary epoch. Then there were the organic islands, which were always situated in deep ocean beyond the 1,000-fathom line, and were of volcanic formation, containing no sedimentary rocks, no native mammalia or amphibia, and but a few reptiles, birds, and insects, which differed from those on the Continent or resembling them, according as the facilities of diffusion had been greater or less. The study of island life, as he endeavoured to present it, perhaps more than any other branch of natural history, served to impress them with the interdependence of organic and inorganic causes in bringing about the present distribution of living things. The doctrine now held by many scientific men must be adopted as the foundation of a successful inquiry into the past history of the earth and its inhabitants.

COMMERCIAL PHOTOGRAPHY IN THE UNITED STATES.[*]

By far the larger portion of commercial photography in the United States is devoted to photo-mechanical reproduction, and this may be divided into three branches:—1st. That class depending upon the copperplate press for multiplication of copies, of which the photo-gravure may be regarded as an excellent illustration. 2nd. The class which is reproduced lithographically, depending upon the repellent and absorbent chemical qualities of a sensitised film for the result. The Albertype is the best example of this class. 3rd. The numerous typographic class, which, although indirectly covering a larger range or field than any of the previous classes, is valued more from a practical than an artistic point of view. The zincotype belongs to this order.

Of the first class I shall simply say that the photo-gravure is carried on in the United States under various names, the methods, however, being essentially the same as on this side of the water, except that perhaps we do not produce such good work.

In the second class we find many important establishments, the Albertype being produced with singular beauty; the heliotype and various modifications of both these methods are in a flourishing condition. One of these methods is worthy of note. A negative is taken (we will say) of a rose, leaving out all the colour but the red; a second is taken of the green, and a third of the shades and shadows. These are reproduced by the Albertype method, and printed in register with each other in tints as near as possible the original colour. The result is a soft, pleasing, and lifelike print, depending, however, greatly upon the chemical manipulation of the operator, and also upon the proper choice of colours by the printer.

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[*] This symbol w must be clearly understood to refer to the value of the work taken up by the motor, as measured electrically. The whole of this work will not appear as useful mechanical effect, however, for part will be lost by mechanical friction, and part also in the wasteful production of eddy-currents in the moving parts of the motor. What proportion of w appears as useful mechanical work depends on the efficiency of the motor *per se*, which we are not here considering. In all that follows immediately we shall suppose such causes of loss not to exist; or the motor will be considered as a perfect motor.

[*] Extracted from a communication to the Edinburgh Photographic Society, by J. P. Suyzasnor.

In the third, or typographic class, to which I now refer, two methods are commonly in vogue—first, the zincotype class, which simply depends on photography for the image and upon the action of a corrodent for the relief; and, second, those which, like the gelatinotype, depend for relief upon either the swelling or dissolution of a sensitised film of gelatine or gum. In the zincotype and the swelled gelatinotype the negative is of the ordinary opaque description, such as is made use of in photo-lithography, and is usually intensified with lead or copper. In the case of the dissolved gelatinotype the negative that is used must be a reversible film, which is made in this way:—The glass is very thinly albumenised, and, after the negative is obtained and dried, it is treated to a coat of india-rubber dissolved in sulphuric ether; this is, when dry, coated with collodion. The glass is then immersed in water or dilute acetic acid, when the impressed film comes away quite easily, is quite strong, and can thus be readily reversed; and after use, instead of being scraped into the cleaning trough, it is taken off its support and put away for further reference.

Zincotype, as commonly practised, consists in transferring an inky image to a suitable piece of metal by the well-known photolithographic method. This transfer is dusted with resin flour, which serves the double purpose of further protecting it from the encroachment of the corrodent, and also of protecting the sides of the slightly-etched lines from undermining from the same cause. This is done after the first application of the acid by slightly warming the plate, causing the resin to melt and run down on the sides of the lines, which are thus shielded from the subsequent applications of the corroding agent. I may say that the zincotype has given way to the gelatinotype almost universally; and I will close with the three most usual forms of the latter process, the first and second depending on the expansion of portions of the film, and the third upon its melting or dissolution.

With the swelled gelatinotype No. 1, an ordinary glass is coated with the sensitised solution of gelatine, giving a film the thickness of a very thin card. This is printed under a negative, which is carefully masked to prevent over-printing in the shadows. When printed the plate is immersed in a solution of tannin or alum, where it remains till the unprinted portions are sufficiently swelled. The printed film, of course, retaining its normal condition and thickness, assumes the appearance of small but regular depressions all over the surface of the plate. A wax cast is taken from this, which in turn gives the matrix for the stereotype.

In the second swelled gelatine method any thin sheet metal is used instead of glass; but the metal must be protected from the action of the bichromate, otherwise the plate will soon become corroded and useless. The plate, after printing in a screw-back frame, is placed in a chrome alum bath, and when sufficiently raised is cast direct in plaster and electrotyped, which makes the process somewhat shorter than the foregoing one.

The last gelatine method, or dissolving, process is done in this way:—The melted solution is poured into large plate-glass trays with a raised lip or edge. These trays have previously been flowed with a thin solution of beeswax in ether to prevent the film, which is nearly 1/16in. in thickness, from adhering to them. They are then levelled up in the drier, and when chilled are placed face downwards until dry, when the large sheets of gelatine are easily stripped from the trays. With a pair of shears a piece of the size wanted is cut off these sheets and placed under the negative in an ordinary frame. After a short exposure it is taken into the dark room and temporarily fastened to a glass with shellac; an ordinary brush, such as is used by silversmiths, is then immersed in warm water and rubbed over its surface, and the unprinted portions dissolve at once, leaving the printed parts intact. When sufficiently dissolved the plate is placed in alcohol for a few seconds to free it from water, and is them dried, when it is ready for the electrotyper at once. A word upon the intractability of gelatine films of appreciable thickness may not be out of place. The addition of glycerine hardly helps matters much, as in the swelled gelatine process we find that, when sufficient glycerine has been added to prevent the cracking of the film, the entire film after soaking becomes flaccid and easily displaced.

The peculiar way in which gelatine films will crack off the plates—flying into numberless pieces, frequently taking the glass with them—is annoying, to say the least; and I find that even here the phenomenon is not unknown. I have seen a piece of plate-glass ¼in. thick coated with a film hardly thicker than this paper, which, when subjected to a change of temperature, cracked with a sound like tearing strong cloth. Upon examination the surface of the glass in places was found torn out to the depth of ⅛in., and adhering to the gelatine fragments which strewed the floor. A mere acciden led to the discovery of a remedy. An experimenter having mixed up his gelatine to soak was suddenly called away. At the end of three days he returned, and was assailed by the odour that greeted him from his gelatine, which had taken advantage of his absence to decompose thoroughly. He was about to throw it away, when the idea struck him that perhaps it might act differently from ordinary gelatine; so he cooked it, made up his plates, and, after testing them in every possible way found they would neither crack off, swell off, bubble, frill, nor act in any of the inconvenient ways with which gelatine workers used to be so familiar, and perhaps are not entirely free from yet.

SCIENTIFIC NEWS.

THE Gresham Lectures on Astronomy for Feb. 27, 28, March 1, 2, will be upon Comets, and the Great Comet of 1882. The lectures commence at 6 p.m., are free to the public, and will be illustrated by limelight views, including, in this case, some photographs of the Great Comet, taken at the Cape, lent by the Council of the Royal Astronomical Society. Judging by the syllabus, the Rev. Edmund Ledger's four lectures will be very interesting. Amongst the drawings will be some made by Dr. Hooke, of Halley's Comet, in 1682.

A committee has been formed to erect a permanent observatory on the summit of Ben Nevis, to prosecute the work which Mr. Wraggo has carried on with such unflagging zeal. A sum of about £5,000 is required, and the Scottish Meteorological Society has already received about a third. Ben Novis is probably the best site in the kingdom for such an observatory as is contemplated.

Col. Emile Gautier has been appointed Director of the Geneva Observatory, a post held by the late Professor Plantamour for more than 40 years.

An exhibition of meteorological instruments will be held on March 21, at the Institution of Civil Engineers, by the Council of the Meteorological Society, who invite co-operation, and are desirous of obtaining as large a collection as possible of instruments designed for, or used by, travellers and explorers.

The summer meeting of the Institute of Mechanical Engineers will, on the invitation of M. Trasenster, be held in Belgium, at Liège, commencing on July 23, and comprising a visit to Antwerp at the end of the week.

Prof. Dolbear observes that if a galvanometer is placed between the terminals of a circuit of homogeneous iron wire and heat is applied, no electrical effect will be observed; but if the structure of the wire is altered by alternate bending or twisting into a helix, then the galvanometer will indicate a current. The professor employes a helix connected with a battery, and surrounding a portion of the wire in circuit with the galvanometer. The current in the helix magnetises the circuit wire inclosed, and the galvanometer exhibits the presence of electricity. The experiment helps to prove that magnetism is connected with some molecular change of the magnetised metal.

In a lecture recently delivered under the auspices of the Glasgow Science Lectures Association, Prof. Ayrton referred to the electric transmission of power, and mentioned that electric tricycles could not yet become popular because of the difficulty of getting the supply of stored electricity replenished. He thought, however, that the time is not far distant when an "electric tricycle" could be taken on tour, and the smallest item in the tourist's bill would be the sum paid for electricity. According to the American papers, that is not Mr. Edison's opinion; for that gentleman has, it appears, expressed himself strongly about accumulators, and declares that they are beginning to be found out. Apart from Mr. Edison, there is much reason to believe that, in practical working, none of the recent inventions are better than Planté's secondary battery so far as durability is concerned.

Mr. Flinders Petrie is about to publish a work on the measurements of the Great Pyramid, in which he will show that the new measurements are irreconcileable with those on which Prof. Piazzi Smyth has built his hypotheses.

Lecturing on the progress of telegraphy before the Institution of Civil Engineers, Mr. Preece stated, last week, that in the British system the three forms of battery used are the Daniell, Leclanché, and bichromate in the proportions respectively, of 87, 56, and 21. If those figures are read as thousands, they represent nearly the actual number of cells of each kind in use. Magneto-electricity is applied for some forms of apparatus, and dynamos are occasionally utilised to supplement batteries. Of A B C instruments there are 4,398; needles, 3,791; Morse printers, 1,330, and 2,000 sounders, an instrument which is gaining ground rapidly in England. Sound-reading is almost exclusively adopted in America, but is rarely used on the Continent, although it is the most rapid and accurate. There are 224 Wheatstone's automatic instruments in use, and in England 319 duplex, and 13 quadruplex circuits are at work.

The Patent Office derives a large portion of its income from "inventors" who stop short at provisional protection. Two inventions of this class recently noticed deserve mention—one was for cutting cheese, and consisted of a wire tightly stretched to a suitable frame. Another was for storing up energy in a velocipede by making it coil up a spring as it ran downhill.

Various delicate experiments have been made in order to determine the so-called "reaction time" in sensation—i.e., the time between the moment of excitation of the sense, and the moment at which the person indicates by a signal that he has become conscious of the sensation. M. Beaunis, of Nancy, has recently sought to measure the reaction time for smell. He gives (*Comptes Rendus*) a table of the numbers obtained with ten substances; they range from 37 hundredths of a second for ammonia, and 46 for acetic acid, to 63 for mint, and 67 for carbolic acid. In the case of musk, he was unable (notwithstanding repeated attempts), to fix precisely the moment of the smell-sensation. The numbers given show that the reaction-time for smell is longer than that for touch, sight, and hearing. (In the author's own case, it is shorter than for touch.) Dr. Buccola, of Turin, has recently made experiments on smell, with different apparatus, and gets results which agree in the main with those of M. Beaunis.

Some information appeared a short time ago, regarding the mica-masks and spectacles supplied for workmen by Herr Raphael, of Breslau. One special merit is their great lightness. By a recent patented improvement, it is possible for any workman to insert in the spectacle-frame a new piece of mica when required, the pieces costing only about 1½d. Thus the frame may have long use. One gets quite accustomed to these spectacles, it is said, after a day's wear or so. Herr Raphael further provides grey and blue mica glasses, which are quite transparent, and the colour of which is fireproof. They are very pleasant for workmen at large fires, as they prevent strain of the eye. Masks for half of the face weigh only 40 grammes (less than 1½oz). Herr Raphael also supplies masks to cover the whole face, and, if necessary, also the neck.

The Agricultural Society of Breslau has recently offered a prize of about £50 for a cheap, easily applicable, and effectual means of suppressing field-mice. Proposals to be sent in before the end of August.

The colour of the water of different lakes and rivers is known to be very different. Tyndall attributes the blue of sea-water to a cause similar to that of the blue of the air, which is believed to be produced by reflected light, while the transmitted light has a red colour. M. Spring has lately described, in the Belgian Academy, some researches on the colour of water. He finds that pure water in a tube about 33ft. long has a distinctly blue colour, whereas, according to Tyndall, it should appear red. M. Spring also shows that water in which carbonate of calcium, silica, clay, or salts are suspended in a finely divided state, offers no inconsiderable resistance to the passage of light. As the red and violet light in the spectrum is much weaker than the yellow, such rays are fully absorbed, while the yellow still pass through in considerable quantity. This yellow light gives, with the blue colour peculiar to the water, the various shades of green.

Vegetable parasitism in fishes appears, from recent observations by MM. Olivier and Richet, to be so constant that it may be regarded as normal. They examined about 150 different fishes taken in the Channel and the Mediterranean, and in all of them they found, in the peritoneal liquid, in the lymph, in the blood, and so in all the tissues, microbes more or less numerous, having all the characters of land-microbes and capable of similar reproduction. These organisms were mostly the bacterium called *Bacillus*. (In other vertebrates, it is to be noted, microbes are not found in the blood and the lymph). The authors cultivated the microbes successfully. They also repeatedly made an experiment which consisted in putting a whole fish or part of it in paraffin melted at 120° or 140°. After solidification, the paraffin was coated with several layers of collodion and Canada balsam. The tissues thus guarded from atmospheric germs, all showed, after a few weeks, an extreme development of microbes (which were not those of putrefaction). The authors propose to investigate the mode of penetration of these parasites, and their influence on the vital functions.

An "Alarm Foot-mat" is now supplied by Mr. Applegate, of New York. On the underside are concealed two systems of electric wires, which are joined by pressure of a number of spring contacts, when a person treads on the mat. The wires are in circuit with an electric bell. The system affords information—e.g., as to the passage of persons in and out at a particular door.

A notable improvement in the plant used in removing reefs and other submarine obstructions has been recently made by Mr. Saunders, of the Ingersoll Rock Drill Company. He surrounds the drill with a tube which, for deep-water work, may be made in telescopic sections. Inside this runs an independent tube, through which a stream of water may be discharged on the bottom of the drill-hole to remove the material broken down by the bit. The lower section of the inclosing tube carries an ejection-pipe, through which the *débris* is conveyed by the discharge of water. When the drill is withdrawn for any purpose, the inclosing tube maintains the connection of the drill-hole with the water-surface, so that the hole can be quickly found again for further drilling, or for charging and tamping, without the aid of a diver. The hole is prevented from being filled up by material washed in by currents, and the insertion of the charge and accompanying operations can be performed from the surface of the water.

The number of immigrants into the United States last year was 712,542; of whom 229,996 were German, 83,071 Canadians, 77,725 English, 62,461 Irish, 58,742 Swahians, 29,317 Italians, 26,185 Norwegians, 12,305 Austrians, and 11,619 Scotch.

An apparatus meant chiefly for measuring the heat of the blast used in blast-furnaces has been recently patented in Germany by Herr Schoops. It consists of a vessel played upon by the blast, and a Bourdon gauge, which is connected with it by means of a capillary tube, and stands in the room of the man in charge. The vessel is filled with a dry gas (air, nitrogen, or the like), and the gauge-tube with a liquid of very small tension, such as glycerine or oil. The pressure in the vessel, corresponding to the temperature of the medium about it, produces changes of form in the tube of the gauge, which are indicated by a pointer in the usual way.

It is proposed to form a North Bohemian Industrial Museum at Reichenburg, the aim being to further, by means of a collection of the aids afforded by art and science, and by facilitation of their use, the cause of general education; but especially industrial improvement in Northern Bohemia. A German Colonial Society has been recently founded at Frankfort, under the presidency of Prince of Hohenlohe-Langenberg.

Spectroscopists who have studied the solar protuberances, affirm that the matter of these rises with the tremendous velocities of 80, 100, or 120 leagues per second. M. Faye, however, who has been lately expounding his theory of solar phenomena in the Paris Academy, explains the appearances in the following way:—The protuberantial gas, expanding in space, is enormously cooled, and ceases to be visible; but presently the solar radiation, which amounts to 1,300 to 1,500 calories per square meter, and per second, heats it again, and renders it perceptible. The visibility commences at the lower side of the cloud of hydrogen, and progresses upwards to the top. M. Faye holds that it is this phenomenon that is propagated with the high velocity just referred to, and not the gas itself.

It is now recognised that there are in the Northern hemisphere two poles of cold, or two places where the lowest temperature is reached; one in the north-east of Siberia, the other in the Arctic Archipelago of America. Their geographical position has not been exactly defined; but it can be affirmed (according to *Die Natur*) that the pole of Asiatic cold is to the north of Yakutsk, and that of American cold to the north-west of Parry Island. Near the Siberian pole, which is inland, and at a comparatively low latitude, between 60° and 70°, the climate of the continent is characterised by a severe winter and a hot summer; at the American pole, in a maritime region, between 65° and 88° lat., the winter is milder and the summer cooler. Till recently, Yakutsk was thought to be the coldest place on the earth, its mean temperature in January being −45°; but there have been found, near Werkojansk, in Siberia, at a latitude of 67°, places with a mean January temperature of − 55°. The pole of cold is localised at this place during four months of the year—viz., November to March; but during April and May the pole is displaced towards the north-west, returning afterwards in the direction of Werkojansk, which is the only place always inclosed in the isotherm of −40° during the months of November, December, January, and February of each year. The mean annual temperature of the pole of Siberian cold is estimated to be 2°. M. Klutschak, a member of Lieut. Schwatka's expedition to the Adelaide peninsula and Cockburn's Bay, between 66° and 68° lat., found a place colder than all others; the temperature in January, 1880, fell to − 72°, and in Dec. 1879, and Feb. 1880, it reached − 68°. The mean temperature of Dec. to Feb. is − 48°. It differs very little from that of Werkojansk; but it is lower by 18° to 21° than that noted previously as the coldest in America.

USEFUL AND SCIENTIFIC NOTES.

Telephony in Paris.—The telephonic system of Paris, which on the 1st of November, 1880, numbered 454 subscribers, had 2,392 at the beginning of this year. The service is now divided among 11 stations. The length of wires between subscribers and stations is now 2,187 miles. The line system is entirely subterranean. The wires both between the subscribers' places and the stations, and between the stations themselves, are joined in cables and suspended in the vaults of the sewers. Each cable contains 14 insulated conductors, forming seven double lines. The subscription in Paris is about 600f. for a line, 1,100f. for two lines, and for three, or more, in the name of one subscriber, 500f. per line. For these sums the company constructs the line, furnishes and fits up the apparatus for the subscriber, maintains it, and, by night as well as by day, gives all the communications asked. As regards instruments there has been unification, and the Ader transmitter and receiver are now furnished to all subscribers. At the stations 103 girls provide nearly 20,000 communications per day; or, on an average, eight communications per subscriber per day. The day service is wholly provided by girls; the night service by men, to the number of 35. There are about 1,000 communications by night from 7 p.m. to 8 a.m.

ACCORDING to Mr. Traill, the engineer of the Giant's Causeway and Portrush Electric Tramway, the total prime cost will be about £21,000 for six and a-half miles of tramway, the cost of buildings, rolling stock, electric plant, engines, law, Parliamentary and engineering expenses. He says also that the electric car is able to ascend a long, continuous hill of about one and a-half miles in length, and with a gradient of 1 in 35, drawing a second car behind it, and work as readily and as well at a distance of two miles from the generator as adjacent to it.

MESSIEURS STOCKLIN ET VETILLARD, having experienced great difficulty in driving piles into the fine wet sand of the sea-shore, have succeeded by the adoption of the system of leading a jet of water along the sides of the pile to be driven, to from 7in. to 12in. below the point, by means of an india-rubber tube terminating in a metallic nozzle. Two such tubes are employed, one on each side of the pile, care being taken to keep them as vertical as possible, and to move them continually for preventing their being closed in by the sand, which again becomes compact directly the flow of water stops.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

THE PERPETUAL ALMANAC.

[21093.]—IT ought to have been mentioned in connection with my recent communication on the above subject, that the propositions therein given are worked out after an entirely original fashion, with only two exceptions, and as such I submitted them to Professor de Morgan in 1867. I give you his remarks upon them.

He writes as follows:—"This much I see, that your rules are of a structure which is correct in plan. Some examples verify well; and I have no doubt you have made many verifications."

"The plan of detaching each rule from all others is very good for a work which is to be taken up at intervals, and forgotten."

"Your plan is easy enough for those who can follow a rule."

The solutions to the seven examples, appended by way of illustration to my paper, are worked out in the following manner:—

```
Ex. 1—Here we have ............. 585 B.C.
      Subtract .................   1
                                 ---
      Divide by 532         532)584(1
                                532
                                 ---
      Remains ..................  52
      Subtract from ............ 532
                                 ---
      Remains .................. 480
      Its fourth part........... 120
                           ⎧Jan.   31
                           ⎪Feb.   29
    The day of the year    ⎨March  31
                           ⎪April  30
One day less for leap year ⎩May    27
                                 ---
      The sum is..............7)748
      Divide by 7 ............   ---
                                 106  6 rem.
      Subtract ................       2
                                      —
                                      4
```

Hence, it fell on *Wednesday*, the 4th day of the week.

```
Ex. 2.—Here we have ............   4 B.C.
       Subtract ................   1
                                  —
       Divide by 19            19)3
                                  —
                                 0—3 rem.
       Subtract remainder from 19  19
                                   —
                                   16
       Multiply by 11              11
                                   —
                                   176—26
rejecting multiples of 30.
       Hence we have ..............  26
       Number of months from March   1
       The day of the month........  13
       The number 5 ...............  5
                                     —
                                     45
       The third part of century ....  1
                                     —
                                     44 or 14,
```

rejecting multiples of 30. Hence the moon was 14 days old—i.e., at full.

```
   Ex. 3.—Here we have, divided by 19) 828 (43
                                       76
                                       ——
                                        68
                                        57
                                        —
                                        11
     Multiply the remainder by 11       11
                                        ——
                                        121 or 1
```

Hence we have 1
The third part of the century 2
The number of months from March 10
The day of the month 25
The number 6......................... 6
—
44 or 14

Therefore the moon was 14 days old, i.e., at full.

Ex. 4.—Here we have .... 668 A.D.
Its fourth part 167
The day of the year .... { Jan. 31
(One day less in leap year.... { Feb. 29
{ Mar. 25
—
Divide by 7.............. 7) 920
—
131 — 3 rem.
Subtract 2
—
1

which proves it was Sunday, the *first* day of the week.

Ex. 5.—Here we have 15
Subtract the *Epact* 20
—
Borrowing 30 and note the diff. 25

Divide 25 by 7, and adding 3 to remainder, there results the number 7. Subtract this from the *Sunday letter*, which is 2, and borrow 7, we obtain a result 2.

Hence, putting together 2 and 25, and adding to March 21, we get March 48—that is, April 17, which is Easter-day.

Ex. 6.—In this case the New Moon falls on March 11, and the changes are as follows:—Jan. 10, Feb. 9, March 11, April 9, May 9, June 7, July 6, Aug. 5, Sept. 3, Oct. 2, Nov. 7, Dec. 30.

Ex. 7.—This example is simply a recapitulation of the preceding.

James Pearson, M.A., F.R.A.S.

Fleetwood Vicarage, Feb. 13.

JUPITER'S RED SPOT—THE SEARCH FOR TELESCOPIC COMETS.

[21094.]—Mr. D. Smart (letter 21068) should have referred to the list of transits of the red spot given in reply to query 49340, p. 508. On the date of his drawing, the spot passed the central meridian of Jupiter at about 6h. 48m., so that the object he has drawn (Feb. 5, 7h. 30m.), indenting the S. side of the great southern equatorial belt, and clearing the W. limb, was undoubtedly the ghost of the red spot, as he surmises. If he will look at Jupiter at one or other of the following times, he will observe this spot to be about central:—

		h.			h.
Feb.	24	7.5	Mar.	3	8.2
,,	25	13.2	,,	4	14.0
,,	26	9.1	,,	5	9.9
,,	27	6.0	,,	6	5.7
,,	28	10.7	,,	7	11.5
Mar.	1	6.6	,,	8	7.4
,,	2	12.4	,,	9	13.1

At intervals of 12 days (= 29 rotations) the red spot crosses the C.M. of Jupiter at nearly the same times as before.

The Search for Telescopic Comets.—If Mr. Gemmill will refer to the English Mechanic, Vol. XXXV., p. 281, he will find that some information upon this subject has been published since the date he alludes to. I had intended, in conjunction with several amateurs who had volunteered assistance, to undertake a rigorous search for telescopic comets; but ill-health rendered it compulsory that I should absolutely abandon the project. I felt anxious, however, that the matter should not entirely fall through in consequence, and I suggested to Dr. Copeland that the organisation of the observers should emanate from Dun Echt. This was duly arranged, and I believe that comet-seeking has been systematically carried on in this country since that time. Should Mr. Gemmill, or any other of your readers, desire to enter this field, I feel certain that Dr. Copeland will be very glad to utilise such help as they may be able to afford.

Bristol, Feb. 16. **W. F. Denning.**

ENCKE'S COMET—GREAT COMET, 1882.

[21095.]—Your obliging contributor "F.R.A.S.," in reply to a querist about particulars of Encke's comet, stated in letter 21062, last par., p. 545, that he fancied it was not observed during its last perihelion passage in November, 1881, as he had seen no record of such observation. It was, however, seen *previous* to its perihelion passage, at different observatories. It appears to have been first found on August 20, at Strasburg, by Dr. Hartwig and Professor Winnecke, and on August 24 by Director O. Struve, at Pulkova. Then, in this country, by Mr. A. Common, at Ealing, on August 27, and Mr. Lohse, at Dun Echt, on August 28.

I find that I examined it with 4·3in. Wray object-glass, six times, between Sept. 16 and Sept. 28, when it appeared as a nebulous mass, nearly circular, with a diameter of 3′ to 4′, and showed a slight condensation near to the centre. The presence of moonlight during the early part of October (when it was nearest the earth) prevented it being observed at that time with my limited means. Its great southern declination afterwards, during the perihelion, must have rendered it difficult to observe in the northern hemisphere.

I again observed the Great Comet of 1882 on February 13, at 9 p.m., when the moon was a little over six days old, and I was surprised to see it so plainly in the moonlight. The increasing moonlight of the following evening (14th) overpowered the faint nebulosity of the comet, as no trace of it could be detected. Possibly the air may not have been so transparent as on the previous night.

A gentleman writes, in a weekly scientific contemporary, that he saw the tail of the comet on Jan. 30, with the naked eye, and in a private letter since he writes: that "on the 11th inst., at 8h. 5m., when the comet's head was not near any bright star, I could glimpse it with the naked eye, and also suspected the tail, which would doubtless have been certainly visible but for 19 Leporis." This observation will likely be found unique. Judging from the faintness of comet as seen in the telescope, I did not attempt such a feat with the naked eye. It would be interesting to know if it has been seen elsewhere within the past three weeks without optical aid.

Belfast, Feb. 17. **Isaac W. Ward.**

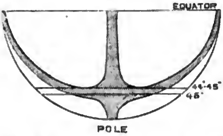
[21096.]—When "F.R.A.S." (letter 21064, page 545) wrote "I fancy that it (Encke's comet) was not observed at its last return to perihetion in November 1881, as I can find no record of such observation," he was probably either in a hurry or away from books of reference. As a matter of fact, it was seen by Dr. Hartwig and Prof. Winnecke with the six-inch comet seeker at Strasburg, on Aug. 20th and 25th., it being at that time 4′ in diameter. It was also observered in this country by Mr. A. A. Common, with his 3ft. reflector, on the evenings of Aug. 27th and 28th. Furthermore it was seen in America on Sept. 20th, when it was near β Aurigæ (Vide Vol. XXXIV page 86). Finally M. Bigourdan made a series of observations, and found that the different parts were of sensibly uniform brightness (except the circumference) up to Sept. 27th, but that after this date, the preceding portion became more brilliant (ibid. page 181.)

These are but a few out of probably many observations, but they will suffice to show Mr. Cornish that the comet was "observed at its last return to perihelion."

A Young Astronomer.

TRIPLE ECLIPSE OF JUPITER'S 4th SATELLITE.

[21097.]—I enclose you a sketch of the eclipse bands of the fourth satellite, as also the following data, from which it is laid down.



The Middle Eclipse, Central on the Meridian.

Equator. Latitude.		First. Duration of totality.		Interval between totalities.		Middle. Duration of totality.		Interval between totalities.		Third. Duration of totality.	
°	′	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
		0	3·1	2	17·5	0	5·5	2	17·5	0	3·1
24	0	0	3·88	2	0·6	0	7·4	2	0·6	0	3·88
43	0	0	16·0	0	44·4	0	31·1	0	44·4	0	16·0
44	0	0	21·5	0	29·25	0	41·0	0	29·5	0	21·5
44	30	0	52·0	0	16·6	1	12·0	0	16·6	0	52·0
44	45	Continuous station oscillating in shadow									
45	0	Ditto. Three times central								2	9·2
48	0	Simple eclipse only, Central on Meridian								1	24·0
54	0	Ditto.				Ditto.				0	22·5
63	0	Ditto.				Ditto.				0	8·6
90	0	Polar Ditto.				Ditto.				0	2·78

The elements from Chambers, last edition.

Time, 10 hours to one Jovian day (= 9h. 55m. 28·7s., Earthian hours).

Shadow undiminished off Meridian; Jupiter taken as a sphere.

Would Mr. Buffham kindly say in which Vol. "E. M." the announcement of these occurrences was first made, and also that of the observations he mentioned? Was it observed after the theory, or otherwise?

The lecture was the first intimation the amateur who told me, or myself had.

The greater part of the apparent shadow is, in reality, the inner edge of the penumbra, the shadow cone being 857 miles on the Meridian; the Satellite being 2,928 miles.

Do the laws of gravitation present any obstacles to the theory, that the dark bodies recorded to have transited the Sun, at different times, may have cometary orbits of long period?—Vulcan, for instance; supposing Lescarbault's observations to have been genuine, and that Lias may have over looked it. **H. Broughton.**

θ AURIGÆ.

[21098.]—On the evening of Friday, Feb. 16, I had a view of θ Aurigæ—a star to which the Rev. T. W. Webb has recently called attention—under pretty favourable conditions so far as definition was concerned, though the sky was not quite free from haze, and the moon was bright and near. The companion was best seen with a power of 495 on my 7¼in. refractor, and I estimated it of about the 8½ or 9 mag. I think it could hardly be less than 9 mag., as it presented a very neat disc of a greyish white tint. It was well seen with an aperture of 6in., and was still to be made out when the aperture was further reduced to 5in.

In a letter which appears in your last issue, your correspondent, "H. S.," says that Burnham rated the mag. of the companion "as 10·5 Σ with the Dearborn refractor in 1878." I find that in Mr. Burnham's "Double Star Observations," printed in Vol. XLIV. of the *Memoirs* R. A. S., the magnitude of the companion of θ Aurigæ is given as 7·5 under date 1878·041. Is there a misprint in either case? or have we here evidence of variation of light?

I may add that I failed to catch either of the two small stars mentioned by "H. S.," owing, doubtless, to moonlight and haze; and that I estimated the magnitudes of the two old companions to be 11½ and 10, both which estimates, for the same reason, are probably too low.

George Knott.

Knowles Lodge, Cuckfield, 19th Feb.

ASTRONOMICAL WORK.

[21099.]—Mr. Gemmill's letter (p. 546) is very timely and suggestive. It is simply waste of energy to be eternally squabbling about the merits of reflectors v. refractors—the question will always remain an open one. Each form of instrument has its special uses, and each its inherent disadvantages. Where cost is no object, and the instrument is intended for micrometer work on double stars, I should say, unhesitatingly, procure a large refractor, driven by clockwork, and supplied with all needful accessories. But for selenographical or planetary work, clusters, nebulæ, comets, &c., the reflector is unequalled. And for the colours of stars, a matter in which I have had some experience, I decidedly prefer the reflector.

The measurement of double stars is, as a rule, best left to professional astronomers, at large observatories. It needs a long training to use the micrometer in a really skilful and trustworthy manner, yielding results fit to be compared with those of Struve, Dawes, Dembowski, Burnham, and other first-class observers. How many amateurs, with their limited opportunities, are likely to attain this standard of excellence? Meanwhile, there is abundance of work to do, and that well within the grasp of the ordinary observer. A vast amount of really useful knowledge may be obtained with a good opera-glass and star atlas. To come to the point, then, I will take the several headings from Mr. Gemmill's letter in their order.

Variable Stars.—Here is, alone, an almost exhaustless field, in which a little patient labour is sure to bring its reward. There is the list published by Messrs. Espin, Gage, and Read, in Vol. XXXV. of the "English Mechanic." I am sure that Mr. Espin would gladly receive the names of those who are willing to take a share in observing these 343 suspected variables. Then there is the appeal made by Prof. Pickering, of the Harvard observatory, which, I am glad to find, has been heartily responded to. For the benefit of those interested in this matter, I may briefly indicate the method of observing variables which is set forth in Prof. Pickering's pamphlet. It is this. Having made a careful map of the vicinity previously, (preferably from Heis) or a list of comparison stars from the catalogue; observe a star which is a little *fainter*, and another which is a little *brighter*, than the variable (the difference between the comparison stars must not exceed 1 mag.), estimating the relative position in magnitude of the variable between the two comparison stars. For instance, let comparison star $a = 6$ mag., and $b = 5$ mag., v being the variable. Then if v be ⅜ of the scale from a to b, we should have $a\ 3\ v\ 7\ b$. Any other star which exactly equals the variable should also be noted. The nearer together in magnitude of the comparison stars, the more accurate will the result be; indeed, it is not difficult to get it within $\frac{1}{10}$ of a magnitude.

Star Colours.—I have made some thousands of observations of these, with both refractor and reflector, and I prefer the latter for this class of work, especially. A large aperture is necessary; and, if a refractor, the secondary spectrum vitiates the result. The absolute achromatism of a reflector gives an immense advantage in this respect. Another serious item is the *artificial light* used in making notes, etc. This is generally yellowish, and must bias the eye. In my own case, the electric lamp (Swan incandescent) has superseded oil, with a marked improvement in whiteness.

Selenography.—When will the surface of our satellite be accurately mapped, on a *large* scale? The late Mr. W. R. Birt, worked hard in this direction; who will take up his mantle? Here again, the reflector reigns supreme; and yet there are plenty of such instruments lying idle!

Planetary work.—No useful purpose will be served by making sketches of the planets with *small* telescopes. A large reflector, with as high a power as the atmosphere will bear, and *careful* drawing—will alone be of much service. Photography cannot compete here at present: witness the photograph of Jupiter in the 37in. reflector. I may say that Dr. Terby, Louvain, Belgium, will be glad to receive sketches of Jupiter from various observers; as I believe he is preparing a monograph on that planet.

Star Clusters ought to teach us something of the laws of distribution and aggregation in space, if properly studied. Why should *red* stars be so often connected with clusters?

Comet Sweeping.—Mr. Dennnig's laudable efforts among British observers have not been in vain; the scheme is being reorganised by Dr. Copeland, at Dun Echt—much interrupted, though, by the transit of Venus expedition.

Meteors.—These, again, want more observers. Mr. Denning, would, I am sure, be glad of help in this department, which he has made almost his own.

W. S. Franks.

SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[21100.]—I BEG to apologise to Mr. Calver for the last sentence in my letter 21072 in your last issue—the word *another* being omitted. It should read: "I should like to learn the opinion of *another* optician, such as Wray or Lancaster, &c., &c." I named those gentlemen as makers of refractors, who could tell us if allowance is made for the focal image of moon in stopping the light of the object-glass from the eyepiece.

In answer to Mr. Westlake's request to look at the full moon with a 14in. stop before my 15in. mirror, and with a 1½in. flat, I have just put the telescope under the conditions named, and looked at some houses about a mile away. I first focussed the telescope on the houses, and then put on the stop. I see the houses still—not very well defined, as the outside rim of the mirror is not so good as the centre, but showing that none of the light of the mirror is cut off by the flat being too small. Taking the eyepiece away, and putting my eye in its place, I see the outside rim of the mirror clearly and distinctly, showing that there is nothing to prevent the light of it being reflected into the eyepiece. I then changed the flat for one of 2in., and could not perceive any improvement in the light.

I would have tried the experiment on the moon last night, but did not think of it, and I fear I may wait some time before I get another chance. But if it can show the houses at a mile, of course it will show the moon better at a greater distance, as the focus will be shorter, and the flat nearer to the mirror.

This proves clearly that the flat is large enough to reflect the extreme marginal light of the mirror into the eyepiece, and, therefore, when the stop is removed *all* the light of the mirror is reflected; and if so, how can a larger flat reflect more than all?

I will ask Mr. Calver from what part of any of my letters on this subject he can conclude that "I now see and acknowledge my mistake about the necessity for providing the flat large enough for the moon's image." I must distinctly deny that I see, nor do I know, where I have acknowledged this mistake. I believe the mistake to be on the other side. Not that a larger flat cuts light from the larger mirror, but that it is a much more expensive thing, and that expense thrown away.

Mr. Calver doubts that Herschel put a flat of one inch to a 10in. mirror of 10ft. focus, and says it is half its proper size. I ask him, would he put a 2in. flat to a mirror of that size and focus.

Again, if a customer were to request him to make a mirror of 6in., and of the focal length of Mr. Westlake's mirror, would he put a flat of 2½in. for it. If so, the best part of his mirror would be lost. I do not deny the superior defining power of a large aperture; but I deny that you get more of it by using a larger flat than that which will reflect *all* parallel rays into the eyepiece. This the flats I use will do, and I deny that a larger flat does more. I do not know where Mr. Calver gets "my views," as he says, that refractors should have a long tube in front of the object-glass; but I say that if the tube were blackened it would by no means hurt the definition of the object-glass. In fact all have a short one, as a dew cap.

As I have only two Newtonian telescopes with metal specula, and Mr. Calver says their makers did not know what they were about to use flats so small as they have, I will ask all readers of our magazine who possess Newtonians with metal specula and flats, to give the size and foci of the mirrors and flats, so as to show if others have telescopes like mine.

Sunday night being fine, I took the opportunity of trying the experiment requested by Mr. Westlake, which I had tried on the houses as described. As it is an interesting and conclusive experiment, and my telescope peculiarly adapted for trying such a one, I will describe its mounting. It is a ponderous tube—taking in the 17¼ mirror of 9ft. 3in. focus, as also the 15in. and four of 12in., two by Mr. Calver, as well as a 10¼ With-Browning and a 9¼ by Grubb, of Dublin, and each of these several mirrors I can put into the tube in the dark in one minute, and find it in perfect adjustment. This tube lies on a large iron ring, hung by two trunnions on a fork, having a spindle turning in an iron tripod and upon a pivot, suspended by a screw so as to be raised or lowered, and thus caused to turn easily in the conical bearings in which it turns. The tube with the largest mirror in it is counterpoised by three half-hundredweights under the tube, and between the arms of the fork, so as to bring the centre of gravity to be directly over the spindle and the trunnions of the fork, so that the telescope will stand in any position, and at any elevation, either horizontal or vertical. A weight is now added to the mirror-end, so as to raise the mouth of the telescope, and this is regulated by what I call the gimlet and string, consisting of two double pulley-blocks, one attached to the point of the telescope and the other to an arm fixed on the spindle, and the string passing through these pulleys and thence to the gimlet gives it four powers, and moving the end of the string 1in. moves the telescope a ¼in., which I find to be enough to follow a star with ease and convenience. The telescope being thus arranged, if when pointed at any object in the sky, the mouth is pulled down, if let go again it will rise to its former position and the object to which it was pointed be still in the field of view, if it was not held down long enough to be carried away by the rotation of the earth.

Two arms are fitted to the sliding plate carrying a flat each, one 2in. in minor axis and the other 1½in., and the change from one to the other can be made in a few seconds, so that if the telescope is directed at any object, and a change of flat required, such change can be made and the telescope again put on the same object before it is out of the field of view.

Last evening the 2in. flat was in the telescope as I had left it when looking at the houses as I have written; I therefore directed it at the moon, and adjusted the focus, I then put in the stop, and of this I must state that it was cut out for testing the 17¼ mirror, and was 14¼in. in diameter, so that when it was truly centred on the face of the mirror, a thin strip of light was left only ⅜in. wide.

On directing the telescope again at the moon, I saw each crater and mountain just as I did before the stop was put in, but not well defined, but enough to recognise each one. The light also was but little comparatively, as the hollow cone of light from the mirror was only ⅜in. thick. But this is a great advantage in comparing the effect of any change of light. I then placed the telescope so that the moon was just coming into the field of view, and then pulling the mouth down, changed the arm, to that one carrying the 1½ flat. On letting the telescope rise again, and looking into the eyepiece, the moon was in the middle of the field; and no difference in the appearance, nor *any less light than* when I used the 2in. flat.

This I consider a conclusive experiment, and proves what I have always asserted—that if the flat is large enough to reflect all the parallel rays into the eyepiece, no larger flat will do more.

I will ask Mr. Westlake to repeat this experiment with his two flats, cutting off all but a very thin rim of his mirror, as any difference in quantity of light is then more easily perceived. I should feel obliged if Mr. Calver will also make the same experiment and report thereon, using a flat only just large enough to reflect all the light of his mirror into his eyepiece; and then putting in a flat as large as a dinner-plate, if he pleases, and I'll venture to predict that he will find no more light from it. We've had a deal of theory, now let us have a little practice.

Feb. 19. **Philip Vallance.**

TELESCOPE MATTERS.

[21101.]—I DARE say many of our readers begin to wonder why they have not seen a letter from me before; but the fact is I have been out for a fortnight, almost purposely to examine and test telescopes of the old great masters; a kind of mystical halo hangs about their work which I was desirous of investigating, and finding out where their respective excellence lay, and as to whether we amateurs may ever hope to equal them. We have heard so much of the perfection and handiness of the old Gregorian and Cassegrain telescopes, that I felt desirous of having an opportunity of carefully examining them, and reporting for the information of all upon their qualities. I have had this opportunity through the kindness of two of our correspondents, Mr. Vallance and Dr. Edmunds; the result I purpose giving in this letter, leaving for a future letter the results of the testing of the specula of our great modern masters, Mr. Calver and Mr. With. I would observe that we are as much indebted to the shadow test and the zonal test for the greater perfection, and to a still nearer approach to absolute perfection, yet to come in specula, as we are indebted to the perfect planes and straightedges of Whitworth and our American friends for the great advance in our workmanship of late years in our engineering productions; in both a more perfect test induces to more perfect workmanship. I should, therefore, advise every amateur speculum-worker to master the shadow, and especially the zonal test, the latter giving exactly how far off or how near our approach to the parabola is, or whether we have a regular or irregular curve.

I will describe the results of my fortnight's out in the order in which they occur, so as to make the information more easily remembered by our readers. Of course I had taken my testing apparatus with me. I spent the first week with Mr. Vallance, among his unique collection of telescopes. He possesses between 30 and 40 reflecting telescopes, ranging from a Short of 2½in. diam., of the year 1735, to one made by Mr. Calver 17¼in. diam. Mr. Vallance has about the same number of refracting telescopes by many makers, up to a 6in. diam. by Troughton and Sims. We picked out a number of the best specula of the old masters' work, about which we were pretty certain for one day's testing, so as to get a correct comparative idea of their capabilities. I will describe these, in a short way, in the order in which we tested them.

1. A Cuthbert Gregorian 9¼in. diam., 5ft. focus. This mirror was fearfully turned down round the hole, and a little turned down at the outer edge. This turning down of the inner edge, I explained to Mr. Vallance, I was not surprised at, as I had given up the attempt to make a 6in. Cassegrain partly for the same reason. I got in the mirror, no matter how I attempted to parabolise it, a similar turning-down of the inner edge. I explained it by supposing that the hole had, as it were, imprisoned a lot of the rouge round its edge, and thus keep up a better supply of cutting material near the edge, and so wore more of the edge away, and thus turned down the edge. This had always been my own explanation of my own failure, and I was not surprised to find the same fault, under similar circumstances, show itself with Cuthbert, and all the more so as the Tulley mirror that our correspondent "L. L. L." brought with him on a visit to me, and which we very carefully tested together, had exactly the same fault; though, singular to say, its outer edge was turned up instead of being turned down, as in all the other old masters' work I have tested. I began now to generalise, and told Mr. Vallance that I believed all specula worked with a hole in their centre must have the same defect from the same cause; but, what most surprised me was to find so much turning-down of the outer edge, as, in my mode of working specula I never get a turned-down outer edge; nor could I, with my present mode of working. This little turning down of the outer edge of the Cuthbert made me begin to think that we moderns were not so far behind the old masters as we are apt to suppose, and that it was distance and the want of a rigidly correct test applied to them, that had added enchantment to the view we took of their work. The amateur will bear in mind my explanation of the turning down of the inner edge, both in my own attempts and in the work of the old masters, as I shall have to refer to it again.

2. A Lassell, Gre., 7¼in. dia., 3ft. focus. The same general figure as in the Cuthbert, but nothing near so bad either in the turning down of the inner edge or of the outer edge. In fact, the outside was only just visibly defective. Here then, Lassell, a comparatively modern worker, was superior to Cuthbert. He had evidently improved on the old masters, for this mirror was one of the best of all we tested with a hole in the middle.

3. A Howlett, New., 6¼in. dia., 7ft. focus. What at once struck me when I was testing this mirror, was the superior middle of the mirror as compared with the other two with a hole in the their centre; this was a much better figure, though it was evi-

dently over-corrected. The beauty of the figure, as compared with the two previous specula, convinced me of the correctness of my judgment formed by my attempt to work a Cassegrain—that the only true way to work a mirror with a hole in its centre, was to fill up the hole with the same material as the speculum, and figure it thus; after which remove the centre plug, when the figure would be true to the inner edge.

4. A Tulley Gregorian 7in. diam. 3ft. focus. This was as near a spherical surface as possible, the outer edge a little turned down, the inner edge very much turned down. How it was that with this spherical mirror Tulley could get a good definition we shall see farther on; and because the old masters adopted a means of getting tolerably good definition out of all sorts of figures, and therefore used up all sorts of figures, I did not think it necessary to test these mirrors zonally, as it would only have shown a great variety of figure, and not one particular form which the old masters found to be the best; I believe they had no particular form that they kept to. What we moderns have to do in attempting a Gre. or Cas. is to decide theoretically what workable figures will give the best results, and with these and our superior mode of working and testing, I believe we could produce very short and superior telescopes, better even than the old masters.

5. A Short or Adams Gre., 5in. dia., 2ft. 3in. focus. Mr. Vallance was not quite sure whether this was a Short or an Adams mirror; it was very much corrected as compared with the others; the outer edge turned down a little, the inner edge more again than the outer. I shall have to refer to this further on.

6. A Ramsden Gre., 4in. dia. 2ft. focus, had engraved on the vertical semicircle, "The optical parts by Adams." Now whether Ramsden made the mirrors or Adams, we may be sure that Ramsden would not let a telescope go out of his hands with the optical parts inferior to the best that could be produced in his time (the latter half of the last century), such was his love of perfection in his productions; we may, therefore, take this mirror as a good specimen of the old masters' work. It had the same general figure as the other Gre. I had tested, with turning down of the inner edge more than the outer edge, the surface not being so tarnished as some others; and upon this subject of deterioration of the old metal specula I may observe I was surprised to find them all in a much better state of preservation than I had expected; some, this one among the number, for instance, looked almost as good as the first day of their completion. Of course, how often they had been brightened up we could not say: they certainly did not show any marks of being often polished up. I am sure the old speculum metal will keep its polish if simply covered, longer than most would suppose. Mr. Vallance had not seen some of these mirrors for over ten years, had taken no special care of them, simply stopping up the ends of the tubes, and putting them by in some corner or box; yet their preservation was marvellous.

7. A Bond Gre., 6in. diam., 2ft. 6in. focus, had been, Mr. Vallance said, a very good one to define well in its own tube, and with its own concave mirror; but had been cracked by some one to whom Mr. Vallance had lent it. It was turned down a little on its inner edge, but with scarcely any turning down of its outer edge. By the little turning down of its two edges I account for its superior definition, which Mr. Vallance said had been about the best of all his Gre. telescopes; it had a little correction, but not so far as the parabola, I should judge. For so short a focus, its figure was more regular than most of the others; this was occasioned by the turning down of its inner edge being less than most of the others, for this turning down of the inner edge in most extended from ¼in to ¾in. into the mirror, thus destroying the regularity of the general figure.

8. A Short (the date 1735 engraved upon it) Gre., 2¼in. diam. 9in focus. A very little turning down of the inner edge, and little or no turning down of the outer edge; had some correction, and was the most regular, perhaps, in figure of all I had tested, except perhaps, the Lassell's (No. 2). Mr. Vallance and I compared its definition on a distant object, with a good refractor of larger aperture, but about the same power. I was surprised at how well it compared; we both thought that with the aperture of the refractor reduced so as to bring its light to be no more than the small reflector, the latter would have been equal, if not superior, at the same time being a very short and handy telescope. I may observe that one of our distant objects was a watch-face.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

(*To be concluded.*)

ORNAMENTAL LATHESCREWS.

[21102.]—Our old and valued friend, "J. K. P.," will serve us much if he will assist in the discussion of this question; but he appears to have written without having had his attention called to the matters at issue, and his letter simply demolishes objections which have never been made to these obsolete screw-threads.

I have first to thank him for kindness personal to myself in rectifying my orthography and my diction. He tells me that I ought to spell the word "mandrel" *mandril*. But as he subsequently uses the word eight times in his letter, and each time spells it "mandrel," I cannot discover whether I ought to follow him in his precept or in his practice. In regard to my diction, he disapproves of my using the word "obsolete" for these Holtzapffel screws, because they are still manufactured as good enough for amateurs. I find, however, that in my use of the word obsolete, though "J. K. P." is against me, Cicero is with me. The word is Anglicised Ciceronian Latin. Then, again, the writer of the second leader in to-day's *Times* (Feb. 19) describes Bradlaugh as "the victim of an obsolete law." Arabi was armed with flint-lock pistols; are flint-guns not "obsolete" because Birmingham people still manufacture them as good enough for savages? If I had inherited from my grandfather a large stock of lancets, and persisted in bleeding everyone who had the misfortune to be sick, would it be right for my patients to protest that I treated them on "obsolete" principles? I might fairly urge:—1st. That having inherited all these lancets from my grandfather, I ought not to waste them. 2nd. That my grandfather was a most able and conscientious practitioner, and always bled such people. 3rd. That if I did not bleed such people, they would get well in a week; whereas, when I bled them, they were ill for three months; and therefore that bleeding patients was good for trade. 4th. That it was a scandal to apply the term "obsolete" to my practice while I still carried it on. Now, if I turned sulky and rude to an old patient of the practice, who asked me to manage his case without bleeding him, would it be right for such a patient to discard the lawful inheritor of the practice, when his forefathers had been regularly bled?

As to the screws, what is needed is for someone to show that screws which, practically, cannot be cut by wheels are, *cæteris paribus*, better than those which can; and this is a task which, if a possible one, "J. K. P." is the man to attempt. No one has ever said that a 9·45 screw will not be efficient as a binding-screw; that it cannot be cut with a comb-tool, or with a mandrel-guide. What has been said is, that these Holtzapffel screws cannot be originated without highly-complicated sets of change-wheels, whereas aliquot pitches can be originated easily and promptly by the permutations of a very small number of change-wheels, that they lend themselves perfectly to calculations, while, in all other respects, they are quite as efficient as those of fractional pitches. And our friend "J. K. P." himself, last April ("E. M.," page 108), says: "As a practical man, I should never dream of putting anything but a Whitworth thread on a new mandrel"; yet his letter (page 499) now reads almost as if he had changed his mind. But I have no doubt he will make his meaning clear, as he cannot have advanced backwards so far as this in one short year.

"J. K. P." shows that if H. & Co. knew what were the proper change-wheels to supply to their clients, they would give them a 63-tooth wheel, and that then it would be possible for them to cut this old and fish-like 9·45 thread by means of a particular sequence of four wheels. The answer to this is that the 10-thread screw can be cut with *any* three wheels, so only that two of them are alike; and I ask "J. K. P." kindly to give us the settings for the other 11 Holtzapffel pitches, which he will find completely set out in my summary of the subject ("E. M.," No. 892, page 173). Those settings will be valuable for those poor amateurs who are *in partibus infidelium* stuck up with the Holtzapffel screws, and at present quite unable to originate their screw-threads when any accident happens to their apparatus. To us who are within reach of "J. K. P." and Charing-cross, these settings will enable us to see how many hundredweights of change-wheels we shall need to set ourselves up with.

"J. K. P." contributes to literature a third case, in which a Holtzapffel lathe-nose has broken off. He also contributes the fact that in his own Holtzapffel tools the angle of the deep thread (described as "about 50°") is really 45°—of this I could cite other cases—and it is clear that the Holtzapffel thread of "about 50°" is really anything from 45° to 55°.

"J. K. P." thinks that on the ⅞ nose nine threads would be better than ten, because it would thereby be the same as a Whitworth bolt. But the new mandrel is ·9in. diameter outside the thread, and being bored it is to be screwed rather as a tube than as a solid bolt. Moreover, Holtzapffel's own practice has been to put the 9·45 thread upon lathe-noses $\frac{13}{16}$ths, $\frac{14}{16}$ths, and even of larger dimensions. I cite noses I have myself measured during the last week. The ten-pitch thread is, therefore, not only the simplest and the best mechanically in an ornamental mandrel of this size, but it is abundantly within the limits of Holtzapffel's own practice.

The cylinder at the root of the new mandrel nose is ·95in. diameter and ·15in. long. It is made $\frac{1}{20}$in. larger in diameter than the top of the screw-thread, in order that it may serve to centre chucks upon as well as assimilate the mandrel-nose more to the shape of a tree-trunk—i.e., largest at the base. The resolutions referred to, although unanimously adopted by the council as recommendations, will have to come before the annual meeting of the members in May next, when a final discussion and a general decision will be arrived at by the members. If, meanwhile, "J. K. P." and other friends will look over the letters on the subject which appeared in the English Mechanic in the early months of 1882, and assist in completely ventilating this important question, no one will be more pleased than myself. **James Edmunds, M.D.**

Grafton-street, Bond-street.

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[21103.]—Raising Water (49529).—A small windmill-pump is made by Warner and Sons, of Cripplegate, which is affixed to the top of the house, and raises water for gentlemen's country-houses.

Hot Water (49551).—The means by which chalk-water is to be heated is by applying the heat to a closed coil of pipe containing distilled water, alkalised with caustic soda. The pipe will bear almost any pressure, and the quantity of the water is so small that even in case of bursting, there is no danger. A coil at one end of the system is heated by the fire, and a coil at the other end occupies the centre of a cistern in which the water to be heated is contained. The two coils lead into each other at the top by a pipe which conveys the heated water out of the top of the fire-coil into the top of the cistern-coil; at the bottom the chilled water from the cistern-coil runs down into the bottom of the fire-coil. Thus a perpetual circulation is kept up in the closed coil of steel pipe, while the heat that enters the water from the fire is transferred to the water in the cistern. Any length of pipe almost, if properly packed, may intervene between the two coils. The water in the cistern deposits its chalk in the open cistern, and upon the outside of the coil from which it is heated. Of course, this can be swept off, and taken or washed out of the cistern occasionally; but practically, it never blocks the pipe. Inquire, for further particulars, of Perkins, King's-cross, London.

Foul Tongue (49552).—Get personally examined by a competent doctor.

Gums Receding from Teeth (49573).—If the querist is old the teeth also are old, and may be dead. Get examined by a dentist.

Threatened Rupture (49276).—This query was not addressed to me; but a letter reached me privately asking me to reply to it. My long note on rupture some weeks since answered this fully, and was as complete a practical epitome of the subject as it would be useful to publish in the Mechanic. My correspondent should get personally examined by a competent medical man, if his case is not met by the general instructions already given by me.

James Edmunds, M.D.

Grafton-street, Bond-street.

LEGAL REPLIES.

[21104.]—Landlord and Tenant—Dilapidation (49455).—I presume the querist has no lease, for, if he has, it probably contains a covenant to repair, which would doubtless include everything. But, even though he is only a yearly tenant, he is liable to make good dilapidations, and to keep the house wind and watertight. There is no definite rule of law as to what this means, but the cases are generally in favour of the landlord, and I should advise the querist to put in the glass and leave the latch, as going to law over it would cost him more.

Partnership and Assets (49463).—This question is very confused, but if the work in question was done while the partnership existed, and it was agreed that A. should take the assets, he is clearly entitled to the profits of this work.

New Road—Adjoining Owners (49468).—The local authority is not bound to take over a new road until it is satisfied as to its state and condition. This road, as far as I can see, has not been so taken over; for, although the querist says they partly repaired the footpaths, this was only because they had taken it up to make the sewer. Until a road has become a public highway, and has been taken by the local authorities, the adjoining owners are liable to its repair, and the rates levied have nothing to do with the question.

Marriage Settlement (49484).—I cannot possibly answer this question without reading the settlement. What is not clear to the querist might be clear enough to me. The phraseology of legal documents has evidently been too much for the "Constant Reader."

Debtor and Creditor—Marriage (49493).—A woman against whom a judgment has been obtained continues as liable upon it after her marriage as she was before. The querist can issue execution against her goods if she has any; if not, he can summon her to show cause why she should not be committed. If the husband takes goods with the wife he becomes liable to pay her debts to the extent of those goods, and so he can be sued accordingly. The querist does not say when the marriage took place, though this is most important. He had better read my shilling handbook upon the New Married Women's Property Act.

Landlord and Tenants—Fixtures (49500).—There is a vast amount of legal learning upon this point, which is always regarded as a mixed question of law and fact. But I think it may now be taken that a tenant can remove gas-fittings, pipes, and even kitchen ranges, provided that he does no damage, and leaves the house in the same state as before; unless, of course, there is a lease or agreement dealing with fixtures.

Right to use Party-wall (49503).—This is a very small matter; and I certainly think B. has as much right to fix the beam of his swing on the new-raised wall as he had on the lower one. Assuredly the querist can have no possible claim for rent, and there can be no rent without a letting or an agreement. If B. is wrong at all he is only liable to damages in an action of trespass, which would be laughed out of any court, and at the plaintiff's expense.

Sale of Horse—Market Overt (49510).—The querist does not say how or where he bought the horse. If the sale did not take place in market overt—that is, at a fair or regular horse market—and if the horse were stolen and obtained under false pretences, it will have to be given up to the owner. If the sale did take place in market overt, then it will be valid, presuming the requisites of the Statute as to entering all particulars in the Tollgatherer's book were complied with. But even then, upon the conviction of the thief for stealing the horse, it would have to be given up to the true owner. Those who buy horses of strangers should be very careful.

Right of Way—Pump (49547).—In this case the pump should have been mentioned at the sale, and a right of way ought to be contained in the deed, and perhaps it is, only the querist may not have understood it. Anyhow, a user for over 20 years gives a prescriptive right of way to the pump, and although the purchaser of No. 2 can, of course, bring an action for trespass, I believe a defence setting up this right of way acquired by prescription would be successful.

Railway Company—Negligence (49569).—The Railway Company cannot be in any way liable to pay damages in this case. The luggage was under the passenger's control in the carriage, and the porter in fixing it up on the rail acted as the passenger's servant, and not on behalf of the company. The gentleman only can be liable, and as the plaintiff must prove his case, the whole onus of showing that the porter acted on the gentleman's instructions, and was negligent in so doing, will fall upon him.

Sale—Sewing Machine (49576).—This question does not say whether the machine was sold to A. right out, or was let on the hire system. If it were sold, then of course the original seller can have no claim against any one. If it were let on hire only, he would have a right to recover it back again.

Fred Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall, E.C.

RATIONAL DRESS.

[21105.]—Now the Food and Drink question is closed for the present in your columns—I must say the discussion has been to me a most interesting one—I should like to hear if Dr. Edmunds, Dr. Allison, and "Sigma" have anything to say on the subject of rational dress. Like most of my fellow men, I go to church in a frock coat, top hat, and trousers, all of unimpeachable respectability, but discard all these with feelings of relief when at leisure or bent on pleasure or amusement, in favour of garments more comfortable. I never gave much thought to the matter till I read a paper on Art Costume, by a Mr. Gotch, which appeared in the *Building News* of May 26th and June 2nd of last year, which interested me very much. The writer advocated the abolition of trousers and top hats in favour of knickerbockers and billycocks, and the substitution of a more sensibly cut coat. I would advise any reader who may be interested to read the paper, and if possible, the discussion which followed it in the same newspaper, and in the course of which an enthusiastic gentleman named Simmons took a prominent part, subsequently publishing a humorous pamphlet on the subject, which I saw advertised in the *Echo*, and read with amusement. I also read last week an account of a meeting of a Rational Dress Society in London, at which Dr. Richardson presided, and regarding which it was stated that its supporters had come to the conclusion that the tight bodice must be abandoned, the divided skirt adopted, and thirdly, that the frequent changes caused by fashion should be disregarded. I presume the Rational Dress Society concerns itself principally with ladies' dress; can any reader say if this is so, or if men's dress is thought of at all, and also say something about the aims and whereabouts of the Society? It seems to me that a dress for men, something like a bicyclist suit, and made of some light warm woollen material, with grey or black woollen stockings and a billycock or Tam o'Shanter hat would be healthier, handsomer, and cheaper than the garments in which it is considered necessary to appear at business or in society. If a few thousand of the readers of Ours could be induced to make the change simultaneously it would keep the timid ones in countenance, but first let us hear something from our medical and other friends who have liberally dealt out their knowledge on the food question.

Teetycrumbs.

SUNDIALS—TO MR. LECKY.

[21106.]—By a curious coincidence, your question (letter 21082) is partly answered in an article of the same date in the *Builder*, which I transcribe in case you do not happen to see it. It is headed "The New Street from Piccadilly to Bloomsbury." After mentioning its erection by a Mr. Neal, the builder of Seven Dials, it continues, "his column bearing seven dials at top was removed in July, 1773; it now stands surmounted with a coronet on Weybridge-green, as a memorial to the Duchess of York, who died at Oatlands." Possibly, however, the dials may not have been re-erected, as, although I have been there, I have no recollection of them.

Chas. J. B. Trindon.

[21107.]—"W. H. R.," query 49557, asks for the rule for constructing a vertical dial declining to the east or west. It is simply a case of an oblique spherical triangle, one angle (A) of which is the hour angle at 15° to the hour, the other angle (B) is 90° plus or minus the angle of declination, for the morning and evening hours as it may be, to the east or west—e.g., should it be towards the east 90° – angle for morning hours, and 90° + angle for evening hours—*et vice versâ*; the side (C) contained between these angles being the co-latitude of the place. From these three dimensions you find the other two sides (a and b) of the triangle, the side (a) opposite the angle A being the measure of the angle formed by the hour-line on the dial with the XII. line. The ordinary formulæ for this is—

$$\left\{\begin{array}{l}\cos.\dfrac{A+B}{2}:\cos.\dfrac{A\sim B}{2}::\tan.\dfrac{C}{2}:\tan.\dfrac{a+b}{2}\\ \sin.\dfrac{A+B}{2}:\sin.\dfrac{A\sim B}{2}::\tan.\dfrac{C}{2}:\tan.\dfrac{a\sim b}{2}\end{array}\right.$$

The sum of these last terms gives the side opposite the larger angle; the difference that opposite the lesser angle. There are other more direct formulæ for finding a single side, but they involve a mixture of logs. and natl. sines or tangents, which makes them much more tedious and unhandy than logarithms alone.

Robert J. Lecky.

DIRECT-ACTION TRICYCLES.

[21108.]—I have been in the habit of buying a tricycle every spring, during the last six years, and disposing of each towards the winter. In that way I have well tried the greater part of the best makers, with the result that there was always something that did not quite satisfy me: either I could not readily mount hills, chains slipped, or brake roller or cog-wheels did not act, besides which it was quite a long job to clean and oil all the different parts of friction. Last year I was struck with the plain and simple method of direct-action, which, combined with the moderate price, induced me to buy one of the Coventry National Co.'s make. After riding it a very short time I got quite accustomed to the seat being placed higher than in the others I have had, and now really find that a great advantage, for, being rather near-sighted, I can see so much further ahead than I was able to on the others; also I can now climb all hills; in fact, have not met one to beat me yet, and can clean and oil all the parts necessary in five minutes, by which I save a lot of time and trouble. I think I shall still further improve my ease, in that having followed my usual plan, and disposed of the machine, I have given an order for one like it; but with the addition of ball bearings. For some time I thought it was a "fad" of mine to prefer such a simple and cheap tricycle, therefore kept quiet about it; but so many of your correspondents having now made their favourable opinion of it so widely known, I can add my testimony to the fact that I believe it is *the best in every respect*, and I shall stick to nothing else but—

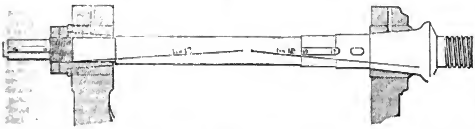
Direct-Action.

PLANING ON THE LATHE.

[21109.]—I accept "F. W. G.'s" observations, for I can scarcely call them criticisms, on my "lathe planer," as fair discussion. "Mechanicus" is, or rather was, a practical engineer—one of the old school, in which the hammer, chisel, and file did most of the fitting, and the "heel tool" was the principal one used at the lathe; but I can't leave the "shop," and so I continue to work, but now merely as an amateur. My past experience, nearly 48 years, may, however, be of use to some of your readers, and I give it for what it is worth. The lathe I illustrated a short time ago was all *handwork*, with the exception of the planing of the saddle and the leading screw, both of which were done by one of our leading Leeds machinists. As I particularly and repeatedly observed in my letter, "the necessary limited scope of a lathe-planer," I do not think I assume too much for my device, and I particularly mention that it is only suitable for small work proportioned to the lathe, such as small slide-rests, vee-strips, model cylinder valve faces, &c. He, "F. W. G.," is quite right in his objecjection as to want of support for *thin work*, but in such a case it can easily be backed, especially if the work has any openings or screw-holes. I have not, it is true, had occasion to use the "planer" very much. I think three small slide-rests and their vee-strips (all cast with a chucking dowel), and the valve faces of a pair of 3in. cylinders for a small boat-engine, is, up to the present, the amount of actual work it has performed; but I must say that I found no tendency in the work to spring away from the tool. Perhaps this is owing to the fact that my little lathe is, for its size, about twice as stiff as any other of equal height of centre and capacity for work. The mandrel is full ¾in. at the nose, and ½in. the smallest end of the front cone. The poppet-cylinder is also ½, and the head and tail stocks are of malleable cast iron, and all the wrought-iron work is casehardened. I may as well here take notice of "F. A. M.'s" remarks, in the same issue of your paper, on mandrel noses and conical fittings. He is perfectly right in his remarks about chucks running out of truth by "overturning." I have often wondered that our leading lathe-makers, especially of ornamental lathes, have so long stuck to the old-fashioned plan of having such very narrow bearing-shoulders on their mandrels, considering that on this bearing-surface the lasting truth of a chuck depends. The shoulder is generally hard, and in ornamental lathes the chucks are nearly all brass or gun. Now it stands to reason that each time a chuck is run up on the nose, a slight *blow* takes place on the two seats coming into close contact, and that each successive blow, however small, slightly indents the shoulder of the chuck, and allows it to screw further round on the mandrel nose. Now, if we could make the chuck and nose a dead fit, this would not so much matter, for so long as the nose-thread was not a drunken thread, the chuck would still run true; but for practical purposes, these two must be such an easy fit as to be easily removed without the use of a lever. The best way to obviate the above defect is to have a large bearing shoulder, as in the old French mandrels. In all the lathes I have ever designed—and they are not a few—I have invariably used the broad shoulder. Of course, for shop or engine lathes this involved (for collar mandrels) putting the mandrel in from the front; but I found no practical objection to that, and again, I have, for some years past, adopted the plan now recommended by Dr. Edmunds, of having a plain cylindrical portion left unscrewed on the nose; and not only I, but many of our leading makers, both in Lancashire and Yorkshire, have, and do, use the same plan. In my practice, I always made my mandrels of larger dimensions than usual, on the ground that all the power applied to the mandrel, either by belt or gearing, has to be transmitted through the hitherto weakest part, most noses being grooved out at the back of the thread to its full depth, merely to *allow the chasing-tool to run close home to the shoulder*. This throttling of the nose, by reducing the sectional area of the iron, naturally reduced the resistance to torsion and also the limit of elasticity; hence the frequent chattering on some lathes. There was a very good paper on mandrels by an American about a month ago in the "E. M.," and his observations and remarks as to cast-iron mandrels are perfectly correct. The mandrels in most of the double railway-wheel lathes are cast iron, but in these the mandrels do not drive—it is the chuck or face-plate which is driven. I have, however, seen quite a number of modern French lathes for wood-turners, with both traversing and steady mandrels *of cast iron*, doing their work well. Of course, they were rather larger than their wrought confrères, and would not stand much heavy "mallet chucking"; but they were remarkably cheap, less than a third the cost of such a one (in comparison for size) as I described a short time back, and which, as being the first lathe I had to do with, naturally became *my* pattern. In all my lathes the mandrels were made or specified to be made—of fagotted iron, well and thoroughly casehardened; they are far more reliable than steel, or even than those with steel laps and collars welded on, and I have never yet known one to fail. The defect of chucks running out of truth does not so much apply to machine or engine lathes, except as regards *face-plates*, and they *ought* to run true: but for all others it does not much matter, so long as the centre point is truly central; but for ornamental lathes, absolute truth in the running of all geared, or of those carrying a false nose, chucks, is a *sine qua non*. As to "F. A. M.'s" cone-chucks, I also use something like his device, but without the screw-cap, and very handy they are. But *revenons à nos moutons*. I am pleased to find that "F. W. G." has succeeded in obviating the digging propensities of his bent-arm form: but if he will just cut out for himself a little diagram of his planer-head *and bed* of cardboard, and apply *a force*, in the direction of the cut, to the point representing the tool, he will find that as a rule, this form *must dig*, if the tool used is at all proud. I should like to see his planer, if he will favour me with his address, and it is not quite so far as Jericho.

Since writing the above, I have been looking over some old working drawings, searching for the details of a 6in. slide and screw-cutting lathe. I found, to my surprise, the sketch drawing of the mandrel which I inclose. You will perceive that I was, even so many years back as 1850, alive to the fact that a cone seating for chucks is one good way of insuring truth in running; and you will also observe the nose with a small cylindrical portion at the base of shoulder. The threads of nose are made to die off into the cylindrical portions, and are screwed eight to the inch. On referring to books, I find that I designed this lathe, which was a very complete one, for an eminent German firm at Mannheim. This mandrel almost answers the remarks of "F. A. M." on fitting chucks on to mandrels. One great objection I had to steel collars welded on to lathe-mandrels was, that with the best of smiths you could never be sure of having a perfect weld (I have seen cases where the steel actually peeled up after hardening), or that the same thickness of steel, or nearly so, would be left all round, and it is mostly to this irregularity that I attribute the defect above mentioned. Good quality iron, casehardened, is free from these defects, and there need be no fear of noses dropping off, as I have seen on two occasions with *steel* mandrels, through water cracks in the hardening, and therefore no wasters; but if steel is used, it should not be hardened, except in the case of ornamental traversing mandrels. I have so applied it, the mandrel running in very hard bell-metal collars, and found it wear well. Still, I prefer casehardened iron.

Mechanicus.



SCREW-THREADS AND THE AMATEUR MECHANICAL SOCIETY.

[21110.]—I have been asked how I reconcile my statement at the recent meeting of the Society of Arts, in the discussion on Mr. Evans's paper on the Lathe, to the effect that no resolutions of the character described by Mr. Evans had been passed by the Council of the Amateur Mechanical Society, with the paragraph that appeared in your issue of the 26th ult. (p. 474), in the shape of a report of the proceedings of the Council on the 10th January: and as a good many of your readers are interested in the subject, I ask leave to make my explanation in your columns.

The question of screw-threads, originally raised by Dr. Edmunds, in January, 1882, occupied the attention of the Council of the Amateur Mechanical Society, and was discussed by them at intervals until December 13th, when Dr. Edmunds having offered to embody his views in the form of a circular, for distribution amongst the members, they decided to postpone the decision until the annual general meeting of the Society, when the views of a larger number of members could be ascertained and acted upon.

The subject having thus been temporarily disposed of, dropped out of the agenda for the January meeting, and no notice was given respecting it in the summons, as required by our by-laws; but I was unfortunately unable to be present, and could not, therefore, point out at the time the informality of the proceedings shown by the minutes to have taken place. It was, however, my duty to do this at the next meeting (14th February), when that portion of the minutes containing the three following resolutions (differing from those reported on p. 474) was not confirmed:—

"That the thread of the ornamental mandrel nose and the screw of the back-poppet cylinder be henceforth screwed at the rate of ten threads to the inch."

"That the base of the screwed nose of the mandrel be a short cylinder instead of a groove."

"That the screw-thread for the ornamental mandrel-nose, and other fine purposes, be an isosceles triangle of 50°, the tops of the threads being just flattened down or rounded off to the extent of 7¼ per cent. of its pitch (more exactly, ·0723 of its pitch), thereby producing a thread whose altitude is equal to the length of its base, and whose depth is equal to its pitch; thus simplifying all calculations connected with the strength of the screw-threads and of the shafts, and combining the utmost strength with the greatest durability."

Being much occupied, I did not examine the minutes of the meeting of 10th January until shortly before the next meeting (14th February), hence it was that I was unaware of what had happened when I spoke at the meeting of the Society of Arts.

I do not know the origin of your report of the January meeting (p. 474). It is certainly not official, nor can it be described as accurate, for, in addition to the discrepancy already pointed out between the actual and reported resolutions, I find from the minutes that only five members were present out of a possible twelve—not a very "full" meeting—and there was no "report" on any subject to be brought up by any one.

If you can afford me space for a few words more, I should like to say that I entirely concur in Dr. Edmunds' views as to the beauty of a symmetrical system of screw-threads, and in certain conceivable cases, also its use; but as a practical amateur, who has used a Holtzapffel mandrel for something like twenty years without discovering any one of its alleged inconveniences, I am bound to admit that I also agree with every word "J. K. P." has to say on the subject (p. 499), taking exception only to the amazement he says he would experience on finding an amateur who could fit a chuck to a lathe in workmanlike fashion. I know "J. K. P." to be an excellent workman, and a job would have to be nearly as perfect as Dr. Edmunds' screws to command his approval. Still chance throws a good many amateurs in my way, and I think I could afford him several occasions for such amazement.

I will not trouble you with any detailed remarks on the proposed new mandrel, but only suggest to those who care to come to a conclusion on the subject to ask themselves, if possible, after seeing a model of the new pattern, whether, in the event of their being about to order a new lathe, they would choose the old or the new mandrel-nose.

Feb. 19. **T. W. Boord.**

GEOMETRIC DRILL AND TOOL GAUGE.

[21111.]—With the Editor's permission, I would wish to make a correction of my letter 21084, page 549, where it states that the sketch is a full-size one. The original sketch was "full size"; but obviously to save space, and in consequence of my own neglect to suit sketch to the size of the columns of "ours," the engraver has shown it about "two-thirds" the full size. In every other respect it is a *fac-simile* of the real object.

J. S. Fisher.

HEALTHY HOUSES.

[21112.]—While so much has been said upon what we should eat and drink, and the best house to live in, I am very anxious to have some information on a point which has not been much touched upon—namely, smells in houses and how to test them. Most readers of ours are aware that typhoid fever arises from an escape of sewer or drain gas into the house, and typhus from overcrowding of the inmates, damp houses giving rise to colds, &c. What is wanted is a simple and reliable means of determining what kind of smell it is, so that the proper remedy may be applied before it has had time to destroy life. Chemists have test-papers for acids, &c., of the most delicate kind. Can some of Ours not tell us of some such simple means to test the air in our houses, so that we may know whether it is simply damp or containing poisonous germs. If such can not be got, I daresay anyone knows how to fill a bottle with the suspected air, and if such were done could a reliable report of the contents be got, from any of our noted analysts, say for a fee similar to the charges made for testing wall papers, food adulterations, &c. Any information bearing upon this matter will be gratefully received by

Ventilator.

["Ventilator" and others might read with advantage a paper entitled "Home, sweet Home!" in to-day's *Building News*.—Ed.]

FULLER'S "FORGET-ME-NOT" CALCULATOR.

[21113.]—I beg to thank your correspondent "Iota Pi," for having drawn my attention to this highly ingenious arrangement of a logarithmic scale by which one of *ten feet in length* has been compressed into a space of 5in. by 2in.

But I am anxious to see this very clever arrangement still further utilised, and I trust Mr. Fuller will be induced to bring out one of double the effective length, and ten times its present application by the adoption of what he aptly styles a "gridiron," scale, in addition, so that it will be possible to have two sets of scales of the same dimensions capable of being applied directly to one another, as in the ordinary slide-rule, so that being once set to solve a problem of a specified kind, the solution is capable of being read off for any quantities. This can, I think, be done readily, so as to have a logarithmic scale of *twenty feet* effective lengths, on a card of about 16in. by 8in. wide—a size by no means inconvenient to use.

At present, a piece of semi-transparent paper ruled specially for the existing scale has to be applied in two or more operations to solve a problem; but with a regular "gridiron" scale having the bars and spaces of the same breadth, and each bar divided like the existing scale—as one part of the apparatus—and another scale ruled on the 16in. by 8in. cardboard, with the variation made of having an addition to each of the existing line sections of the said scale, of the first half of the next succeeding line, and last, having the first half in number of the line sections thus drawn repeated after the hundred.

The "gridiron scale" would be about 10in. by 5in. and the fixed scale would cover 15in. by 7½in., and when the former is adjusted to the latter there would be two complete scales in contact with one another. I am sure Mr. Fuller could arrange this admirably, and, with simple instructions for its use, I feel pretty confident that it would have a large circulation. **Gamma Sigma.**

GREAT NORTHERN ENGINES, AND THEIR WORK, PAST AND PRESENT.

[21114.]—I see that in my letter (20113, p. 288, Vol. XXXV.), on this subject, I omitted from my list of old express engines No. 221, a "Hawthorn," of the same class as No. 212. The complete express list will, therefore, stand thus:—Rebuilt Cramptons (11), Nos. 91—100 and 200; "Hawthorns" (13), Nos. 203—214 and 221; Wilson's "Jenny Linds" (3), Nos. 201, 202, 222. These last had 6ft. wheels, and cylinders 16in. by 20in. The Cramptons and Hawthorns had 6ft. 6in. wheels, and cylinders 16in. by 22in. All were "single" engines, and as I showed in my previous letter, performed for many years the fastest running on the narrow gauge.

Respecting the old "coupled" engines, I may add that Nos. 71—75 were Hawthorns, and Nos. 76—90, 216, and 217, Wilsons. Nos. 218—220 were small four-wheeled tanks, with inside cylinders (11in. by 17in.), driving an intermediate shaft, which was coupled by outside cranks to the leading and trailing-wheels (5ft. diam.). I am informed by an ex-officer of the G.N. Loco. Department that it was a common thing for the drivers of "coupled" engines, when taking fast trains, to take off their side-rods, with the idea that they thus secured easier running.

With regard to "present" speed, I have been surprised to see no notice of the express (arriving at King's Cross 2.5 p.m.) which, in January last, was running regularly from Grantham to Peterborough in 33m., and from Peterborough to King's Cross in 1h. 29m., each being one minute quicker than was done by the fast trains which have received so much attention in these columns. The complete run from Grantham to King's Cross was 2h. 2m., including stopping at Peterborough. I have been longing to read full particulars of the remarkable trip from Leeds to London in "exactly 3 hours," by the Duke of Edinburgh's "special." Cannot any correspondent give the times, number of engine, and other particulars? They would be most interesting—more so even than those of the "Lord Mayor's Special" to Scarborough, which we had last year. I hope the information may even yet be forthcoming, the run being certainly the most wonderful on record.

Wellington, N.Z., Nov. 30, 1882. **C. R. M.**

AN ELECTRIC PARCEL POST.

[21115.]—I amused myself some time ago in working out an idea for the conveyance of parcels by means of electricity, and thinking that some of your readers might have more time and opportunity of trying than I have, I now write, so that if you think it of interest, you can lay it before them. I suggest using an electric motor running on four wheels, the wheels to be grooved and to run on wires, the same wire to carry the current to drive the machine. I find that the motor must have no dead point, or you may get it in a position in which it will not start when the current is switched on. No. 8 or No. 11 wire can be used, and when it is necessary to go round a corner, flat iron-bars must be used, and the wires soldered in at each end. The wheels of the machine being fixed on the axle would not turn a corner, so I make them conical, and in turning they ride up on to the outside, and so travel over more distance than their fellow-wheels on the other end of the axle. Of course the lines are a little further apart on the curves than on the straight, to allow of the wheels riding up. The load I place in a small car hanging underneath the motor.

The insulation was a difficulty; but I got over it by soldering the wire, when it requires support, on to a piece of iron grooved at the top to fit the wire, and carried down and fixed into the top of an insulator. I do not know whether Siemens' patent for railway is infringed by the above—I should think not. We may, perhaps, some day, see the system introduced generally, and a centre started as in telephony, and a parcel exchange established in our towns.

The above would really be of use between parts of works, or anywhere where dynamos are running from which they could shunt part of the current.

Walsall. **Frederick Brown.**

DIET AND AGILITY.

[21116.]—I still quote (in conclusion of my letter, 21080 as promised) from Graham, and use the numbers of the paragraphs in his work. It is a mine of wealth.

(990.) . . "Hence, flesh-meat is not so conducive to suppleness, agility, grace, &c., as proper vegetable food."

(993.) "A mulatto girl," says George Paine, Esq., of Providence, R.I., "came to live in my family in her twelfth year. Previously to this, she had remained at home with her parents, who were very poor. She had always lived in the plainest, simplest and coarsest manner. During her summers she had subsisted almost entirely on fruit, in its natural state; and through the whole year she ate very little except the plainest vegetable food. On very rare occasions she ate a little flesh, but not enough to render it, in any proper sense, a part of her diet. She drank water exclusively, and slept on straw. When she first came to live with me, her suppleness, activity, agility, and strength so far exceeded anything that we had ever seen before in such a child, that she absolutely filled us with astonishment by her feats. Of her own accord she was up in the morning as soon as it was light, and wherever she went she always went upon the run, and with the nimbleness and fleetness of a deer. In all her movements she exhibited uncommon natural ease and gracefulness, and in her muscular efforts she evinced a surprising degree of strength. She would, for our amusement, often throw herself down at length in the grass, and imitate the motions of a snake, that it sometimes gave one very unpleasant feelings to look at her; and in a great variety of ways she exhibited the most wonderful suppleness, nimbleness, and agility, that I ever beheld in a human body. Her powers of mental apprehension and retention, and facetiousness and wit, were a source of surprise and amusement to us. On coming into my family she began gradually to accustom herself to flesh-meat, and in the course of two or three months she became very fond of it, and ate it very freely. And to our astonishment—for we could not then account for the change—in less than six months all her remarkable suppleness, activity, and agility were gone, and she became exceedingly sluggish, heavy and stupid. We could not get her up in the morning until breakfast time, without special and direct means; all her movements became slow, heavy, and sluggish, indicating great indolence, and her mind became as stupid and inactive as her body; and such she has ever remained since, being now fifteen years old."

(994.) "I took a boy from the Alms House, in the year 1827" says Mr. Thomas H. Burling, of Winchester county, New York. "He was then in his thirteenth year, and had always before this subsisted entirely on vegetable food. When he first came to my house he was very remarkably supple and nimble, and threw a somerset backwards two or three times in succession with great ease. I had a notion that he was good for nothing to work unless he ate flesh, and so I encouraged and urged him to do so. He soon became fond of flesh, and ate it freely, and in less than six weeks he became so clumsy, that whenever he attempted to throw a somerset he fell like a log."

(996.) "The Greek peasantry and the lazzaroni of Naples, who subsist on the simplest and plainest vegetable diet, are distinguished for their suppleness, activity, and grace.

(997.) . . . "There came over with us to New York, as one of the ship's crew, a Greek youth, a native of Thessaly, whom we called John. He was nineteen years old. He had from his childhood been driven about among the Turks, almost in the condition of a dumb beast, and subsisted on the plainest, simplest, and coarsest vegetable food, mostly in its natural state, and chiefly fruit. His nimbleness and agility far exceeded anything that I ever before saw in a human being. Without exaggeration I can truly say, that he would run up and down the shrouds, and out on the yards, and jump about on the rigging, with all the nimbleness and rapidity of a squirrel. Indeed, his exploits of nimbleness upon the rigging often filled me with amazement, which was sometimes mingled with fear for his safety."

(998.) . . . "The wild girl that was found in the forest would run up trees and leap from branch to branch, and from tree to tree, with the nimbleness of a sqirrel; but she lost all this remarkable suppleness and activity when she became accustomed to eat flesh."

(999.) "Benjamin Howland, Esq., of East Greenwich, R.I., was quite a feeble and infirm man at forty year of age. He abandoned the use of flesh-meat and took to a plain, simple and unstimulating vegetable diet. He soon became a healthy and remarkably active man; and now at the age of eighty-two, he has more suppleness and agility than most men at fifty. Few young men, indeed, walk with so quick and elastic a step as he does. When crossing the fields, if a fence comes in his way, instead of pulling it down or crawling clumsily over it, he places one hand on the top of it, and springs over it like an active youth."

These are a few records showing how to become *heavy and dull*, or *active and lively*, and are from the experience of another man. Let readers think over this, and give it a try.

T. R. Allinson, L.R.C.P.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48752.]—**Adulteration of Tea.**—The mill or mixer "Robjant" mentions must, I think, be a very different arrangement to the one known as Hebbert's patent, to which I referred. In this a barrel revolves against a fixed knife. The barrel is built up of a number of chilled cast-iron ratchet-wheels from ¼ to ½in. thick, and 3½ to 4in. in diameter, and having from 16 to 20 teeth, threaded upon a spindle about 1in. diameter: these are separated by wrought iron washers of same diameter, and $\frac{1}{16}$in. thick, thus forming a number of cells. The teeth being chilled are too hard to conveniently turn, and are therefore ground up perfectly true and sharp by means of an emery-wheel running at high speed and carried along in the slide rest. The knife is of cast steel, about 2in. by $\frac{1}{16}$in. hardened as hard as water will make it; this is fixed to the frame, and made to be adjustable down the barrel, or just to clear; the edge being ground sharp to an angle of 45°. The barrels are from 6 to 18in. long, and there are from 1 to 4 of these in a mill. Some of the mills are arranged to be driven by power. Obviously this arrangement is intended to do something more than *mix*, and to my mind would cut in right good earnest. At least, it seems to me strange that such a formidable instrument should have been invented to perform a work which it is possible to do with the fingers and a sieve—A. Francois.

[48942.]—**Telegraph Instrument.**—To Mr. Lancaster.—The small fork I referred to should, with its two prongs, just move forward, sufficiently to hold the needle, or at any rate not allow it to move through more than a quarter of an inch. You will obtain the idea, in a moment, by holding a penholder in your right hand, then let it swing, and when in a perpendicular direction, bring two fingers of the left hand forward, so that it will be at once arrested.—W. J. Lancaster.

[48984.]—**Street Medical Coil.**—To Mr. Lancaster.—The make and break for a swing must be made with a sidespring of thin hard brass, something like the rough representation here ⊣. Let the vertical part be part of the swing, and the horizontal part be the spring when the swing is coming down; contact is made, and the armature is pulled down towards electro-magnet, then circuit is broken, and so you get the pendulum motion. The swing and the see-saw can both be worked in same manner.—W. J. Lancaster.

[49026.]—**Geological Query.**—I cannot add anything to what I originally wrote in answer to this query, except, perhaps, to tell Mr. J. E. George, of Liverpool, that I am acquainted with Jamieson's theory, and, although not at the meeting of the G.S. when the paper was read, June 21st, last year, still, I have heard of it, and have read the extract in our *Quarterly Journal*; but the hypothesis is altogether a fallacious one, and would not survive any discussion at all. The short extract from my last letter as given by "H. T. W.," page 504, is the belief of nearly every geologist.—W. J. Lancaster.

[49043.]—**Problem (U.Q.)**—W. Couster appears to ask for an impossibility—viz., to find the correct quotient in a long division sum, by using an incorrect divisor. The *modulus* of common logarithms is a non-terminating decimal, and, while only a portion of that decimal is used as a divisor, a certain portion only of the quotient can be correct: the more the divisor is extended, the more correct will be the quotient. Unless your correspondent has more leisure time than he knows how to employ, it is hardly worth his while to work out the sum to any length. The base *e*, the *modulus*, and the Napierian logarithms of 2, 3, and 5, have all been long ago calculated to 200 places of decimals. I do not know any book which gives the whole of the working; but information on the subject will be found in Hutton's "History of Logarithms," and the twentieth volume of *Abstracts* of the Papers communicated to the Royal Society. In the twenty-seventh volume of the *Proceedings* of the Royal Society, 1878, Professor C. J. Adams gives the value of the *modulus* to 307 places. The methods of calculation are fully explained in the new edition of the *Encyclopædia Brittanica*, Vol. XIV., Art. "Logarithms."—H. C. L.

[49073.]—**Electric Clocks (U.Q.)**—What does "Progress" mean when he says that his clock will tick and move on properly, carry hands without a weight by simply moving pendulum? Does "Progress" wish to convert his eight-day clock into an electric one, and what does he mean by a few cinders will do that? I wish to inform "Progress" that there are many different electric clocks made; and although I have very little time to spare at present, still I will assist him if he will state exactly what he wishes to do with his clock; expecially so, as there have been many inquiries about electric clocks of late in "ours."—J. Cooper.

[49114.]—**Link-motion as an Expansion Gear.**—I thought some of our railway men would have answered this query; but as probably, like myself, they do not quite understand what the querist is driving at, perhaps a little explanation may help him. The link is at full throw when starting, in order to keep steam on the piston for the greatest possible time, the train having to be moved from a state of rest. The regulator is only partly opened because the full supply would very likely cause the wheels to slip, and because the sudden flow of steam might take extra water into the cylinder; but as soon as the train begins to "run," the regulator is opened to its fullest extent to allow the steam free access to the valve-chest, and the reversing lever is notched up so as to use only so much steam as is needed—in fact, to work the steam expansively, and consequently economically.—Essah.

[49124.]—**Wheel Gearing.**—If you have not Vol. XXV. of the English Mechanic containing Mr. Rose's articles on Pattern Making, you can get his "Pattern-maker's Assistant" of Van Nostrand, New York (probably Sampson Low and Co., or Trübner and Co., London); but looking to what you will get beside, I should think it would be cheapest to buy the volume of this paper. I presume you mean how to set out and make patterns for wheel-gearing.—T. P.

[49124.]—**Wheel Gearing.**—The only book that I know of is Blackie and Son's "Engineer and Machinists' Assistant." The text-book is all you would require; but it is rather dear (two guineas). Can be bought of Lockwood and Co., Stationers' Hall-court. I have not much time, but if "Young Pattern Maker" states the points he is deficient in, I will try to help him, and give some hints which may be useful to others.—Tox.

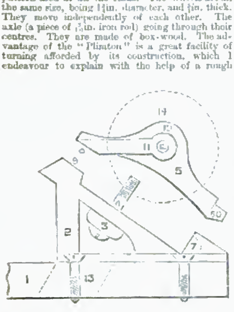
[49138.]—**Organ-Building.**—To "Uranium."—Unfortunately I have not the number of the "E. M." by me at present in which my query appeared. Certainly I did not intend to write the sentence you quote which puzzles you. Before your reply appeared, however, I got over my difficulty, and so simply, I was astonished it was a difficulty to begin with. We had an organ to put in a schoolroom, on a platform raised 23in. from the floor. To save room on the platform, we wanted to put the bellows below; but 23in. was not high enough for both feeder and reservoir. Of course the way was to have reservoir and feeder separate, and the organ is now building on that plan. Thanks for your offer to assist.—KUNST MACHT GUNST.

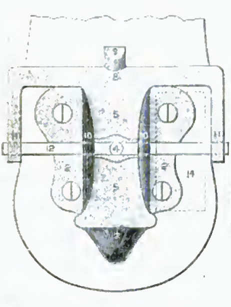
[49142.]—**Legal.** — This query is a puzzle. "China" can sell anything he has patented, subject to any duty there may be on it; there is no license or duty merely because it is patented. He has only to purchase the stamps for his patent, and if he has not done that, he has not a patent. I never heard of any duty on china plates or any license for selling them, except the license that the patentee grants for making them.—NUN. DOR.

[49145.]—**Sulphur Moulds.**—In all sorts of proportions. Melt the sulphur and stir in the gutta, or reverse the process if you like. Will you excuse me for suggesting that there is nothing like trying experiments?—NUN. DOR.

[49151.]—**Brittle Brass Chain.**—If you will get some of that small copper wire cable, that is now in use for hanging large pictures and paintings to walls, and use that for your gas chandelier, I think you will find it answer your purpose very well, as it will work quite noiseless, and it is capable of sustaining a great weight and very elastic; and the loops at the ends may be very readily made, by just bending them round and soldering them, or you may tie a knot before soldering if you choose.—COMET.

[49156.]—**Roller Skates.**—You do not say what pattern of skates you desire; but I should advise the "Plimpton," as it is the best, being the pattern used at all the rinks. The wheels are all the same size, being 1¾in. diameter, and ⅝in. thick. They move independently of each other. The axle (a piece of $\frac{3}{16}$in. iron rod) going through their centres. They are made of box-wood. The advantage of the "Plimton" is a great facility of turning afforded by its construction, which I endeavour to explain with the help of a rough drawing:—1, wooden sole-plate; 2, standard support; 3, a rubber cushion; 4, screw-connecting axle belonging to standard; 5, axle bearer; 6, tail-piece; 7, socket to receive tail-piece; 8, V, to rock on standard edge; 9, standard edge; 10, inside axle-bearer; 11, outside axle bearer; 12, axle; 13, hole through sole-plate to admit screwdriver to tighten screw (4); 14, wheels. The arrangements of the wheels on toe are the same as on heel, with this difference—the whole mechanism is put on facing that on heel; that is to say, the tails (7) point to front on toe and back on heel, also the wheels on front should come just under the ball of the foot: the effect of this is that the skater, by bending the foot right or left causes the axles of the front and back wheels to assume a position more or less at angles to each other, the point of angle being the side inclined to, and so to turn in that direction with ease. Some time ago I bought some odd parts of skates from a failed rink, from which I made a pair for myself and several for my friends. If G. Fryer will give his address, I will lend him (or any other subscriber wishing to make a pair), the parts given in drawing as a pattern. All the ironwork is cast; but, I suppose, malleable cast. I should think, if this was unobtainable, common cast would do for number 2, and a smith could make number 5. I should mention, they are fastened to the foot by wide buckles, not the narrow straps of ice-skates.—T. WEST.





[49158.]—**Eggs and Chickens.**—In reply to the above query, I beg to say that I have kept hens and bred chickens for many years. If "Chime" will set thirteen eggs under a hen, and at the expiration of four days break one, he will find a spot of blood about the size of a sixpence in the centre of the yelk, when other five days have elapsed let him break another egg, when he will find the chicken gradually forming out of the yelk. About four days before the chickens are due another egg may be broken, when it will be found that the chicken is almost perfect but with a long glutinous band fastened to its navel, two days before the chicken breaks its shell it begins to imbibe the white of the egg through this glutinous band until it is all gone. When the chicken appears it has this glutinous band still fastened to it, but by the action of the air this soon dries and falls off, leaving the chicken perfect. The above may be relied upon as a positive fact. Any further questions on the above subject will meet with prompt attention by—SEMPER EADEM.

[49179.]—**Glass Sweating During Frost.**—I have given the subject a great deal of consideration, and tried a great many experiments without success, until two winters ago, when I had my slow-combustion stove placed near the window. Since then my window has been free from sweat, and the goods there keep dry and in good order.—F. E. R.

[49182.]—**Liquid or Size Glue.**—This is made in the laboratory by adding nitric acid to good pale glue prepared in the usual way. About 3 to 4oz. of nitric acid to the pound of glue, and about a pint of water that quantity of glue. The liquid glue of the shops is mostly either shellac dissolved in wood naphtha: or, shellac three parts, borax one, boiled in water and evaporated to suitable thickness.—NUN. DOR.

[49157.]—**Piano Frames.**—Surely "Brakesman" is joking. Why, it will cost him as much to make the pattern for his piano-frame as he could buy one for. I think Mr. W. H. Davies gave an illustration of one some time ago; but, if I wanted one, I should ask that gentleman to sell me one, and I have no doubt he would.—NUN. DOR.

[49194.]—**Salt in the Fire.**—I found an opportunity for testing one of the diverse explanations I received in answer to my inquiry. A cinder fire chanced to become most beautifully clear, and almost free from smoke and ordinary flame. The back part, however, was covered with the pale-blue flames said to be given by carbon monoxide. I threw in some salt. A quantity of the salt-flame at once appeared, and was, thus, visible alongside of the C O flame, when it was easy to perceive that the colours of the two flames were essentially different. After some time, a number of small flames got up in the front, coloured sodium-yellow, and the C O flames disappeared. I have also noticed, that when a portion of the salt gets into an ordinary white or yellow flame, it gives no purple, but tinges the flame the usual sodium colour. —AZIOLA.

[49196.]—**Injector.**—It is not an easy matter to say what is the fault with any injector without examining it, and this query does not render the matter very clear. Still, as the injector works sometimes it ought to work always, and there must be some reason other than what appears in query.—ESSAR.

[49218.]—**Plain Malt Spirit.**—If "Nun. Dor." will again refer to his reply, he will find that he distinctly states that distillation and rectification are two distinct trades; and, taking the subject further, I think he will also admit that distillers are divided into two classes—namely, one who makes "grain," or crude spirit, only, and one who distils from malt only. He also tells us that a large quantity of crushed, unmalted grain is used with a proportion of malt. This is just what is done by the "grain" distillers; but when he refers to the distillation, he confounds the two distinct branches of the distilling business (I do not here refer to the rectifier). The fact of the matter is, that the grain distiller uses a still known as the "Coffey," which consists of an analysing column, into which the wash is pumped, and a rectifying column, from which the finished spirit flows. The alcohol is then sent to the rectifier, who, according to law, must have his premises some distance from the distillery, and it there undergoes rectification, the result being a "plain spirit" (not a "plain malt spirit"), which is used for the production of British gin and brandy. On the other hand, the distiller from malt only uses what is known as "pot still," which produces in one operation spirits of different strengths and flavours. This must be distilled a second, and perhaps some of it a third, time before it becomes marketable. The second and third distillation may, if he takes the dictionary meaning, be called rectification; but it is not known in the trade or to the authorities as such. This, I think, will justify my objection to "Nun. Dor.'s" reply, and, I hope, convince him that I am as anxious as himself that your readers should know the truth.—RERA.

[49238.]—**Pendulum.**—If querist will get 6in. of verge watch-spring, and straighten it, now take a piece of brass, file it square, so that it will move easily in the loop of clock crutch, let it be 1¼in. long, saw a cut at one end, and insert end of watch-spring; now drill a hole and rivet to. At the other end tap a hole to fit a stout iron wire 39in. long. Now tap end of wire, and screw it into brass square at bottom end of wire, tap it about 6in. up, and make a nut to fit slide on the bob which you already have, and screw it op with the nut a few inches. Put three holes at top of watch-spring to hold it on to the part at back of works, and put a needle through to suspend it by middle hole. Now time it by raising the bob or lowering. —PROGRESS.

[49251.]—**Microscope.**—To MR. LANCASTER.—I do not happen to have a drawing of the microscope you mention; but if you will give me size of body and arm, and say whether you wish to put the fine adjustment to the side of the body, or to the arm, I will then give you instructions for drawings to work from.—W. J. LANCASTER.

[49260.]—**Wimshurst Influence Machine.**—To MR. LANCASTER.—(1) Any hard spirit varnish will answer. (2) A condenser does not answer so well as the Leyden jars. I have tried several different forms of condenser, but cannot get the same effect that I obtain with the Leyden jars alone.—W. J. LANCASTER.

[49269.]—**Photo Lens.**—The ordinary combinations work best, separated to a distance equal to half their equivalent focus. You can get this quite near enough by taking the exact centre between the two lenses. The ring separating the two lenses in back combination should be $\frac{1}{16}$in. to ⅛in. in ¼-plate and $\frac{3}{16}$in. in ½-plate lenses. So much depends, though, upon the build of the lens that it is impossible to lay down hard and fast lines.—W. J. LANCASTER.

[49271.]—**Speaking-Tubes.**—More depends upon the speakers than depends upon the tubes; ½ compo quite large enough.—JACK OF ALL TRADES.

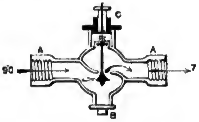
[49271.]—**Speaking-Tubes.**—I have spoken through a greater length of compo. tube than you require, and could both be heard easily, and could hear a whisper from the opposite end. The point not to be overlooked is to have as few bends as possible, and to have them as round as they can be made; no sharp bending, or the sound will be lost by interference.—W. J. LANCASTER.

[49289.]—**Speculum.**—Your query is not clearly expressed. You infer that with small mirror you can see the image produced by large mirror, but when eyepiece is put in its place, &c., you have not put eyepiece in place of small speculum. This is, or cannot be, your meaning. The only point that may be wrong is the distance of the specula from each other, as the larger one is 18in. focus, and smaller one 3in.; then the smaller one must be 18 + 3 = 21in. from larger one. Let it at this point be in focus with eyepiece for a star, then it will work right. Perhaps you have not used a small pinhole diaphragm over the eyepiece. If not, you will be unable to see anything clearly. This diaphragm must be adjustable, and will require a little patience to get it in its proper position.—W. J. LANCASTER.

[49295.]—**Cement.**—Take one pound of good glue, and when melted mix an ounce of treacle with it; thin it down with a strong decoction of nut-galls, and it is fit for your job.—JACK OF ALL TRADES.

[49298.]—**To Mr. Lancaster.**—You would be unable to do any lunar photography with your telescope, unless you can put it on an equatorial stand, and drive it with a clock. You can, however, photograph the sun. I shall be pleased to give you full instructions if you care to photograph solar spots and faculæ.—W. J. LANCASTER.

[49294.]—**Low-Pressure Air Reservoir.**—The sketch here given will put you in a way to reduce it to anything you require, and if you can use your tools you may very soon make one out of a globe valve. A A, ends for connections, the arrows showing the inlet and outlet; B, is the bottom for



high-pressure valve; and C is the top of the low pressure regulator. The valve B is connected to piston with a cup-leather, which is in contact with a spiral spring. The pressure is adjusted by the screw upon the top. The area of the piston should be thirteen times the area of valve, and would act best if it was turned: C, for bottom; B for top; and if you have a pressure-gauge, by the screw C you can adjust it to anything you like. Valve ⅜in., piston 1⅜in. will do it.—JACK OF ALL TRADES.

[49299.]—**Clarifying Extract.**—I do not know how "Gimel" managed to get his muddy mass with his Mocha. If I should be so unfortunate, I would take a tube of glass, and about 6 or 8in. from the end put a pellet of clean cotton-wool, and upon this about 2in. of charcoal, then another pellet of cotton-wool; fill the tube up with the tincture, and put a piece of cotton-wool in to keep out the dust, and stand the tube in the bottle I intend to keep it in, and it will only be a question of time to filter it.—JACK OF ALL TRADES.

[49301.]—**Organ Stops.**—In further reply, the "tuba mirabilis" is always voiced upon very heavy wind, and to produce as firm and round a note as possible. The same applies to the "harmonic trumpet," but with more of the "clang" of that instrument. Good stops of this kind are comparatively rare. The "tubas" are sometimes stuck out in the horizontal position in front of large organs, a very injudicious arrangement.—URANIUM.

[49304.]—**Restoring Vulcanite.**—You might polish the outside with a piece of cloth and oil and rouge. This is the only way in which you can restore the colour. Of course, if there is any engraved work upon it, you cannot get it restored.—W. J. LANCASTER.

[49309.]—**Playing-Marbles.**—A paraffin oil cask fitted with a cross-piece and gudgeons will make a good rumble, and answer all purposes.—JACK OF ALL TRADES.

[49317.]—**Ingot Joints.**—Your mould must be made hot to make a job of them. It is not so much the ventilating of your mould as it is the chill of the mould.—JACK OF ALL TRADES.

[49318.]—**Induction Coil.**—To MR. LANCASTER.—Your measurements of sizes are nearly right. You must alter the core—this must not exceed ⅝in. instead of 1in., wind 16 silk-covered for primary, and the 36 ditto for secondary. Condenser will answer well. With 4 quart Bunsens you would get, *cæteris paribus*, a spark 1¼in. long. The Leclanché cells will be useless.—W. J. LANCASTER.

[49322.]—**Induction Coil.**—See my answer above (49318), then add 1in. to the length and ⅛in. to the diameter of core; primary, same wire and two layers; secondary, ¼lb. more, and wind it in two sections, with an ebonite disc between the sections. Any further information you want I will give you.—W. J. LANCASTER.

[49323.]—**Dyeing Rabbit Skins.**—Thoroughly cleanse them from grease with mahogany, oak, or beech sawdust and pollard, and lay them in Judson's dye, the colour you require; they want no boiling.—JACK OF ALL TRADES.

[49324.]—**Joshua and the Sun and Moon.**—With reference to reply on p. 552, E. M., where is this statement as to Chinese record to be seen? Could your correspondent quote it at length? It would be exceedingly interesting. I had always thought that the great proof that no such occurrence could ever have really taken place was, that Chinese records of the period made no reference whatever to anything of the sort.—F.R.C.S.

[49324.]—**Joshua and the Sun.**—I am afraid the points noted by "Lamplighter," p. 552, would verge rather too far on the border of theological subjects, or at least irritate the susceptibilities of foolish people who insist upon regarding anything which touches upon their preconceived notions, as if it really concerned religion. I can only say that in the references mentioned, Isaiah says nothing directly about the sun, though he refers to a "strange act" connected with the day of Joshua's battle; that battle was a decisive one in the conquest of Palestine, and was in itself a strange act, because it was in defence of a Canaanitish people. The reference in Habakkuk is contained in what is expressly called a prayer or hymn. It is a poetical reverie or rhapsody of the writer. But there can be no doubt that the book of Jasher, from which the statement seems to have originated, was in currency ages before the times of either Isaiah or Habakkuk, and the probability is, that the extract itself had found its way into the text of Joshua before their times. There was no reason why people ignorant of the bearings of the subject should doubt this wonder, or see its difference from the many local suspensions of ordinary natural conditions which they believed. Teachers and preachers in all ages draw their illustrations and instructive lessons from the commonly received ideas, or from parables and poetic images; and such references are no evidence of the truth of facts. The mistake made is a purely modern one, in lumping together as authoritative statements of fact, everything contained in a set of writings which in themselves, and as received in earlier times, were well known to be of very diverse value and authority. Of what conceivable consequence is it that Habakkuk, for instance, in writing out a hymn, made incidental reference to a common legend? or is it certain that when he said, "The sun and moon stood still in their habitation," he recorded a fact any more than did the writer of the 114th Psalm, when, in a similar originating strain, he said, "The mountains skipped like rams, and the little hills like lambs." A little common-sense is useful even in these matters.—SIGMA.

[49326.]—**Air Current.**—You do not say how you have arranged it—*i.e.*, whether the current of cold air is injected through the side of hot-air shaft, and whether you want the air to convey the cold air with it anywhere, which I am led to think by the query is the case. If so, enter the cold-air pipe through side of hot-air shaft, and with a bend turn upwards. By these means your hot air will eject the cold.—JACK OF ALL TRADES.

[49329.]—**Heating Drying-Room by Hot Water.**—You would require from 800 to 1,000 feet of 4in. pipe, and your pressure would be from 50 to 60lb. per sq. in. The hot-water pipes generally used would not do: they must be high-pressure pipes, and wrought iron preferable for safety.—JACK OF ALL TRADES.

[49331.]—**Reflector.**—As "Aldebaran" has not answered your query, I have much pleasure in giving you the information you ask for. The powers you ask for will be obtained by the following lenses: 60, 1in. and 3in., mounted 1½in. apart; 150, ½in. and 1½in., mounted ¾in. apart; 220, ¼in. and ¾in., mounted ⅜in. apart; 340, ⅛in. and ⅜in., mounted ⅛in. apart; 500, ⅛in. and ⅛in., mounted ⅛in. apart. The holes in diaphragms should range from ¼in. diameter for lowest powers, down to a pinhole for highest power. I have just come across "Aldebaran's" reply; but as he has not given you the foci of lenses, I have sent on the above answer.—W. J. LANCASTER.

[49336.]—**Bichromate Battery.**—In reply to "Os," it is not necessary that an "alum" should contain alumina, and the "iron alum" which "Os" mentions has not any alumina in its composition, as its formula will show:—$Fe_2, 3SO_4, K_2SO_4 + 24H_2O$. By an "alum" is understood a sulphate of a monad element, combined with a sulphate of a diad element, crystallising in the regular system with 24 molecules of water. There are twenty-four alums now known to chemists, among which are the following:—

$Cr_2(So_4)_3, K_2So_4 24H_2O$. $Mn_2(So_4)_3, K_2So_4 24H_2O$
$Cr_2(So_4)_3, Na_2So_4 2_4H_2O, Fe_2(So_4)_3, (NH_4)_2So_4, 24H_2O$
$Cr_2(So_4)_3, Na_2So_4 24H_2O, Al_2(So_4), Li_2So_4, 24H_2O$

Fe, Al, Mn, and Cr may combine with silver, cæsium, rubidium, and thallium to form alums. Crystals of alum have been formed which contain many of the above, in separate and distinct layers one over the other on the same crystal.—GEO. G. BLACKWELL.

[49336.]—**Chrome Alum.**—Most certainly the purple crystals formed in the bichromate battery are chrome alum. "Os," p. 552, is quite right in what he says, but does not go far enough. Alum originally and properly means a compound salt, in which the sulphate of alumina combines with an alkaline sulphate. But the name is extended to any salt which consists of the two types of sulphate united with the proper quantity of water in the particular crystalline form. An alum, therefore, is a double sulphate of a tri-atomic and a monatomic base with 12 atoms of water, or, in other terms, a sesquisulphate and sulphate crystallised together. An alum is conceivable consisting of sesqui and protosulphate of iron, but I do not think it exists. However, iron, chromium, or manganese can replace aluminium. Chrome alum is a common commercial name for the substance which is used in dyeing. The iron alum which "Os" mentions is one in which iron replaces alumina—not potash, as he supposes. The zinc salt also crystallises in the battery in greenish-coloured crystals containing, I suspect, some further reduced chromium; but this only happens occasionally, when the solution has been worked to exhaustion.—SIGMA.

[49338.]—**To Mr. Lancaster.**—You can enlarge from the negatives, so that letters, &c., can be easily picked out. You want a good lens to take the negatives with, and then you could either read off with a magnifying lens, or you could enlarge from the negative and take a transparency. Let me know in what way you wish to read the figures, &c. Do you wish to retain the negatives and refer to them when wanted? or do you wish to produce copies to circulate?—W. J. LANCASTER.

[49342.]—**Waterhouse Diaphragm.**—Cut midway between the two combinations—that is, of course, between the inner surfaces of front and back combination.—W. J. LANCASTER.

[49343.]—**Crystoleum Pictures.**—There is an article upon this subject in the *Queen* for March 18, 1882, entitled "Enamelling Photographs." The photo is to be taken off the card and laid in a saucerful of sweet oil, until it becomes transparent (there is nothing said about rubbing away the back of it with sandpaper); it is then fastened to the glass with flour paste; use plenty of paste, and squeeze out the surplus at the edge. If you put on very little paste, it forms shining patches on the face of the photo. I believe there is a paper on crystoleum painting in the *Year-Book of Photography* this year.—R. H. B.

[49344.]—**Violin Queries.**—"Fiddler" may well say "I suspect this idea is a novelty, even to the musical world." For the sake of the younger and less-informed of your readers, permit me to beg "V." and all interested to insist upon proof of what "Fiddler" states before believing it. He says "a clarionet played by a street-musician will sound differently in pitch in reference to the position of the listener . . . in the next street, the pitch will be lower, and *vice versâ*, will be higher when heard close to." As a clarionet-player, permit me to contradict this statement. True, I am not a street-musician, but if he intends to limit his theories to street-musicians he begs the question. Next, he says "A wave has no return action . . . . and induce reaction." I omit part of the sentence, but it seems to me that these two phrases contradict each other. If, however, "Fiddler" means to introduce a new theory of his own in opposition to the generally-received explanation of sound, let him, at all events, collect facts on which to found his theory; otherwise, it may be said of his views, "some are new, and some are true; but what are new are not true, and what are true are not new." There is not any sound produced without reaction, without elasticity, without opposition, vibration, and all those other movements which these and other expressive words are intended to assert. Let "Fiddler" read his own sentence (which I last quoted, the beginning and end) and explain the middle of it with a drum in his mental vision, and I believe he will give us something different.—HAMPSTEAD.

[49351.]—**Corrugated Tile Roof.**—Dress it over with silicate of soda and lime, or with hot lime. Wash with a pint of linseed oil to every gallon. If tarred, it will be fearfully hot when the sun is upon it, and tar would be no use of itself.—JACK OF ALL TRADES.

[49352.]—**To Mr. Lancaster.**—The lamp I referred to was one of my own of very low resistance, just over 6 ohms, in fact; but you can have even a lower resistance than this, with lower candle power. How many cells have you? and what kind are they? Let me have this information, and I will tell you the best lamp for your purpose.—W. J. LANCASTER.

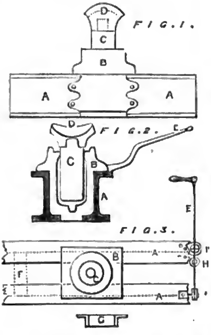
[49358.]—**Locomotive Boiler.**—It is with regret I read the reply of G. Sumner that a model of a "portable boiler which he had made would not burn charcoal," and, therefore, also not coal. Some two years ago two correspondents gave instructions how to make a boiler for "Lee's model locomotive of 1in. scale," one of whom asserted in the firebox coal could be used. The largest of these fireboxes was 6½in. by 4½in. I am anxious to make a model of a portable engine, and therefore feel some dismay at the prospective failure. Will some other correspondent favour us with his experience, and also would G. Sumner say if he filled his portable boiler with hot water before starting the fire, and dimensions and number of tubes, &c.?—J. S. M.

[49366.]—**Hydraulic Ram.**—There is no leather upon the piston, as you call it, only in the neck, in the shape of a U leather or O flanged leather, and the cylinder need not be bored only in the neck or gland; the rest may remain rough from the sand, with the exception of dressing with bitumen the while it is hot, to keep the action of the water from it, and bind the sand. (See 49393.)—JACK OF ALL TRADES.

[49392.]—**Mill-Stones.**—Opinions differ about speed and dress as best suited to the kind of wheat ground; but for stones 3ft. 6in. diameter, 120 to

130; 4ft., 110; 4ft. 6in., 90 to 100; 5ft., 80.—Ton.

[49393.]—**Bending Press.**—This, I think, you will find rather an awkward affair vertical. I am thinking I had to do with the construction of one some years ago for the same purpose. I herewith forward a sketch with dimensions, and what I think will be the cheapest way of going to work. Fig. 1.—A A is a wrought iron girder H—16in. in web, web not less than 1in. thick and 8in. flange; there will be two of these required, one being removed to show the construction of press. Cylinder B; C is the ram 10in. diameter, with a pivot upon the top for shoe for bending; the cylinder should not be less (in good cast iron) than 3in. thick in the thinnest part. Fig. 2 is a section: A, girders; B, cylinder; C, ram; D, shoe; E, lever-hand for working the pumps, of which there are two of gun-metal, one 2in. ram and the other 1in. for high-pressure, the lever F to one, and with the small pump one man of 10 stone will be able to give a pressure of from 30 to 40 tons, and a small cistern with 5 gallons of water will be all that is needed. The girders, 6ft. long, the flange cut away on one side for the cylinder to bed in, and upon the top. Fig. 3 is top plan of it: A A, girders; B, cylinder; C, ram; E, lever for pumps; F, distance pieces; G, flanged leathers; H H, pumps; I, fulcrum from which they are worked. If not plain enough publish your address for further particulars.—Jack of all Trades.



[49416.]—**Harness.**—The length of double harness, present style, is easiest got by measuring a set, to be seen in almost any district; but no "amateur" could even make a trace, the simplest part. Many who serve seven years cannot do it.—Progress.

[49439.]—**Zodiac of Denderah.**—I thank "F.R.A.S."; but, in pursuance of previous advice from him, I purchased "Astronomical Myths." I still desire something fuller and more precise. Letronne discussed it—is there nothing more recent?—Spica.

[49442.]—**Electric Clock.**—See "E. M.," Feb. 13 and 20, 1874.—F. J. R.

[49443.]—**Canoe.**—Canoes are usually decked with cedar or Honduras, about $\frac{3}{16}$in. thick. These woods may be bought in London sawn to this thickness for from 3d. to 4d. a square foot, and can be got fully 2ft. wide. The deck may be fastened to the deck-beams, which need not be more than $\frac{3}{4}$in. thick, by the ordinary copper boat-nails and roves, or by small round-headed brass screws (Nos. 5 or 6), and should be well dressed with boiled oil inside and out, and varnished with boat varnish or good copal varnish, or French-polished. The deck-beams should be cambered, so as to make the deck arched, and about 8 or 10in. apart.—Robinson Crusoe.

[49445.]—**Engine.**—A double-cylinder engine with cranks at right angles, cylinder 5in. and 10in. stroke, and 35lb. pressure, with engine making four strokes to one revolution of a 12in. drum, after deducting 20 per cent. for friction, should develop sufficient power to lift 15 or 16cwt.—W. R. Evans.

[49446.]—**Feed-Water.**—You would doubtless be able to get some benefit by fixing round the funnel, if you conveniently can, a wrought-iron casing, say about 2ft. 6in. deep, and sufficient to hold about 20 gallons, from which you could supply a constant feed to the boiler. It would be best to place the supply-pipe at bottom of casing, and take the feed from the top.—W. R. Evans.

[49447.]—**Dumb Piano.**—I should advise "Cefer" to obtain an old set of keys, which may often be picked up for a few shillings, and with a little extra weight, to make up for the absence of an action, they would answer much better for general practice than any other substitute. In this I speak from experience, for when I was an apprentice, not overburdened with pocket-money, I used to bang for hours together, and often mastered difficult passages, without either myself or my fortunate neighbours becoming weary of the melody.—W. H. Davies.

[49447.]—**Dumb Piano.**—Purchase one of Chappell and Co.'s "Digitoriums," and spend the time in exercising your fingers on it rather than in making it. As to Kalkbrenner's "guide-mains," it is merely a wood bar fixed to the front of the keyboard, level with the white keys, and on which the arms rest while practising. In his "tutor" it is stated that Novello's, 1, Berners-street, keep it for sale. I do not know if it is still made, but write and ask them. The price can't be much.—Kunst Macht Gunst.

[49450.]—**Weathercocks.**—In the northern and midland counties weather-vanes, lightning-conductors, caps and copings of high chimneys are usually repaired by men called "steeple jacks," who sometimes use a kite to get first a sling and then a cord across otherwise inaccessible heights. An advertisement in a Manchester or Blackburn paper would probably enable "Gallus" to get an estimate for the job; but 'tis risky work.—Robinson Crusoe.

[49450.]—**Weathercocks.**—When I was staying at Ross, Herefordshire, some time ago (3 or 4 years), I saw the weathercock on the spire of Ross Church, which is very high, reached by means of ladders fixed up the spire. I have no doubt a letter to the churchwardens would obtain for "Gallus" the address and terms of the men who did the job.—James Ward, Aylesbury.

[49462.]—**Lathe - Mandrel.**—Does "Mechanician" want his mandrel for step, or cone bearings? Has he a set of change wheels, and what size are they bored out to? Also, has he the headstock, its length, and thickness of verticals? If "Mechanician" will forward me these particulars, and advertise address in "E. M.," I will send him sketch, dimensioned, for what he wants.—Mechanicus.

[49464.]—**Chemical.**—"Sic Est Vita" will find most oxides to be soluble in nitric acid, either strong, or dilute or boiling. The exception to this will be the oxides of tin and antimony. From these, however, nitric acid will take up the whole of the sulphur, which may be estimated as sulphate of baryta. Care must be taken that neither lead nor baryta itself is present. As to the estimation of nitre and copper, consult any chemical work—Fresenius, for example. Now as to nickel: by dissolving this in hydrochloric acid and evaporating to dryness, and dissolving again in a large excess of acetate of ammonia, diluting with water and acidulating with a few drops of acetic acid, filtering, and then passing through the solution a current of sulphuretted hydrogen, all the nickel is thrown down as sulphide, but none of the iron, and may be collected on a filter and washed with a weak solution of sulphide of ammonium in water, and afterwards, the filter being pierced, the sulphide is washed off into a white basin; in this it is washed with water containing some sulphuretted hydrogen acidulated with very weak hydrochloric acid, and finally collected as quickly as possible on a small filter. The precipitate is now calcined in a porcelain crucible with a cover, and the filter being burnt apart, the ashes are added to the calcined sulphide; and lastly, the whole is wetted with a weak solution of carbonate of ammonia, and then gently heated to expel the same. The residue is a mixture of sub-sulphide of nickel, oxide of nickel, and the filter ash, which may be neglected. Now, sub-sulphide of nickel contains the same amount of sulphur by weight as oxide does of oxygen; they may, therefore, be weighed together as oxide, and from this the nickel may be calculated. Care should be taken that none of the metals precipitable by sulphuretted hydrogen in a weak hydrochloric acid solution are present. If they are they must first be extracted from the alloy, by solution in hydrochloric acid, precipitation by sulphuretted hydrogen, and filtration. Care must also be taken to carry on the operations as quickly as possible, particularly that of the washing of the sulphide of nickel in a weakly acidulated sulphuretted hydrogen water.—Lux.

[49466.]—**Watchmaking.**—If fourth wheel has 56 teeth, and escape-pinion 7, you will get 7,200 beats per hour, or 120 per minute, which will be the proper train. To find this out, divide number of teeth in wheels with number of leaves in the pinions—viz., centre-wheel with third pinion, third wheel with fourth pinion, fourth wheel with escape-pinion; multiply figures thus found one with the other, also with 15, number of escape-wheel, and you will find the figures as above.—G. Dreher.

[49470.]—**Leaky Boiler.**—I think you will find this receipt for cement answer your purpose. Dried clay in powder 6lb., iron filings 1lb. Make into a paste with boiled linseed-oil.—J. H. G.

[49479.]—**Chamber Organ.**—No. 3 should be a continuation of the Stopt Diapason upwards. No. 4 a soft reedy toned stop, say small-scaled gamba, if you can afford it. No. 5, a 4ft. open or stopped metal or wood flute. It is rather unusual to find the voicing of your pipes easier than the tuning: the opposite is generally the case. There is very little in tuning, and anyone with a good ear and a little practice can very soon tune very fairly. I know this is quite contrary to G. Fryer's opinion. It would not take above half a column of the "E.M.," to practically explain it all, but I would advise "G.T.B." to purchase one of the small works on "Organ Voicing and Tuning," and study for himself. If you find any difficult point, write, and I will explain.—Uranium.

[49483]. — **Massachusetts Washing.** — The Massachusetts style of washing has for three years been making headway in England. The "trade secret," so-called, can be easily known by asking Messrs. Stobbs, 150, Holborn, London, for a circular concerning the "steam washer" sold by them. The factory, I believe, is at Newcastle-on-Tyne, owned by a Mr. Mitchell.—Suds.

[49487.]—**Ostend Rabbits.**—The following appeared in the *Field* some little time ago, which may be of use to "Horner":—"Like many other things that have specially identifying names given to them, 'Ostend' rabbits are so called because they have hardly anything to do with Ostend. They are merely shipped from that port to this country. The rabbits themselves come from places a long distance from Ostend, many of them from the middle and lower provinces of France. They are not, as has been popularly supposed, bred in large numbers on farms or warrens specially designed for them. The idea that they are seems to have gained a hold on many enterprising and speculative minds, who, deploring the large sums we are in the habit of paying annually for imported rabbits, have at various times projected schemes for breeding and fattening rabbits on a large scale in this country. None of these ventures have, so far as we remember, been fraught with any success; and, indeed, in the face of the illimitable supplies at a merely nominal rate—which, it appears from the information furnished us, are always forthcoming—there is hardly any likelihood of the schemes being remunerative. The rabbits themselves are of the ordinary domestic description with which all of us are familiar, and are bred in various numbers by the farmers and labourers in the agricultural districts of Belgium and France. They can hardly be said to form an item in the various occupations which are engaged in by farmers for profit, since, although they are bred with the ultimate intention of selling them, they are nowhere cultivated in such numbers, or with that careful attention which characterises other pursuits forming a staple industry. It is even a common thing for them to be bred in twos and threes by young children. From these various sources they are collected periodically, by what we should call higglers, who go round from place to place in vehicles, and buy such as are then in a condition for killing. The smallness of transactions at this time may be estimated from the fact that the vehicles brought by the higglers are no bigger than what were known as children's "go-carts," drawn by dogs. The collections thus made, of various sizes, are disposed of to dealers, who thus secure, in the aggregate, considerable numbers. About Wednesday in each week the rabbits are killed, by an incision being made in the throat, after which they are hung up, disembowelled and skinned. They are then packed in boxes, and the greater portion of them consigned to commission agents in Ostend, though some are sent to other ports, as, for instance, Antwerp, by whom they are consigned to dealers in London, who distribute them to the retailers.—J. M. J. Dacomb.

[49488.]—**Blast and Exhaust in a Flour-Mill.**—I do not think you can get a useful reply to this. It wants well looking into to find the cause. Is this right: stive-room 10ft. high, 8ft. by 6in.? If so, I think it too small. Cannot you try some scheme with it yourself? A piece of leather tacked on so as to partly close the meal-spouts—i.e., outlet. Can you reduce the blast, and give more stive-room for exhaust?—Ton.

[49488.]—**Blast and Exhaust in a Flour Mill.**—The baffle partitions, from top to bottom, and the canvas space, probably obstruct the passage of the air, and thus cause the discharge from the meal-spouts. "Celt" should increase the size of his monkey-trunk, say, to 18in. by 11in.; he should make the stive-room as large as he possibly can; he should then make the discharge outlet from the stive-room to the exterior of the building at least 4ft. square, thus affording an outlet from the stive-room at least ten times as large in area as the inlet to the stive-room. The object of this is to enable the air to leave the stive-room at a much slower rate than it enters, thus giving time for the flour-dust to be deposited on the floor. The smaller canvas space may be dispensed with, if the outlet is made very large in area. If, however, "Celt" desires to keep the canvas for the purpose of catching the flour-dust, then the area of the canvas surface should not be less than 1,000 square feet for every square foot in area of the inlet to the stive-room. This seems a large proportion, but it is the result of good practice; and with such a proportion of canvas-surface it would only be necessary to sweep it down every 4 or 5 hours to keep the meshes clear. "Celt" will probably find it best to arrange the canvas inside the stive-room.—Laura.

[49489.]—**Lead Pencils.**—Many thanks to "W. J." for his reply: it is just what I want. The expense of making the machine is of no consequence, provided it will turn out quick and clean work. Would you mind sending a further description of how you fix the cutters eccentrically upon the spindles? A slight sketch (sectional) would be better still, if you could oblige, and the Editor kindly allow room, as the machine will be of some considerable value to me. What diameter would you advise for the grooved steel roller to form cutters? There is a great difference in the rate of output between your answer and J. Poulson's—a difference of about 60 and 30,000. I fancy pencils made after Mr. Poulson's fashion would cost too much in labour.—Uranium.

[49489.]—**Lead Pencils.**—The idea of rounding pencils with a half-round plane is rich (p. 555). The pencils are made up in wood of square, or nearly square, section, the groove being cut with a circular-saw. The two portions being glued together and allowed to dry, are then run through a rounding machine, the actual cutter being a sort of thimble, with a knife or knives on its inner surface. The pencils are then cut into suitable lengths. In America, they make them by planing up pieces of wood of the proper length, and cutting six or more grooves at equal distances apart, but only half the thickness of the plumbago. Two of these pieces are glued together when the composition is inserted, and are put into a press, whence, when dry, they go to a machine, which cuts the six or more beads and turns them out as pencils, ready to be varnished if they require it. The cutters in these machines run at a high velocity, and leave the wood with such a surface that glass-papering would roughen it.—Nun. Dor.

[49490.]—**Speed of Shafting.**—Put down the number of revolutions of the driving-shaft, and above it place the required number of revolutions of the object to be driven, in a fractional form; then get the diameters in the same manner as the rule for screw-cutting. The numerators will represent the driving-pulleys, and the denominators the driven pulleys. Or, multiply the number of revolutions required into the diameter of the driven pulley, and divide the product by the number of revolutions of the driving-shaft, and their quotient will be the required diameter for the driving-pulley. Therefore the diameter of the pulleys you require will be—drivers, 35 – 28; driven, 9 – 14. Second number of rev. of article driven = 700; first number of rev. of driving-shaft = 90. Would advise you to procure Thomas Greenwood's "Turners' and Fitters' Handbook," which will give you all particulars of speeding.—F. W. K.

[49494.]—**Chemical**—I think that "Meddler" can best mend his mixture by passing H_2S until all the colour or the iodine disappears, when the liquor may be boiled down, and the iodide crystallised out. If enough iodine is present, the liquor will not contain anything else but the iodide of sodium. This is much better than the plan given by "E. J. T." It must be remembered that iodide of sodium has a peculiar tendency to lose iodine on evaporation. Iodine should therefore be added from time to time, and the evaporation carried on as quickly as possible.—Lux.

[49496.]—**Tramways.**—"Hampshire" would see all he wishes if he could visit the celebrated quarries of Penmaenmawr, as hundreds of tons of stone are weekly brought from an altitude of some 1,600ft. down to the railway sidings, and also the jetty on the sea-coast. He would be able to get every information as to the "brake" power used here for stopping or slowing the trucks, which run on tramways laid up the mountain side, quite as steep as 1 in 10. The Editor has my address, and though I have no connection with the quarries, I should be pleased to give any help to "Hampshire" possible.—Penmaenmawr.

[49496.]—**Tramway.**—In the neighbourhood in which I live there are a great many tramways. Some will have an inclination of 45 degrees or more, and from 100 yards to three-quarters of a mile long. None of them are worked with an endless rope (none of the stone tramways; coal trams are). The full waggon is hooked to the rope at the top of the hill, and the empty at the bottom. In the middle of the tramway is what we call a turn-out, so that a single line of rails will do one half the way, and a line and a half the other half, thus ⚌ At the top of the hill is a very large grooved wheel, round which the rope runs—circular steel-wire rope, 1¼in. diameter—and a brake fixed round the wheel at the upper or lower side. And the brake has sufficient power to control over 10 tons down an incline something near 45 degrees. The tram-waggons when empty will weigh 1ton 5cwt., and the load they carry is three to four tons, and sometimes two, and sometimes three waggons will go down at a time, and the same number coming up. Size of waggon, 6ft. 6in. by 4ft. 6in. by 1ft., that is, the box; the buffers will stand 1ft. 2in. past each end; and the gauge of the tramway, 3ft. There is one quarry where the railway trucks are run up to the quarry, but there is a double line all the way up the hill. The weight of trucks, five or six tons, are loaded with the weight they are allowed to carry. They cross a highway at nearly 90 degrees, and the strips, rails (we call them strips in short) are let into grooves, and so is the rope, that is, there are curbs or crossings put parallel to the rails, and a little above them, so that when carts or other vehicles cross they do not skid. The above is in Lancashire, 22 miles from Manchester and 12 S.E. of Blackburn. Other information if needed. It needs no great engineering skill to make these tramways. Navvies at 3s. 6d. a day are the only engineers employed.—Harry Bhill.

[49497.]—**Size of Focal Image.**—The explanations given by "F.R.A.S.," in answer to the queries of "J. C. L." (pages 282 and 533), are, of course, perfectly correct, and can be easily understood by a mathematician; but as "J. C. L." may like a simpler method, which is approximately true, I send him the following:—In any text-book on geometrical optics, he will find that a point on the object, the centre of the lens, and the corresponding point on the image, are in a straight line; hence he will see that the diameter of the focal image of the sun is the chord of a circle, whose radius equals the focal length, subtended by an angle equal to that which the sun subtends at the lens. This is all perfectly accurate; but when this angle is small, as is the case when the object is a heavenly body, no great error will be made if we assume that the chord is equal to the arc. Remembering that the circumference of a circle = diameter × 3·14159 nearly, and that there are 360 × 60 minutes in a circle, the diameter of the focal image of a planet one minute of arc in diameter = (focal length × 2 × 3·14159) / (360 × 60). In the case of the sun, taking his diameter as 32′; if the focal length of the telescope is 50in., we get the diameter of the focal image to be (50 × 2 × 3·14159 × 32) / (360 × 60) = ·46542in. This result coincides with that given by "F.R.A.S." to five decimal places.—M.A.

[49499.]—**Lathe.**—This is something like making a coat to match a button. What are the head and tail stocks like? If of iron, and back-geared with a through mandrel, they might be fitted to a new double V-bed; but I am of opinion it would cost quite as much, and, after all, not be so satisfactory as a new lathe.—Mechanicus.

[49504.]—**Switches.**—I don't know whether "Dielectric" wants to know the construction of switches for Sawyer Mann, Swan, &c., lamps alone, or whether one used for the Lane-Fox lamps will be of any use; if so, I will describe it. In Fig. 1, A is a wooden switch-box, about 1½in. in diameter; B is an ebonite handle, C is a strip of brass attached rigidly to B, and when in position as in Fig. 1, making contact with two brass nuts *b b*, to which the wires are joined. *c c* are stops to prevent C C going beyond the nuts *b b*. Suppose the lamp is in direction of large arrow, then when the switch is "on" the current flows from the "lead" through the wires and switch, and back to the "return," as shown by small arrows. This switch is shown in Fig. 2 in side view; it looks very neat on a wall, if made of box or deal, and can be made for a few pence. I hope this will be some help to "Dielectric."—E. M. P., Bristol.

FIG. 1.

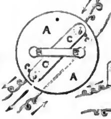
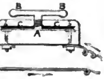


FIG. 2.



[49514.]—**Comets, &c.**—

(1)

Comet.	Period in Years.		Next Return.
Halley	76·4	......	1812
Mechain	13·78	......	1885, Sept.
D'Arrest	6·39	......	1883, June
Faye	7·413	......	1888, May
Winnecke ..	5·55	......	1886, April
Biela	6·62	......	1885, Oct.
Brorsen	5·56	......	1885, April
Eucke	3·30	......	1884, April

(2)

Comet.	Perihelion.		Aphelion.
Mechain	1·03	......	10·51
D'Arrest	1·17	......	5·72
Winnecke......	0·78	......	5·50

(3) α Cassiopeiæ, irregularly variable; γ Virginis, period at least several years; β Lyræ has two maxima and two minima, this double period being 12 days 21 hours. (4) The outer satellite of Mars is called Deimos, the inner Phobos. De Vico's comet, discovered in 1844, with an apparent period of 5¼ years, has never re-appeared.—Swithin St. Clere.

[49514.]—**Comets, &c.**—"A Young Astronomer," in his reply on p. 555, has fallen into error in connection with α Cassiopeiæ. As I pointed out in letter 20612, No. 916, that this star is variable at all has been doubted. To assign a period to a decimal of a day is, therefore, impossible. No doubt the period mentioned by "A Young Astronomer" is that given by Argelander; but, in the valuable essay written by him—and included in the third volume of Humboldt's "Cosmos"—that great observer remarks—"This star is very difficult to observe; the difference between maximum and minimum only amounts to a few gradations, and is, moreover, as variable as is the length of the period. The very different results assigned for it are attributable to these circumstances. The results which I have given represent sufficiently well the observations from 1782 to 1849, and appear to me the most probable." I observe this star whenever I get an opportunity. The following list brings that given in letter 40612 down to date:—

1882.	Oct.	19	2·95.	γ Cass., 2·4
		20	3·05	
		28	"Less than δ," therefore, 3·1 or less.	
	Nov.	9	3·05	"Very deep red-gold."
		25	3·0	
	Dec.	8	"Brighter."	
		20	2·8	α Persei 2·1.
1883.	Jan.	2	2·8	
	Feb.	8	2·7	
		14	2·75	"Light ruddy gold."
		18	2·7	

In letter 21073 *note* should be *wrote*.—S. Maitland Baird Gemmill, Glasgow, Feb. 19.

[49518.]—**Eggs and Chickens.**—Providing the egg is impregnated, the germination commences in the yelk, which is transformed gradually with the white into the perfect chicken.—Henry James.

[49519.]—**Faulty Battery.**—To Mr. Lancaster or "W. S. W."—As you obtain sparks by bringing the handles together, your battery is not "faulty." Shocks could be obtained by placing a contact-breaker in the circuit; but if you want the battery for curative purposes, no shock is required beyond that which is imparted by the sponges being moved about on the affected part, and if the complaint is "neuralgia," a shock is more likely to retard than to effect a cure. If your battery is for curative purposes, your cells are too large and too few in number, and your solution too strong. Your current would burn the skin, and yet lack penetrating power to go through the affected part.—W. S. W.

[49529.]—**Raising Water.**—Why not rig a small windmill to work a force-pump to supply a cistern?—Sigma.

[49529.]—**Raising Water.**—If you withdraw the air from the rising pipe and force air down another pipe to a closed cistern at the spring, the water will rise to the house. This labour may be done at the house, but it would save some valve-work and loss of air-pressure if you go to the spring daily and turn on the supply.—C. S.

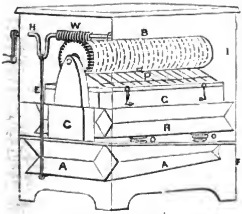
[49530.]—**Neuralgia.**—To "W. S. W."—A "binding screw" is simply a mechanical contrivance for making a metallic contact in places where it is inconvenient to solder the pieces together, and can be bought at an electrical apparatus-makers' for a few pence. The connection may be made by soldering a piece of copper wire to the last piece of copper or zinc, and inserting the other end in the binding screw along with the metallic cord, and then screwing them close together. The metallic cord can be fixed to the brass handle by twisting it once or twice round the tube and tying it, taking care that both are fairly clean. The piece of sponge is well wetted with water, and pushed into the open end of the tube.—W. S. W.

[49532.]—**Clay Models.**—Mix a little red-lead or powdered litharge and a little glycerine with your clay; the red-lead and the litharge will harden them, and the glycerine will prevent them from cracking. You do not say what colour your clay is, or what colour you want them.—J. Poulson.

[49533.]—**Organ Pneumatic Tubes.**—It would be by far your best way to inquire of a professional builder, who makes use of pneumatic tubes, as to the sizes, &c., as a casual answer might lead you wrong. I do not know of any published work on the system. If you have only one row of keys, you are causing yourself a lot of unnecessary trouble.—Uranium.

[49534.]—**Flow of Gas Through Pipes.**—I am not aware of a simple rule which will give the quantity of gas delivered by any size main at different pressures. It would appear that the actual registered delivery for any pipe is subject to so many interferences in practice that no rule will apply; the state of the internal surface of the pipe, levels, bends, speed of traverse in the main, angle of branch to main, &c., all interfere, to a greater or less extent. A table will be found of actual delivery of gas through pipes of definite sizes and lengths, as observed by Mr. Barlow, in the *Journal of Gas-Lighting*, and an abridgment of this will also be found in "Hughes on Gasworks" (Weale's rudimentary series), but both are too long to quote. To show how incidental conditions will affect results, I have had a set of jets tested by independent and accurate observers, and these, under apparently similar conditions, varied some 40 per cent. in the quantity of gas passed in the same time under the same pressure. It is, therefore, evident, that no rule can apply unless all incidental conditions are the same, which, so far as gas-pipes are concerned, cannot be possible in actual practice. — Thomas Fletcher, Museum-street, Warrington.

[49539.]—**Barrel Organ.**—Yes, "J. C." can use his 35 reeds, same as I did for a reed organ, which I made as follows:—F is the case with lid; A, bellows which is blown by rod E, from handle-crank H; upon H is fixed a worm to fit in the teeth you cut at their end of barrel, which end should be hard wood; make that end 2in. wide and ½in. larger than barrel, so that teeth cut in it will be higher to catch the worm; B, the barrel, you make in a lathe quite round, and 20in. long if for ten tunes, so that you can move it for the pins to press levers down in each tune; at I end of barrel the axles must have notches ten in number cut for alteration of tunes; P are the pallets same as in a harmonium with a piece of brass at the ends to touch the pins in barrel; G is reed chest, C is the trunk which conveys wind from A, the bellows, to R, the reservoir, which has two springs under it, O O.—Progress.



[49535.]—**Engraving on Brass**, like most other trades, is properly learned only after a long and careful practice under a master's supervision; but if "F. W. S." is a good hand at lettering, he may soon be able to do plain work. For engraving door-plates, &c., the following articles are necessary. For drawing or sketching in:—parallel squares; a pair of compasses or dividers; a T square and a steel point. For the cutting:—a hammer; several chisels; a square graver and an oil-stone. For waxing and polishing:—a medium file; a flat kitchen iron; sealing-wax; basin of cold water; one pound of white and light pumice-stone; emery paper No. 2½; a cloth buff; sperm oil and powdered bath-brick; also several rags or dusters. Drawing on:—when the lines are marked off with the compasses, draw them in with the parallels and a lead pencil. Rough out the name in pencil, then sketch in carefully, until every letter is properly spaced and proportioned. Now draw the lines firmly with the point and very carefully run over the letter, with a pen and ink, using the T square for upright strokes. Cutting:—for block lettering, only flat chisels are used, these graduate in breadth from $\frac{1}{16}$ to ¼in. at the points. The shape of the tool is shown in Figs. 1 and 2. For hairlines in Roman or Old English lettering a square chisel is used, the shape is shown in Fig. 3. Chisels can be bought from dealers in engravers' tools. A square graver is also required for finishing off: it can be bought for 2d. or 3d. When chiselling, hold the tool in the left hand at an angle that will just allow the fingers clearing the bench, and hammer sharply but steadily, taking off a thin peeling first, then deepening afterwards. When the chiselling is finished, file off the burr; draw your lines afresh and run up the sides of the letters with the graver, nicely squaring it all before waxing. Smooth with the file and emery, blow out all the dust in the cavities, then place the hot iron on the plate for one or two minutes. Break up the wax, place a bit here and there in the letters and melt them in with the lower edge of the square end of the iron. When all the letters are filled up, let the plate cool, then polish off the surplus wax and file marks with the pumice-stone, adding a plentiful supply of cold water the while. Wipe the plate dry, then emery-paper it; wipe again and buff up with the oil and bath-brick. When the plate is well polished, a brilliant lustre can be given it by rubbing off the oil with a rag and some lamp-black. Soot makes an excellent substitute for the black. In waxing, great care should be taken not to let the wax boil, as it not only discolours the wax, but forms innumerable air-bubbles, which turn into holes when polishing. Red wax requires particular care in this respect.—Engraver.

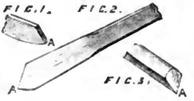


FIG. 1. FIG. 2. FIG. 3.

[49541.]—**Organette.**—"G. M." is informed right when he is told the orchestrionette is best, being more powerful, and a superior instrument every way to the "orguinette," or "organette."—Progress.

[49546.]—**Catgut.**—Catgut in the lathe will stretch; but when it does so, is most easily tightened by unhooking the ends and giving one or more extra twists to it; or, if much lengthened, it must be screwed out of the eye and cut shorter.—F.R.C.S.

[49550.]—**Photography.**—1. Nitrate of silver, 35gr.; water, 1oz. Dissolve the silver in one-half the quantity of water, mix a little iodide of potassium or other soluble iodide in a drachm or so of water, drop into the silver solution, with constant stirring, until a slight permanent milkiness is produced, add glacial acetic acid in the proportion of about 1dr. to every 20oz. of solution, pour in the remainder of the water, stir well up, filter, and the solution is ready for use. If there is any doubt as to the purity of the water used, and should time permit, it is a good plan to stand the solution in the sun for a day or two before filtration. 2. Protosulphate of iron, 15 to 20gr., a like number of minims of glacial acetic acid; water, 1oz. As the nitrate bath becomes impregnated with spirit from the collodion, this will require the addition of a little methylated spirit to make it flow smoothly, but do not add more than absolutely necessary. 3. Pyrogallic acid, 3gr.; citric acid, 3gr.; water, 1oz. Take q. s. of this to cover the plate, and add a few drops of a 20gr. solution of nitrate of silver. It is best applied immediately after washing off the iron developer, and before fixing. 4. Cyanide of potassium (about 30gr. to the ounce of water will do, I think, if it is fresh and good) of sufficient strength to clear the plate in the course of a minute or two, is best. Keep in a well-corked bottle.—W. Robinson, Jun.

[49553.]—**Battery Construction.**—For such a type it is usual to employ carbon-rods, but platinum would certainly be better, and give less trouble at the connections. As 40 or 50 cells are evidently for use as a direct current producer through the body, it will be unnecessary to put a platinum on each side of the zinc. The resistance of the body is so great, and the current so small, that the internal resistance is of no consequence. A strip of half inch width would answer, and should be cut into ribbons at the lower end, to be spread out among the carbon, some pieces of which might well be firmly attached to it. I should not advise silver, as I think it would corrode. The cell should be well filled up with the manganese. Zinc chloride would not answer, as there would be an insoluble oxy-chloride of zinc formed which would ruin the whole concern very soon; sal-ammoniac should be used. The battery is not fit for working a coil; a separate Smee or bichromate battery should be used for this. Of course, a couple of cells might be used to work one of the little pocket coils, but this does not seem to be the intention. Impressing the imagination is of some consequence, and it is desirable to let the subject see something, to give him confidence and hope.—Sigma.

[49554.]—**Diaphragm in a Refractor.**—The use of a diaphragm is to cut off all stray light, and to allow only the cone of rays to reach the eyepiece. When a telescope is used in diffused daylight, the rays pass through the object-glass in all directions; consequently, a large proportion strike against the inside of the tube, and, being reflected, interfere with the distinctness of the image. For celestial work the rays are practically parallel, so that a cap over the object-glass would answer all the purposes of a diaphragm. Its position in a telescope depends upon its aperture, which should always be a trifle less than the diameter of the cone at the same place. If, for example, it is midway between the object-glass and eyepiece, its aperture should be half that of the telescope, and so on in proportion.—Aldebaran.

[49555.]—**Glass Positive.**—Methylated spirit, benzole, or spirit of turpentine (one or other of the first two by preference) will probably effect this, and without injury to the picture.—W. Robinson, Jun.

[49556.]—**Perpetual Almanac.**—I am not prepared with a rule by which the inverse problem can be solved, which will point out the years in which Easter-day will fall on March 25, but I give all the years between A.D. 1600 and A.D. 2000, in which this occurs—A.D. 1663, 1674, 1731, 1742, 1883, 1894, 1951.—James Pearson, M.A.

[49556.]—**Perpetual Almanac.**—I should advise "Hoinos" to get Beckett's "Astronomy without Mathematics," where he will find the whole subject most clearly treated. Independently of this, the book is a very valuable and interesting one, and will well repay its cost (4s.). The doggrel quoted was discussed a few weeks since in two or three successive issues of the *Guardian*.—C. W. Bourne.

[49558.]—**Focussing Screen.**—Take two pieces of flat glass, and rub very fine emery with water between them.—F.R.C.S.

[49559.]—**Ramsden Eyepiece.**—The special advantages of this eyepiece are (1) It has its focus beyond the field-glass, which makes it invaluable for use with micrometers and other instruments where wires are used. (2) It has less spherical aberration and distortion than the Huyghenian eyepiece. (3) It gives a flat field and affords very agreeable views of the moon and planets. It is, however, not quite achromatic, and as your telescope is also non-achromatic I very much doubt whether you would obtain any advantage by its use. At any rate, if your Huyghenian eyepiece will not show you Cassini's division you will certainly fail to see it with a Ramsden.—A Young Astronomer.

[49559.]—**Ramsden Eyepiece.**—A Ramsden eyepiece does not possess special advantages for general observation; though it seems to subdue the glare of such objects as Jupiter and Mars, and allows their markings to come out more distinctly than with the Huyghenian eyepiece. Saturn is a much easier object, and its definition seems about equal in both eyepieces. A single-lens object-glass of 14ft. 6in. focus will not bear an aperture of more than 2¼in., whilst its highest possible power could not exceed 90. Cassini's division of Saturn's ring was first discovered with a non-achromatic telescope of 38ft. focus, and was picked up ten years later by Cassini, with a similar telescope of 20ft. focus under its highest power of 90, so that if Mr. Joy's telescope will really bear that power, it is quite possible he may have glimpsed it. These telescopes are, however, so cumbersome that I should strongly advise him to lay out 7s. or 8s. on a 2in. achromatic object-glass, when he could employ even a higher power with considerably greater comfort, and get better definition, and a larger field into the bargain.—Aldebaran.

[49560.] — **Collodion.** — Collodion may be thickened by simply leaving the stopper out of the bottle, for some of the ether to evaporate.—F.R.C.S.

[49560.]—**Collodion.**—Silver lacquer will answer your purpose, to be applied to the article; but the substance must be warm, and the lacquer laid on with a fine camel's-hair brush; otherwise, the work will appear dull. The lacquer can be obtained at any dealer's or manufacturer's, or if "Mechanic" finds a difficulty in obtaining the lacquer, if he advertises his address, I will inform him where he can obtain it.—J. Poulson.

[49561.]—**Weaving.**—Cartons de tissage are weaving cards, used when perforated with a pattern in the Jacquard machine. I never heard of "carding-combs" for weaving or anything else.

The "reed" was in some places called a "comb." Perhaps that is what the querist means. If so, a "self-acting reed-setting machine" for silk and other fine goods was exhibited in the late Bradford Exhibition by William Davenport, Crampton-street, Horton-lane, Bradford. I can say nothing as to the performance of this machine out of the Exhibition. KUNST MACHT GUNST.

[49561.]—**Weaving.**—The literal meaning for this is, I believe, cards for drawing—that is, the drawing up and separating the necessary cards for weaving the pattern, and these cards vary for each different pattern. There are several machines constructed to cut or punch these cards. This is a trade of itself, I believe, in England now, though formerly the different branches of the art were done under one roof by one or other member of the family. My address is advertised, for further particulars.—R. W. S.

[49562.]—**Emery Bands.**—Try a cement made of gum damar and turpentine; the proportions are half a pint of turps to half a pound of the gum, put them into a bottle, and place the bottle in warm water—not hot—until the gum is dissolved, and then use. I think this will answer your purpose; but, if it does not, it will not be expensive to give it a trial.—J. POULSON.

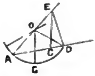
[49563.]—**The Dickens.**—The expression is doubtless a modified or softened oath, and is explained in Bailey's Dictionary, 1757, as being a contraction of "devilkins, or little devils," which is likely enough to be correct.—ACHESPE.

[49563.]—**The Dickens.**—This is said to be a corruption of the Elizabethan oath, "Ods Boddikins," which was originally God's Body. Compare "Zounds" (God's wounds) and several other of these choice expressions.—CALCULUS.

[49563.]—**The Dickens.**—Synonymous with the devil—"what the Dickens are you after." Shakespeare in the "Merry Wives of Windsor."—R. P. G.

[49565.]—**Fan for Forge.**—If "J. H. G." will look at the last page of the ENGLISH MECHANIC, Dec. 29th, 1882, No. 927, Vol. XXXVI., he will see a sketch of what he requires; but he must be careful and not infringe the patent.—J. POULSON.

[49567.]—**Mechanics.**—It is a mistake to suppose there is any force at right angles to rod at A. If so, there could be no equilibrium. Three forces act. 1st. Along A E. 2nd. Along D E at right angles to A D. 3rd. Weight of rod at its middle point. These three forces must meet a point; therefore, C is vertically under E. We have A O G $= \beta$; D O G $= \alpha$. Since A D E is a right angle, A E is a diameter, and $\therefore = 2a$.



Now $\angle$ A E C = A O G $= \beta$

$$\angle \, CAE = 90 - \frac{\alpha + \beta}{2}$$

$$\therefore ACE = 180 - 90 + \frac{\alpha + \beta}{2} - \beta$$

$$= 90 + \frac{\alpha - \beta}{2}$$

$$\text{But } \frac{AC}{AE} = \frac{\sin.\ AEC}{\sin.\ ACE} = \frac{\sin.\ \beta}{\sin.\ \left(90 + \frac{\alpha - \beta}{2}\right)}$$

$$= \frac{\sin.\ \beta}{\cos.\ \frac{1}{2}(\alpha - \beta)}$$

$$\therefore AC = AE \sin \beta \sec.\ \tfrac{1}{2}(\alpha - \beta)$$

$$2a \sin.\ \beta \sec.\ \tfrac{1}{2}(\alpha - \beta)$$

$$\therefore \text{Rod} = 4a \sin.\ \beta \sec.\ \tfrac{1}{2}(\alpha - \beta)$$

—JOHN F. WILKINSON.

[49568.]—**Litho.-Varnish.**—Thin litho. varnish is made generally from gum-kowrie, turpentine, linseed-oil, calcined copperas, red-lead, and sometimes a little sugar of lead is added.—J. POULSON.

[49568.]—**Litho.-Varnish.**—This is made by burning linseed oil—that is, the oil is boiled until it flames, and it is allowed to burn. A thick slice of bread is put in, which quickly becomes brown and supports the flame, the object being to burn all the "grease" out. Thin varnish, then, would be an oil which had been burned only to a certain extent; medium has been burned longer, and strong longer still, until the oil becomes thick and ropy.—A PRACTICAL PRINTER.

[49570.]—**Physical Change.**—W. H. Maguire surely does not see that there can be no periodic change in the constitution of our bodies, inasmuch as change—consumption and renewal of tissue—must be constantly going on. When any injury of a permanent kind takes place, the power of renewal is destroyed.—S. M. B. G.

[49570.]—**Physical Change in Seven Years.**—A boulder in a stream does not illustrate the fact, but an eddy in a stream does, as the eddy continues the same for countless years; but the particles of water are changing every instant. The tattoo marks are not removed by the minute mouths of the capillary vessels; being a foreign substance, they will have nothing to do with. We know that the nails are renewed, but if a nail is injured so as permanently to disfigure it, yet such disfigurement is permanent, just as the tattoo mark is.—SALTBURN.

[49570.]—**Physical Changes in the Human Body.**—There seems nothing difficult to understand in the case queried. The tattoo marks consist of particles of a durable pigment. The particles of which the human body is composed are not durable, but are constantly becoming decayed, dissolved, and expelled. Since, however, our bodies, so long as life exists, possess the faculty of reproducing their substance from the products of the food digested and passed into the blood, these particles are also perpetually being replaced, and little change is visible, while the pigment, not liable to decay, remains just as it was. Supposing we formed letters with gold-leaf on a perishable substance, the substance would undoubtedly perish, and the gold letters would undoubtedly remain, if undisturbed. The latter part of the query is one to which it would be absurd to attempt to give a definite answer, while, as a question of faith, it seems little suited for discussion in your columns.—ACHESPE.

[49571.]—**Electrical Resistance.**—It does not necessarily follow, I think, that the conductivity of a metal increases with its softness; the conductivity of copper being taken as 96, that of lead—a much softer metal—is only 8.—T. G. B.

[49571.]—**Electrical Resistance.**—It is true that the softer the metal the better its conductivity; but that heat softens a wire cannot be correct, since heating a wire increases its resistance. If I may suggest, you will find Prof. S. P. Thompson's "Lessons in Elementary Electricity" a most handy and useful book to have by you when dealing with electricity at any time.—E. M. P., Bristol.

[49571.]—**Electrical Resistance.**—You will just have to accept the fact. It is not of the smallest use for anyone to get up an argument with Nature, and try to persuade her she is in the wrong. Nor is it at all necessary for anyone—especially beginners—to understand the why and wherefore of every fact; we have to be content at a very early stage of inquiry into causes with the final answer—it is so. There is no connection between the facts mentioned, except that if wire is heated enough to soften it, its resistance will be permanently lowered, because its molecular structure will be altered.—SIGMA.

[49573.]—**The Gums.**—An excellent remedy for various forms of sore gums is to rinse the mouth with tepid water to which a little tincture of myrrh has been added. If the part be very sore, the tincture may be rubbed on the place with the finger, but care must be taken that none be swallowed.—HOUSEKEEPER.

[49575.]—**Sidereal Clock.**—Shorten meantime pendulum so as to gain 4 minutes in the 24 hours, and it will give sidereal time within a fraction. Sidereal time, however, is counted as 24 hours, instead of 12 hours day and 12 hours night.—F. J. R.

[49575.]—**Sidereal Clock.**—To "J. J. H."—He will find it better not to change his pendulum or weight, but to slip on a wheel of 24-teeth in place of the short hand, and let this gear with one of 48-teeth, turning on a stud screwed into the clock-face. On the broad rim of this latter wheel the hours are engraved from I. to XXIV. A fixed pointer serves to indicate them as the wheel revolves. Of course, so long as one wheel has twice as many teeth as the other, the actual number is immaterial, and the sizes of them should be so regulated as to bring the 24-hour wheel at the most convenient part of the face of the clock. The rate of the clock can be easily changed by slightly shortening the effective length of the pendulum in the usual way. The hour-wheel thus revolves under the minute hand, which is not altered.—L. L. L.

[49580.]—**Tool-Grinding.**—If "H. R." will advertise his address, I will give him all the assistance I can.—T. K. W.

[49585.]—**Verge Watch.**—Evidently the cause for faults mentioned is in the escapement. The following are among the most probable:—To much endshake to verge, verge pivot holes worn oval, hole in dovetail worn oval, escape-wheel rubbing against pendulum spring collet, or pendulum spring rubbing against plate or balance. In any of the above cases the remedy suggests itself; a large amount of information about the verge escapement is contained in the last two vols.—C. M. R.

[49586.]—**Renovating Old Silver Jewellery.**—Wash well in hot water and soda; then boil for a few minutes in a strong solution of cyanide of potassium. Wash again in warm water with soap, and dry in boxwood sawdust. Be careful with the cyanide; it is a strong poison.—HENRY JAMES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "H. C. L." has replied to 49043; J. Cooper, 49073.

48902. Observing Seat and Lamp, p. 346.
48903. Mangle Rollers, 346.
48904. Jigger Saw, 346.
48908. North London Engines, 346.
48916. Buttons, 347.
48932. Renewing Lathe Collar, 347.
48938. Harmonic Analysis, 347.
48939. Stewarton Beehive, 347.

49110. Sulphate of Magnesium and Glycerine, p. 439.
49111. Alexandra Steamer, 439.
49133. Machine for Edging Paper-hangings, 439.
49136. New Brighton Goods Engines, 439.
49152. The Planet Mercury, 440.
49154. Harp, 440.
49156. S.E.R. Engines, 440.
49165. Engine, 440.
49166. Zither, 440.
49180. Cards for Automatic Musical Instruments, 440.
49183. Show-Cases, 440.
49184. Examination, 440.
49192. Japanese Violin, 440.
49198. Comet Wells, 440.

QUERIES.

[49587.]—**Lantern Projection.**—Some time ago, I saw, at the Polytechnic Exhibition, London, representations of opaque objects (such as the works of a watch) thrown on a screen, from a magic-lantern, by a new arrangement, which enabled glass painted pictures to be dispensed with. Can it be adapted to an ordinary lantern?—GILES.

[49588.]—**Electro-Chemical Telegraph.**—Could you oblige me by plain directions for compounding a fluid most suitable for moistening the paper for the above, and may I ask if there be any dry method besides carbonised paper, which is such a dirty process? I have inquired and searched in vain in all directions—this must be my apology. I fancy there may be something preferable to ferrocyanide of potassium.—E. R. COLBY.

[49589.]—**Painting Room.**—A large room used for kitchen purposes has, by a former tenant, been allowed to get very filthy-looking about the walls and ceiling; I have determined to paint the walls (colour-wash is now on). Will some kind reader kindly say how I should prepare the walls for the paint? Shall I have to wash off the dirty colour-wash, &c.? If required to be distempered, or size, say what with, and the proper paint for first coat? The ceiling is now very yellow and blistered, how can I get it to a good white? Any information will be a favour through "ours."—CYMRA.

[49590.]—**Whitening Dial.**—How can I whiten or plate a clock dial, 9in. diameter by 1½in wide, so as to be a dead white, like those seen in old cabinet clocks?—BRASS.

[49591.]—**Polishing Brass Goods.**—Can anyone say how brass goods, such as dishes, fenders, shovels, &c., are burnished, or name a good modern work where the process is described? Any information on the above will greatly oblige.—BRASS.

[49592.]—**To Mr. A. H. Allen.**—Which is cheapest method of making the sulphocyanides? How can I separate sulphide of potassium and chloride of potassium from sulphocyanides, and detect the same in presence of each other?—K. C. N. S.

[49593.]—**Painting Bicycle.**—I want to paint the bright spokes of a bicycle black. Is any preparation of the steel necessary, and what colour should be used? Any information would be thankfully received by—CYCLIST.

[49594.]—**Firebox of Traction Engine.**—I have a traction engine, and the firebox has two cracks, from stay to stay. I studded them with 1 studs two years since, and now it wants doing again. Had I better put a piece in; and if so, the best way to do it?—ENGINE DRIVER.

[49595.]—**Patching Boiler.**—Will some of our able correspondents be kind enough to inform me the best way to patch the internal tube of a Cornish boiler? The tube is about 2ft. diameter; we never have more than 15lb. to the inch; there is a hole about 1½in. where the plug has been, but it has been plated, and the plate has burnt through?—YOUNG WHEELWRIGHT.

[49596.]—**Boiler Query.**—I am going to make a vertical boiler for an engine 2in. bore, 3½in. stroke. Which of the following would answer best? One with a cast-iron case or shell, ⅛in. thick iron tube for chimney, brazed to a copper firebox 1-16 thick with three cross tubes; the inside tube bolted to case at bottom of firebox and fastened at top with a nut to screw on to the chimney? I send a drawing of the above, and like it best because you can get at the inside any time. Would one 2ft. high and 15in diameter be large enough, and what pressure would the above stand? I have been advised to get a wrought-iron shell and rivet firebox and chimney to it. Which do you think will be best and most suitable for the above engine, and also stand the most pressure?—D. B. Siddall.

[49597.]—**Sick Child.**—To Dr. Allinson.—In letter No. 21048, page 523, the doctor says, "I also wish I had the dieting of children. I would make our children a very lively, jolly and sprightly set." Now I should very much like his advice for my oldest child, a girl 10 years old on 13th of next month, March. She is very thin and white, and a poor eater; we let her have anything she can eat; some mornings she will not eat anything at breakfast, and she is dull and moping about, and moans and sweats in her sleep. Our doctor has ordered cod-liver-oil for her, but we cannot get her to take it. I have just thought of trying "Congreve's medicine"; but on reading the above letter, I thought I should like the Doctor's advice.—H. P.

[49598.]—**L. & S.W. Engines.**—To "W. P. B."—Can you give me a few particulars, including numbers, date, and dimensions of engines Canute, Lacy, Colossus, Achilles, Nelson, Circe, and Sirius? Also stating the builders, and if double-framed, please mention. Also, would you be kind enough to give the same particulars of the engines mentioned in your answer to query 49438, p. 454?—Meteor.

[49599.]—**Refractor.**—I have a refractor of 40in. focus and 2¾in. o.g. With its present eyepiece it has a power of 60. Can this be increased with advantage, and if so, to what extent?—S. E.

[49600.]—**Clear Varnish for Fretwork.**—Would any of your correspondents give me a recipe for clear varnish for fretwork?—J. P.

[49601.]—**Polarising Eyepiece.**—May I ask "F.R.A.S." to favour us with a diagram of Merz's form, described by him on p. 451? Do both, or only one, of the black glass mirrors revolve?—O. V.

[49602.]—**Lathe-Bed, &c.—To "O. J. L."**—I have been rather anxious to see the description of the lathe with the slide-rest arranged on V's on the front side, but hitherto it has not appeared. Can you favour us with a sketch of the arrangement?—O. V.

[49603.]—**Gear-Wheels.**—What is the best possible outline for the teeth of the back-gear wheels of a lathe, so that they shall work together with the least possible friction and noise?—O. V.

[49604.]—**Stamping on Velvet.**—I want to put some gilt letters on velvet. I have the dies, and I know that they require beating before using. But how is the gold leaf prepared? Is it with glair as for leather? It sticks about the velvet.—Omega.

[49605.]—**Daniell Battery.**—I shall be glad if Mr. Lancaster will tell me what sort of lamp it is he mentions in reply 48999; how many of Daniell cells would it require to light one of 25-candle power, the best size for cells, and for how long they would work the lamp without recharging?—E. J. R.

[49606.]—**Sound in Iron Rods.**—Will a thin rod of iron of ⅜in. diam., suspended from point to point, convey sounds produced by striking it at one end distinctly 400 or 500 yards?—R. R.

[49607.]—**Legal—Contracts.**—Under section 109 of the Companies Clauses Act, 1845, an officer gives security by a bond in which A. is named as his bondsman. A. is a director of the Co. Does A., by becoming a bondsman, also become interested in a contract with the Co., and if so, would he, under sect. 86, cease to be a director?—Chatham.

[49608.]—**On Refractors in General.**—The article by Prof. H. L. Smith "On Telescopes of Short Focal Length" in the English Mechanic of January 25, 1883, is exceedingly interesting, and the 4¼in. refractor (therein described) made by Mr. John Byrne, of New York, must be a "real beauty," both for definition and handiness, and its focal length of only 38in. is certainly astonishing. If the extreme shortness of focal length be as great an advantage as Prof. Smith declares it to be, both as regards clear definition of star discs and easy separation of "doubles" by very low powers, I should think that our A 1 makers of refracting telescopes—viz.: Mr. Dallmeyer and Mr. Wray, will hardly feel perfectly satisfied till they have produced fine achromatic object-glasses of, say, 4in. aperture and only 4ft. focus, which would, I believe, reduce the average focal length of such apertures by about 12in.—a thing greatly to be desired. . . . . A good deal has been written in the Mechanic from time to time as to the performances of good 6in. Calver reflectors, and these communications are always interesting; but I, for one, should be greatly obliged if one or two possessors of really good 4in. refractors would favour "us" with a short account of what they can do with this aperture (which is, I believe, a very favourite size with Mr. Wray). For instance: Can they divide "doubles" of about 1" apart? How many stars can they see in the trapezium of Orion? How many of Saturn's satellites are generally visible, and is the "crape-ring" easy? &c., &c.—William Locke Lancaster.

[49609.]—**Dynamo-Machine.**—To "Sigma."—I have a dynamo-machine by Gramme, and the armature belonging to it does not seem to give me enough power for electrotyping. It is wound with No. 16 wire, and is 6in. in diameter. The wire on F.M.'s seems to be about 12 B.W.G., and about 40lb. in weight. Would you be kind enough to give me your opinion about the following description of an armature I propose making for production of quantity?—The iron will be the softest I can get, and will be made up on the mouse-mill principle, divided into eight segments, and wound with No. 10 cotton-covered. I want to deposit copper very rapidly for printing surfaces upon metallic cathodes, so that I do not want much intensity. Will you say if I shall get what I require out of the above armature, or would it be necessary to divide the ring into more parts? I have a gas-engine to drive my dynamo.—W. T. W.

[49610.]—**Internal Resistance of Daniell Cell.**—What should be the resistance of a Daniell cell, quart size? Will the resistance vary as the distance between the zinc and copper cylinders?—C. W.

[49611.]—**Air-Guns.**—Will some correspondent kindly give me a thorough description of the modern air-gun: the exact dimensions, with sketch, of each particular part, and the best way to set about making one? I would prefer it to shoot shot rather than bullets alone; but both would be better if not too formidable a job for an amateur.—Blunderbuss.

[49612.]—**London Preliminary Scientific.**—What are the best books for cramming for the Preliminary Scientific (M.B.) London University next July: botany, physics, chemistry, zoology? Being grounded in the bookwork, would a month's practical work, with assistance, before exam. be likely to get one through?—A Worker.

[49613.]—**Boiler.**—I have a wrought-iron boiler 2ft. by 1ft. In the lower half are five tubes 1¾in. diam., to admit gas-jets. Will some reader kindly suggest a form of jet that will raise and maintain steam? Ordinary jets, with or without burners, will not do. The tubes are open from end to end.—Slocum Podger.

[49614.]—**Dynamo-Machine.**—Supposing one to be driven by a water-wheel, charging accumulators for light at night, can it be left to itself during the day, or must there be an attendant within reach?—Antares.

[49615.]—**Glastonbury Thorn.**—A recent query about the Rose of Jericho reminds me of the quality ascribed to the Glastonbury thorn of blooming in mid-winter. The tradition concerning this thorn-tree is that, how Joseph of Arimathea, travelling through the land to preach the Gospel, reached Glastonbury, where, fixing his pilgrim staff into the ground, it forthwith took root and blossomed. Annually, say our Somersetshire peasantry, unwonted budding at Christmas time may be witnessed at Glastonbury, and in other places fortunate enough to possess offshoots of the legendary staff of St. Joseph. In former times the branches and leaves of the thorn became a lucrative item in the exports of the busy merchants of Bristol. King James and Queen Anne, and many of the nobility, even as late as the early Hanoverian Monarchs, are said to have paid large sums for cuttings from the holy thorn. The English Benedictine Monastery at Downside, in the same county, and not above twelve or thirteen miles from Glastonbury, possesses a fine specimen of the thorn. Many visitors to Downside during the long winter of 1881, according to a letter in last Friday's *Tablet*, recollect the sight of this tree in full blossom, when all around was covered with snow. Can anyone tell us anything about this remarkable thorn?—Trypho.

[49616.]—**Red Colour for Preserves and Confectionery.**—What is the best harmless red colour for jams and confections? Can the red juice of the beet be used for this purpose?—J. T. T.

[49617.]—**Flavours, Artificial, for Confectionery.**—Can any correspondent give instructions how to prepare the following flavours without fruit? Gooseberry, apple, black currant, pear, strawberry, or give name of any book treating on the subject, price and publisher's name also wished.—J. T. T.

[49618.]—**Singing in the Head.**—Would Dr. Edmunds please say if anything serious may result from the following. I have the last five months had a constant singing or sound like as if the escape of steam was at some distance. I have always enjoyed good health, aged 42. What is the cause of it? I saw it in this paper that it was the forerunner of something serious. I do not smoke, and only drink half a pint of ale a day (no spirits).—Phoebus.

[49619.]—**Tonite.**—Can any reader tell me what is the composition of the explosive called "Tonite," what is its power, as compared with other explosives? Why is it that it will not explode, without detonator, under any circumstances, even when put in the fire, or mixed with gunpowder?—T. W. B.

[49620.]—**Organ.**—To "Uranium."—I have a small organ in which stop diapason, principal, fifteenth (all wood) go through, open diapason, and dulcians from fiddle G. Desiring more power, what would you recommend in place of Dul., whose soundboard seems intended for a broader-scale stop, I should prefer a powerful stop going to C C?—Darwen.

[49621.]—**Warped Timber.**—Will some one kindly give me the rules that regulate the warp in timbers, and also mention the titles of several good books on the subject, and much oblige—M. M. I. Sc. S.

[49622.]—**Cotton Bands.**—Can any correspondent tell me of a cheap composition for rendering cotton spindle bands impervious to moisture in the atmosphere? Something to prevent them contracting in damp weather, without injuring the cotton?—Kunst Macht Gunst.

[49623.]—**Nervousness and Sleeplessness.**—To Dr. Edmunds.—I should be truly grateful to Dr. Edmunds if he would tell me what I can take for the above? I am 38 years of age, and the mother of six children, the oldest 14 years and the youngest 18 months. I am so dreadfully nervous, that when it thunders and lightens, or the wind is very high, I am almost in fits. I cannot help it: it acts as an aperient as well. I have no time, with my large family and so much to do, to take any outdoor exercise, which, no doubt, makes me worse. I get so irritable with the children for the least thing, my life is miserable to me. I was always timid, but nothing to what I am now. Can anything be done for me? I am not in a position to go to any great expense, as I am the wife of a struggling tradesman?—F. P.

[49624.]—**Lot's Wife.**—The recent queries about Joshua and the Sun and Moon and a sermon I heard last Sunday have prompted the query as to whether any scientific explanation has ever been offered of the conversion of Lot's Wife into a pillar of salt. I hope no one will reply from a theological point of view. The great charm of "ours" to me is that questions like these may be put and answered without the religious (!) bitterness which characterises some journals, or the vulgar and irreverent atheism which sullies others—to me worse than superstition itself.—Agathos.

[49625.]—**Lithography—Grained Plates.**—Could any of your readers kindly inform me how I could produce different qualities of grains with rosin on steel plates? I have tried to get the same by means of a box with rosin-powder put into, and blown about with a pair of bellows, inserting the plate before the rosin had time to settle at bottom of box; but have only managed to get a grain equal to that which one can get from the litho. stone with sea-sand. I want to reach different textures, if possible, suitable for chromo-litho. printing.—F. N. Bazaary.

[49626.]—**Centrifugal Pump.**—Would some fellow-reader of "ours" tell me what speed a centrifugal pump with a fan 12in. diam. would have to run at to raise 1,200 gallons of water per minute? It is required to put 30ft. of vertical suction pipe and 50ft. of vertical delivery pipe. I have a doubt if it would draw it 30ft. Would it be better if I were to lower the pump 10ft.? Information on this, together with a rule for getting at same, would greatly oblige—A Youngster.

[49627.]—**Moonlight Effects with the Lantern.**—Could any of our photographic friends inform me how I could produce moonlight effects for the lantern? I take wet plate transparencies. I get brighter pictures thus than by dry-plate contact printing. Could I do it by superfusing another glass, or must a fresh transparency be taken, and how?—Barium.

[49628.]—**Coloured Enamels on Brass.**—I want to enamel a piece of brass blue and green. Can any reader tell me the composition of the two enamels, and what flux to use?—H. Regent.

[49629.]—**Carbon in Place of Copper.**—Referring to "Sigma's" reply in last issue of the "E. M.," in which he says "platinised is the best," will he kindly state in what respects it is superior to pure platinum, and where platinised silver is used as the negative element, with a mixture of peroxide of manganese and carbon, and a solution of sal-ammoniac? How long before the platinising would be required to be renewed, the battery working a medical coil, say 30 minutes at a time daily?—Medicus.

[49630.]—**Spirit Varnishes.**—Why are they always put into stone bottles? Is there any chemical action takes place if put into tinware? If so, what is the chemical action?—Petro.

[49631.]—**Thinning White Hard Varnish.**—How should white hard varnish, which I wish to use for a fishing-rod, be thinned when too thick? I ask because I was told at one shop in Long Acre to use turpentine, and at another methylated spirit. They can't both be right. I imagined all these varnishes were made with turpentine—of which they smell.—F.R.C.S.

[49632.]—**"Drop" Measurement.**—How is a drop measured scientifically, and what difference is there between a drop, as commonly understood, and the minim of the pharmacists? The London, Edinburgh, and Dublin Parmacopœiæ give 1 minim=1 fluid grain, and the French Codex 1 goutte or drop, 1 (fluid) grain; but I would ask—A fluid grain of what? And under what conditions this, the lowest fluid measure, is obtained? I have read somewhere that the natural drops of any one kind of liquid are in quantity equal to each other, and if that is so, are not the terms "big," "huge," "tiny," as applied to drops, mere metaphorical expressions? If any reader of "ours" can furnish the information sought above, he will greatly oblige—J. E. A.

[49633.]—**Scent Fountains.**—Would some kind reader of this magazine say how these are made? I think they are cast in a mould. If so, would some person say how I could make a mould, as I have a drilling-machine and materials, most likely, for same. I mean those scent fountains which are sold at fairs and galas, which are composed of lead, and are squeezed to force the contents out.—Semper Eadem.

[49634.]—**Dialyte.**—I was glad to see a few lines from Herbert Ingall in your issue of the 9th inst., referring to his 10in. "dialyte telescope." May I venture to ask him to give such a description of the instrument as will enable an intelligent person to make one? And also his opinion of its performance, and the work he is able to do with it in comparison with other instruments.—E. P., Liverpool.

[49635.]—**Yacht Keel.**—I propose to add about a ton to the lead keel of my yacht, in the following way. I shall put a wooden mould around present keel, leaving a space of two inches between inside of mould and sides of keel. Then pour in melted lead into space left, 2 or 3 cwt. at a time. Present keel is about 16ft. long, and 4 to 8in. thick. I shall be obliged if any correspondent will say whether the lead will burn itself on to the present keel, or would it be necessary to put bolts inside of keel before pouring? Also, whether the hot metal would be likely to distort present keel, or the heat to damage the planking above it?—X. Y. Z.

[49636.]—**Ejectment.**—A. lets a cottage to B. at a rent of 3s., B. dies, leaving a widow who refuses to give up possession. Cannot A. recover possession in the Co. C. under the 50th Sec. of the 19 and 20 Vic. c. 108? Or must action in ejectment be entered under the C. C. A. 1867, c. 142?—Stylus.

[49637.]—**Launch Engine.**—I have a launch engine which is 8in. stroke, 6½ bore; I am going to compound it. I should be much obliged to any of our correspondents if they would inform me what size the high-pressure cylinder should be, as I am going to have the one I have for the low pressure? What size boiler? When compounded, what power shall I have? Engine 125 revolutions, boiler 60lb. pressure.—W. B. S.

[49638.]—**Joints for Hot-Water Pipes.**—Will any of our readers give me their experience in using Portland cement, or Spence's patent metal for making joints of cast-iron hot-water pipe, instead of iron borings? Would it stand the expansion and contraction? The pipe will be about 40ft. high?—Hot-Water.

[49639.]—**Eyelids.**—To Dr. Edmunds.—For the past twelve months I have been annoyed with my right upper eyelid, which towards night partly closes, seems puffed, and requires little or no effort to keep it entirely closed. If you can tell me of anything to strengthen the muscles (if weakness is the cause), I shall feel obliged. Cold water seems to make it worse. There is no pain or loss of sight attached to the defect. All I suffer from is the knowing that I have apparently two odd eyes.—Weazle Eyes.

[49640.]—**Soldiers and their Debts.**—To Mr. Wetherfield.—Is a man who enlists into the army for a short period legally freed by our laws from any and all debts he may have contracted previous to the date of his enlistment?—E. Beattie.

[49641.]—**L. & N.W.R. Engines.**—Wanted principal dimensions of the new eight-wheel side-tanks for goods traffic, and of the following goods engines :—114, 660, 1239, 1371, 1649, and 2289. Also a list of a few goods engines which have wheels 5ft. 2in., and cylinders 17in. by 24in.—J. L. F.

[49642.]—**Gamma Cassiopeiæ.**—When, where, and by whom, was the variability of this star ascertained?—Algol.

[49643.]—**Ground Pipeclay.**—Will "Practical Colour-maker" kindly inform me what colours he can strike upon ground pipeclay? I saw his answer to machine tenter recommending the article in No. 892, Vol. XXXV., p. 178, query 46227? Also, will he kindly inform me how to make chrome yellow?—J. Poulson.

[49644.]—**Siemens Dynamo-Machine.**—Some short time ago there appeared in the pages of this journal several interesting articles on dynamos. These induced me to construct one on the above principle; but not with very satisfactory results, and I now seek a little friendly assistance through these pages, and the better to enable them to do so beg to give a description of how my machine is constructed. The armature.—A piece of soft wrought-iron tube 3¾in. diam., ⅛in. thick, 9in. long, turned and bored true, and fitted with German silver ends, and 1in. shaft. The cylinder, beyond winding, was coated over with guttapercha in solution, and then the wire was wound on in 18 divisions of seven wires wide on the circumference by six deep, having about 33yd. in each section No. 16 double cotton-covered, and the ends joined to the commutator by solder, and afterwards tried by battery for current, and the connections found good. The field-magnets.—These are ten in number, five top and five bottom, made from charcoal iron 1⅞in. by ⅜in. by 18in. long, and wound with 40lb. No. 10 double covered wire, well insulated, and afterwards bored out to 5¼in. diam. to receive armature. The wire on field is 5in. broad, and three wires thick. The two ends, north and south, are carried to the brushes, and well joined up; but run the machine which way I may, it only gives very poor results. The brushes have been placed first one side and the other, and in every position I could think of—both with batteries and without, and in every instance with poor results. Two things suggest themselves to me—either my field wants more wire on, or armature far less; but before trying any more experiments, I will wait and see if any correspondent will kindly assist me.—Engineer.

[49645.]—**Local Boards and their Powers.**—Would any readers kindly give the result of any experience or knowledge they may possess in regard to conditions similar to the following (which are sought to be imposed by a local board upon an owner of certain property, which is furnished with water from a private source, the main pipe for supplying which is laid across and along one side of the public highway)—viz., "2. That no branches shall be put into the said pipe, or any extension thereof made without the consent of the local board." "5. That in case the local board shall construct any sewer or drain, or lay any pipe, or do any other act, and shall in consequence thereof deem it necessary to interfere with the said pipe, or any branches therefrom, or if they shall require any alterations to be made therein, I undertake to make such alterations in the said pipe or branches as the said local board may require, or they may do what they deem necessary, and I undertake to hold them harmless from any consequences of such interference, and will pay to them on demand all costs, damages, and expenses which they may be put to in the exercise of such right." "6. That in case the local board shall provide water for their district, and be willing to supply the above property, I undertake, on request of the local board, to discontinue the said pipe and supply of water thereby, and if required by them to remove the pipe and restore and make good to the satisfaction of their surveyor the public highway, which may be interfered with by such removal." The pipes referred to have been laid for a period of several years, and that without the said local board having either suggested or sought to impose (till now) any condition whatever. The search for water and making of the works cost the then owner several hundred pounds, and there being no public supply of water in the district, it formed a most important factor in determining the purchase value of the property to the present owner. The water is exceptionally pure and good in quality, and unfailing in its constancy of supply. Under these circumstances has the local board power to enforce the "6th clause" without making reasonable compensation to the owner of his outlay, and the prospective value to him of his water-rights?—J.

M. B. Proskauer, in the *Zeitschrift für Analytische Chemie*, publishes his mode of determining the sulphurous acid in the air. He passes a known volume of air through fifty or seventy-five cubic centimètres of a solution of permanganate of potash containing fifteen grammes of the crystalline salt per litre, placed in a Bunsen bulb-tube. To prevent the formation of hydrosulphuric acid, two or three cubic centimètres of hydrochloric acid are added.

At the request of Mr. C. Greaves, M.I.C.E., several observations were taken at frequent intervals during last summer, of the temperature of the surface of the pond a quarter of a mile distant from the Kew Observatory. More recently a float has been moored in the centre carrying maximum and minimum thermometers immersed just below the water-line. This is hauled to the shore every morning at 9 a.m., and the temperatures recorded.

M. Brown-Sequard communicated to the Academy of Sciences at its last sitting a note on the phenomenon which he has named "inhibition." This term he applied when a lesion at a point of the nervous system causes the sudden suspension of some function or activity of nerve force. If, for instance, the nervous system be injured at some essential but relatively remote point, the suspension of respiration, calorification, circulation, &c., may follow.

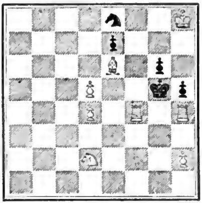
CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden W.C.

PROBLEM DCCCXXIII.—By J. Thursby.

(From forthcoming collection.)

Black.



White. [8+5

White to play and mate in three moves.

Solution to 821.

White.	*Black.*
1. R to B 6	1. Kt to K 2 (a)
2. B takes P (dis ch)	2. Kt takes P
3. B to Q 6 mate	
	(a) 1. Kt to K 3
2. K takes Kt	2. P moves
3. R takes P mate	
	(b) 1. P moves
2. R takes P (ch)	2. K moves
3. R mates	

Game in Mr. Nash's Tourney :—

(King's Bishop's Gambit.)

	W. T. Pierce.	A. Smith
1.	P-K 4	P-K 4
2.	P-K B 4	P takes P
3.	B-B 4	P-Q 4
4.	B takes P	Kt-K B 3
5.	Kt-Q B 3	P-B 3 (a)
6.	B-Kt 3	B-K 3
7.	B takes B	P takes B
8.	P-K 5	K Kt-Q 2
9.	Kt-B 3	P-K Kt 4
10.	P-Q 4	P-Kt 5
11.	Castles (b)	P takes Kt
12.	Q takes P	Q-K 2
13.	B takes P	K-Q sq
14.	Kt-K 4	K-B 2
15.	Kt-Q 6	Kt-B 3 (c)
16.	P-Q 5 (d)	Kt-Kt 5 (e)
17.	Kt-Kt 5 (ch)	K-B sq (f)
18.	P-Q 6	Q-B 2
19.	Kt-B 7	B-Q Kt sq
20.	Q-Q B 3 (g)	Kt-Q 4
21.	Kt takes Kt	P takes Kt
22.	P-K 6	B-Kt 2
23.	P takes Q	B takes Q
24.	P takes B	P-Q Kt 4
25.	Q R-K sq	K-Kt 2
26.	R-K 7	Q R-Q sq
27.	B-B 6	K-B sq
28.	R takes Kt	K takes R
29.	P Queens	K R takes Q
30.	R takes R	R takes R
31.	B takes R	P-Q R 4
32.	P-K Kt 4	Resigns

Notes by Mr. Nash.

(a) $\frac{}{\text{B-Q Kt 5}}$ is generally played here. Wormald recommends 5. B-Q 3 as best, with the continuation 6. $\frac{\text{P-Q 4}}{\text{Castles}}$ 7. $\frac{\text{K Kt-K 2}}{\text{P-B 6}}$ 8. $\frac{\text{P takes P}}{\text{Kt-R 4}}$, &c.

(b) Mr. Pierce delights in sacrifices of this sort, and when he indulges in them disaster generally awaits his luckless opponent.

(c) It is difficult to say what is best to be done here. Perhaps 15. Kt-Kt 3 followed by 16. Q Kt-Q 2 in reply to 16. P-Q B 4 would have been better than the text move.

(d) Beautiful play.

(e) Black's game becomes more difficult; taking the Pawn would lead to speedy calamity. Perhaps something may be said for 16. B-Kt 2, for if white reply 17. Kt-Kt 5 (ch) black can reply 17. K-Kt 3, and shortly bring his Q R into play at K B sq.

(f) This move imprisons the Q R; K-Kt 3, or even K-Kt sq., with the intention of giving up the useless R for the Kt, would have been preferable.

(g) Black's prospects, which have been far from bright for some moves past, are now wholly dispelled by this move.

NOTICES TO CORRESPONDENTS.

Correct solutions to 821 by Fitz Allan, R. A. B., P. C. Pavitt (no variations); T. B. Rowland; J. B., of Boxford, to 821 and 822 by R. T. Adams.

R. A. B.—In your solution of 822, you have overlooked that Black can check by 1. $\frac{}{\text{Kt-K 4}}$.

R. J. Adams.—(1) The solution Tourney commences when the Tourney problems begin to be published. (2) Yes. (3) A "cook" is a second solution.

J. B. of Boxford.—Thanks for the problems, but we must request you to favour us with the solutions.

R. L. R.—We shall be glad to receive original problems, but those you have sent are from Alexandre's collection. We prefer problems without conditions.

J. A. Mills.—Sui-mate received with thanks.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 21, and unacknowledged elsewhere :—

T. Knowles.—W. J. Smullen.—R. S. Smyth.—Dr. Elliott.—T. C. Stack.—J. Wolstenholme.—Mawson and Swann.—W. A. Hunter.—J. B. Spicer.—H. Lovegrove.—Metallurgist.—H. G.—A Reader.—Sawdust.—J. M.—O. H. L.—S. Calton.—Failure.—A. E. B. Smith.—An Anxious Mother.—One who Suffers.—J. S. Sadler.—Abroad.—Kœnig.—An Old Subscriber.—Automatic Vacuum.—C. W.—A. S. L.—Ex.—D. H. G.—A Fellow of the Royal Astronomical Society.—Rev. J. Pearson.—Ne Sutor Ultra Crepidam.—Libertus.—Rojam Semaj.

A NEW VOLUME.

The next number will be the last of Volume XXXVI. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXVI. will be published on March 23, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

Inquirer. (We do not understand what you mean by "lubricate small quantities of oil," but sperm or lard oil is the best for your purpose, and you can improve it by putting some shavings of clean lead in and hanging in the sunshine.)—J. W. Morgan. (You appear to be aware of the objection, which we are afraid is fatal to your scheme. We think it would spoil the draught so far as the side and bottom flues are concerned. You should put the suggestion to some of the boiler-makers; perhaps they have tried it.)—Bucknummus. (That query would be answered by another. What do you mean by spring gun? It is usually understood as an ordinary gun, which is fired by means of a spring. The trespasser is supposed to stumble against a wire or string, which pulls the trigger.)—G. N. T. (Do you think it would be altogether fair to our readers to repeat information already given every time a querist wishes to know how to make a steam-engine or a balloon? As a matter of fact, we continually insert queries which are likely to bring out fresh information, and even repeat old matter when the numbers are out of print, and the matter is in frequent demand. Surely it is not too much to ask that those who want the information should invest 2½d. while the number is still in print. 2. Why should it? The small piece will adhere, but the attractive force, never very great at any distance, is absorbed by the armature. 3. If you will say whether you mean transmitter or receiver, we will endeavour to quote a page where you will find the instructions; but you should look through the indices.)—Harry Bull. (The water gives strong evidence of sewage contamination, and is very hard.)—T. E. L. (Probably you mean the lightning safety wire.)—J. Jones. (There is ample space to build a studio; but you should endeavour to see some of those used by first-rate photographers. Any specific question would, no doubt, be answered; but instructions to build outright would be too much, especially as so much has been said in back volumes.)—Amateur Mechanic. (Use putty coloured to suit, or plaster of Paris. For polishing, see pp. 175, 227, Vol. XXXII. It is cheaper to buy polishes or varnishes.)—T. L. (There have been so many replies that it is impossible for us to discover the one you mean. The box is to be made red-hot, and it is lime, not sawdust, that is used. See p. 264, Vol. XXXII. Is it "smalts" you mean? That is really a powdered glass which contains oxide of cobalt. "Swartz" is a corruption of the German word for black, probably in your case referring to moulder's blacking—charcoal-powder.)—Cymba. (Papers on harmonium construction in many places in back volumes; and American organ in Vol. XXVI. If you had asked for some specific information, we might have been able to have referred you to a given page. However, on p. 433, Vol. XXXV., you will find directions for making a pan.)—A Retired Engineer. (Answers to your questions would require a whole number. If you will refer to indices, you will find references to pages on which much of the information will be found.)—C. W. (For electro-magnets, see p. 336, Vol. XXXIV.)—A Farmer. (See the *Pharmaceutical Journal* for July 23, 1881; or p. 229, Vol. XXI.)—X. Y. Z. (We have no means of helping you. We have not the volume mentioned.)—M. N. (A medical man must examine him.)—Charles

Murray. (There is nothing better than castor-oil.)—Brooks. (The whole process of galvanising consists in making the iron thoroughly clean and dipping it into a bath of melted zinc. The zinc is usually covered with a thick coat of sal-ammoniac; the iron is pickled in sulphuric acid and water, and scrubbed with sand and water. It is preferably made hot before dipping.)—Harden. (The best book was advertised last week on p. ix. 2. We do not know unless you could find the information in back numbers. We have had a good deal about clock repairing.)—An Amateur. (See a reply on p. 551, last week.)—J. Green. (The best remedy is to have a perforated pipe into which the steam could flow; but probably you know the subject is a difficult one. There is a good deal about it in back volumes.)—Telegraph. (For directions how to make single-needle telegraph, see p. 77, Vol. XXVIII.; or pp. 70, 231, Vol. XXII. Illustrations in each instance.)—W. H. C. (How to make a pantagraph on pp. 173, 197, Vol. XXVII.)—A Contributor. (You can dissolve it in bisulphide of carbon or mineral naphtha, or masticate it with suitable machinery. See the papers on the Indiarubber and Guttapercha Industries in Vol. XXXI.)—Comet. (We repeat that it should not be used with articles of copper and brass, unless you will use a very weak solution and be very rapid in immersing in the "quick" and transferring to the plating bath. See p. 6, Vol. XXXIII., and the index to Vol. XXXIV. There is no necessity for its use when the articles are properly cleaned, except in the cases mentioned. To make the salt you name, dissolve bicyanide of mercury in water containing an equivalent of cyanide of potassium.)—R. H. Blyth. (Note forwarded to contributor, who will translate anything further that appears. No further particulars given at present. At the moment, we forget the address of the publisher, but any of the large newsagents would procure the paper for you.)—Blackwater. (Instructions in the art of dissolving-view painting in Vol. XII. Those articles were revised and published in cheap form by Mr. Hughes, whose advertisement you will find on p. ii., last week.)—Rorkatoo. (Not clear what you mean. The lids are soldered on, and a small hole left in the centre, with a little flap underneath. When the cooking process is believed to be complete and air excluded by the steam, the hole is closed by a drop of solder.)—J. M. B. (Look through the back volumes. You want a shocking coil, for which see the indices.)—Pneumatic. (The tube pneumatic action for organs was illustrated in No. 719.)—Dynamo. (Wait until the papers are finished. 2. Merely a sum. The wire must be put on until the coil is as thick as the core, and for four-fifths of the length. The diameter finished will thus be 3in. There are about 46ft. to the pound of the size named naked wire. The covering would make a slight difference.)—Walter Farrer. (Look up recent replies and queries. Such questions involve a great deal of calculation, and we cannot spare space for all sizes in which such machines can be made.)—Ignoramus. (Your curious questions are by no means original, though they may have originated, so far as you are concerned, in your own brain. No, is the answer to both of the first two questions. 2. Very possibly explosive shells fired near rain-clouds would cause them to "drop their moisture." 3. Even if lying on the ground, the pressure of the atmosphere is just as much at the under as at the upper surface. The questions are by no means absurd, and they show that you "think" about things; but they are all answered in the textbooks.)—Puzzled One. (So it does; but you can test its attractive power only at the end. Cut off the end to reach the centre, and the centre is thereby removed back to the middle of the part left.)—Working Joiner. (Much too vague for anyone to give a sketch. What water-power have you? If sufficient to drive a dynamo, you can easily transmit the power over 120 yards to another dynamo, which will act as the motor for your saw. We believe you can see the transmission actually at work near Glasgow.)—An Amateur. (See some recent replies on wood-staining—one last week.)—O. P. Q. (Did you not understand our allusion to a mast and a boat? In a telescope, the object-glass is *the* important part; eyepieces are secondary considerations. You could do as you say, and we believe Messrs. Lancaster issue printed instructions for making such tubes and fitting up telescopes. If you get a good o.g., no doubt your eyepiece end will come in useful.)—Jno. Bracewell. (Borings and sal-ammoniac ought to make tight joints; but what is the liquid stored in the tank?)—Small Boy. (It is done by hydrofluoric acid. See p. 376, this volume, and the indices generally. No kiln or oven either.)—W. O. (The best machine of the type is Charsley's velociman, made by Singer, and illustrated on p. 541, Vol. XXXIV.)—W. E. J. (The calculations are not yet completed. There is no reason to suppose that any great difference will be found from previous calculations.)—C. M. R. (Answered many times. Any of the usual purgatives, and an enema of salt and water after they have operated. 2. The surveyor of taxes in your district will give an answer to your questions, and receive any payments for the licenses.)—Newportonian. (We believe so; but the goldfinch is the best cross. 2. Merely a large kind of rabbit, we believe.)—Modeller. (Size the cardboard, and coat with paper varnish. What you complain of is not the fault of the varnish, but something at the other end of the brush.)—J. K. (Mostly with scratch-brush; but you will find a variety of processes in back numbers. 2. The best remedy is to frequently wash the scalp, and have the hair frequently cut—not necessarily short.)—Young Mechanic. (There is no really satisfactory method of splicing rubber tires; but holes can be filled with rubber paste, and they can be spliced with the same and bound round. Cement is either guttapercha or rubber solution, or such compounds as Prout's elastic glue.)—J. W. W. (See previous answer. The wheel can only be made to run true by making it straight. Scrape or burn off old paint before repainting; or, if not patchy, rub over with glass-paper.)—Amateur Electrician. (See the list of Back Numbers, published in this column the first week in every month. One of your questions was actually answered last week.)—A Young Student of Electricity. (Have you tried to solder it on? Because that is the cheapest metal which does not corrode.)—A Youth. (See p. 290, last volume, and the indices generally. The correspondent named cannot be continually repeating the same instructions, even if we could afford space.)—One of Three. (All the arrangements have been recently illustrated in the papers on Dynamo-electric Machines.)—L. W. D. (It consumes 5ft. with a pressure of 12-tenths. What it would consume at a pressure of 2½in. is a matter for experiment. If you want such a pressure as that, cannot you test by your meter? Yes, in a dry meter, if the leather is allowed to get stiff, the registration is "fast.")—W. E. Plummer. (You can only wash them. Use sponge and a little turpentine, going over lightly and leaving to dry. The paint named tarnishes in the atmosphere. Why not regild? Full directions in No. 870, p. 286.)—Bookworm. ("Phosphorous," as you spell it, is partially soluble in the essential oils, and entirely, we believe, in bisulphide of carbon. If you are so foolish as to take it into your stomach, you must put up with the consequences. Pharmaceutical chemists sell suitable preparations of phosphorus, which are useful when ordered by a physician.)—Varicosus. (They cannot be cured; they are as much a permanent infirmity as the loss of a leg.)—T. M. (The complaint will have no effect on the progeny. See several replies on the subject in last volume.)—T. Swift. (They are all mixtures of tartaric acid and sesquicarbonate of soda in proportion of about 2 parts of former to three of latter. The bulk is increased by the addition of an equal quantity of farina (potato starch), and some add alum.)—M.M.I.Sc.S. (Lockwood and Co. have just issued "Details of Machinery," by Campin, which may suit; but get Calvert's catalogue, Great Jackson-street, Manchester, and you will find a list.)—W. Thompson. (By indicator cards or by calculation, formula for which is given in all the books and many times in back volumes. The horse-power depends on the size of the cylinders and the power of the boiler. The tractive force depends on the power of the engine, size of driving-wheel, and condition of rails. It also depends very materially on the adhesion or grip of the wheels on the rails, for if they persistently slip tractive force is nothing, whatever horse-power may be. On the contrary, it is illustrated in Mr. Reynolds's book and in Vol. XXVII. The second name introduced some modifications in details.)—Downs. (We do not understand what you mean by "polish." A very important ingredient is elbow-grease. In back numbers you will find a variety of recipes for cleaning and polishing the metals named.)—Karl. (Carbonate of soda and tartaric acid are most easily obtained and most perfectly harmless.)—A. Sura. (Illustrations of the Voss machine on pp. 285, 329, this volume, and sundry letters and replies in recent numbers.)—Progress. (Why not ask the dealer who supplied it? For measuring power of eyepieces, see the indices, or pp. 240, 253, Vol. XXXIV. 2. You can deduct the rent of the actual business premises, just as you can premiums paid for life insurance, but we are afraid it will not put you outside the limits.)—Printing Machine Minder. (There is very little to learn about driving them—more about cleaning them. No doubt you could obtain all the information by calling at the office or writing to the company.)—Jos. Leakey. (Have you tried it? That is the simplest way.)—A New Reader. (Better buy the crucible; for the furnace, see pp. 97, 120, Vol. XXXIV.)—Beno Fisto. (Photo. background, pp. 166, 191, 574, Vol. XXXII.; emulsion, p. 155, last volume.)—Belfast. (Hastings, Bournemouth, Falmouth, or any southern seaport. We have no room for reasons or to indicate books. Your medical man will best judge your special requirements.)—Freedom. (You had better consult a solicitor. We cannot say what the "custom" is in your case, or what it would cost to enfranchise the property.)—Moulder. (You would certainly do better and save money in the long run with an Otto gas-engine.)—Anxious. (Acetic acid applied cautiously every night will cure corns.)—Enquirer. (A. had better defy the German lottery broker to do his worst. His threats are probably mere bounce. At the same time, people who are fools enough to be gulled by these advertisements need not be surprised at any unpleasant consequences.)—A. T. B. (Of course, if you have inherited the five houses, you are bound to pay any equitable charges on them. You had better consult a solicitor at once.)—C. J. E. (A county-court summons at once. His advertisement shall not appear till we have had an explanation. Yours is the second complaint.)—Student. (The query had been answered, and we had no more space to spare for the matter asked about. Nor have we for the subject you now propose, which was discussed threadbare many volumes back.)—J. W. C. A. (We are sorry you are aggrieved; but we cannot really remember every question in Todhunter, and the instances of rejection you mention were problems we happened at once to recognise. We object to mathematical queries, because they occupy much space, are difficult to print correctly, interest comparatively few readers, and give trouble to others needlessly. Frequently, as with yourself this week, when a reply has been passed for insertion, or has appeared, a much neater solution arrives, which we are compelled to throw away because sufficient space has already been given, and because we hesitate to go the expense of several diagrams for replies to one question.)—J. Chamberlain. (It would not be necessary, but it would be advisable. Registration at Stationers' Hall is useful simply as evidence that you claimed the title at such a date. 2. See Mr. Pearson's reply to another querist in this number.)

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

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Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately flavoured beverage which may save us many heavy doctor's bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in Packets, labelled "James Epps and Co., Homœopathic Chemists, London."—Also makers of Epps's Chocolate Essence.

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All kinds of **Scientific Apparatus** exchanged for others.—Caplatzi, Science Depot and Exchange.—Chenies street, Tottenham-court-road.

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What offers for ninety-six **Metal**, 28 stopped **Wood** Organ Pipes, gilt organ front, keys, &c.?—Tanner, Rusham road, Horsham.

Organ Pipes, Windchests, Bellows, new and second-hand, ready for performer. Harmonium Pedal Chest and Reeds. Exchange.—W. Johnson, 12, Moxley, Wednesbury.

Pair of 4ft. **Grinding Stones**, runner French, suitable for pig-feed, worth £8. Likewise 17lb. 4in. elastic banding.—Bate, Belbroughton, Stourbridge.

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Writing.—Window Tickets, Show-Cards, Sign Boards, &c., written in a superior style, in exchange for any article of general use.—M. A. Kaw, 4, Hesse-terrace, Commercial-road, Peckham, S.E.

Wanted, **Surveyor's Level**, dumpy or otherwise, in exchange for first class Miner's Dial, by Archbutt, cost £15.—Thomas, 20, High-street, Newport, Mon.

Make your own Gas.—Complete Apparatus for six lights, new condition, worth £4; works by a weight; exchange.—Bate, Belbroughton, Stourbridge.

Portable Equatorial Reflecting **Telescope**, by Horne and Thornthwaite, opticians to the Royal Observatories, made expressly for a nobleman F.R.A.S., and adapted for selenographic and planetary observation and comet finding; can be used for photographing lunar changes; 6in. mirror, 71in. focus, movable hour circle, revolving body, slow motion, finder, one eyepiece, well adapted for India; universal adjustment screws to stand, fitted with two compact cases, mirror alone cost £10. Offers to 15 pounds.—Apply, D. Milligan, 21, Spencer-road, Wandsworth, London.

Splendid ¼-plate **Camera and Lens**, by Millet, with 3 double dark slides for dry plates: in exchange for Prize Demas Fretsaw and Lathe combined, or offers.—H. Nash, Wath, Rotherham.

"**Royal Dictionary Cyclopædia.**" 15 books, quite new, very handsomely bound, full of maps and engravings. Will exchange for harmonium or old piano.—J. Blaca, 147, Kentish Town-road, N.W.

Waltham **Watch**, best timekeeper in the world, only just new, jewelled lever movement, gold hands, crystal face in massive nickel silver cases, with warranty. What offers?—Hutchinson, Millbridge, Liversedge, Yorkshire.

Telescope, astronomical and terrestrial, 1½ object-glass, three draws, two eyepieces. Also large pair of Opera-glasses, new. Will exchange for Double-barrelled Breechloading Gun. Offers wanted.—Hutchinson, Liversedge, Yorkshire.

Launch Engine, new, cylinders 6 inches diameter, stroke 6 inches, gun-metal pump, reversing gear. Can have a two or three blade propeller or screw, coupling on crank-shaft for keying screw shaft to engine. Exchange a Power Screwing Machine, or would sell at half price, value £10.—Mayhew, Engineer, 8, Langney-road, Eastbourne.

Engine (Horizontal), cylinder 2 inches diameter, stroke 3 inches, with governors, complete. Exchange or sell. See above.—Mayhew, 8, Langney-road, Eastbourne.

Lathe, iron standards, 6ft. planed bed, 6in. centre, bend grooved for gut, cylinder, back centre, large five-speed fly-wheel, double crank, adjustable centres, equal to new. Exchange. See above, or sell.—Mayhew, 8, Langney-road, Eastbourne.

Tricycle wanted, in exchange for 52in. Club Bicycle, good condition, suspension spring, oval backbone, difference in cash.—Swan, Lauriston, Bromley, Kent.

Wanted, immediately, in exchange for **Books**, or Black Coat and Vest, a pair of Tinman's Bending Rollers.—Eng-lish, Towcester.

"**National Encyclopædia.**" unbound, £6 10s. Exchanged for "Science Gossip," "Intellectual Observer," Natural History books to same amount.—Singleton, Victoria-street, Rusholme, Manchester.

Britannia Co.'s **Lathe**, Fretsaw, Saw-Bench, and Drilling Machine, all the apparatus in first-class order, emery-wheels and drills, &c., cost £7 15s. Cash or exchange.—J. B. S., 29, Scarsdale Villas, Kensington.

Wanted, a Lancaster's **Instantograph**, ¼-plate, complete, and in good condition. Offers.—C. C. Forster, Frenchgate, Richmond, Yorks.

Wanted, about 5in. iron **Lathe**, screw-cutting preferred. Will give in exchange either new Tricycle or Bicycles. State wants.—C. T. C., 65, Freehold-street, Hull.

Bicycles and Tricycles. Will give in exchange for Lathe, or any Engineer's Tools.—C. T. C., 65, Freehold-street, Hull.

54in. and 52in. **Bicycles**. Will give either in exchange for good iron Lathe, about 5in. centre. The bicycles have ball bearings.—C. T. C., 65, Freehold-street, Hull.

Organette, cost £6 10s., with 100ft. music rollers on, 48in. Bicycle, will give in exchange for any engineer's tools.—C. T. C., 65, Freehold-street, Hull.

Violin, very fine specimen, by Collin-Mezzin, value £12. What offers?—F. B. C., 18, Market-place, Newark.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, MARCH 2, 1883.

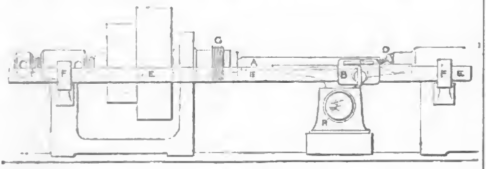
MR. EDISON ON STORAGE BATTERIES.

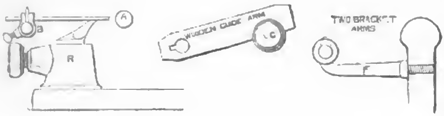
SIMULTANEOUSLY with the publication of the specification of Mr. C. F. Brush, of Cleveland, Ohio, relating to his invention of "Secondary Batteries or Magazines of Electricity," American papers have arrived containing reports of an "interview" with Mr. Edison, in which that gentleman expressed his opinion about storage batteries. Mr. Brush's specification is a formidable affair, as may be judged from the fact that the Patent Office prices it at 2s. 4d. It is illustrated by twenty-one figures, and there are altogether fifty-six "claims," so that there ought to be a good many novel points about the latest invention which the correspondents of the daily papers have taken under their patronage. For the benefit of those who may wish to procure a copy of what must, in one sense, be a remarkable document, we may mention that the No. is 3108, July 1, 1882. To return for the moment, however, to Mr. Edison's opinion, if we may accept the report in a Boston paper, he did not mince matters, but declared the storage battery to be, in his opinion, a "catch-penny, a sensation, a mechanism for swindling by stocking companies." Such expressions do not come well from their alleged author, however true they may be, especially when we learn further on that in 1879 Mr. Edison himself patented a storage battery and a method of using it in a system, after having rung all the changes on it. His plates were prepared like Planté's, which though more tedious to "form," are better than some of recent invention. After his first ebullition of scornful criticism we gather from the report that Mr. Edison went into the matter in the scientific spirit, and whether he is correct in all his assertions or not, his views may be commended to the attention of those who are studying the question from the standpoint of investigators. "Scientifically, storage is all right, but, commercially, as absolute a failure as one can imagine. You can store it [electric energy] and hold it, but it is gradually lost, and will all go in time." Those words express tersely enough views which have been put forward in this country and in the columns of this paper, but Mr. Edison goes on to explain why the storage battery is a failure commercially. The efficiency which at the commencement is very much below that of the current employed to charge the battery, begins to diminish after a certain number of charges, and by-and-by, the capacity also declines. Owing to corrosion of the sustaining plates, the effects of local action, and other causes, the yearly depreciation is, according to Mr. Edison, not less than 30 per cent. of the first cost if used daily, so that in four years, at the outside, a complete outfit of new accumulators will be needed wherever the system of storing electric energy is adopted for the purpose of lighting a building. It may, we think, be safely assumed that the storage batteries do deteriorate in power with age (quite independently, be it noted, of whether they are utilised or not); but if the rate of depreciation is anything like that stated by Mr. Edison, the cost of accumulators will be practically prohibitive in any commercial scheme of electric-lighting. A very simple idea is that with a plant of dynamos and storage batteries, the former could be used during the day to charge the latter, and then during the night both could be used to supply current to the lamps, which is quite true; but, then, remembering what has been said above, and the additional fact that the storage batteries will cost about twice as much as the plant which is to store them, it is not easy to find where the economy can come in. As Mr. Edison puts it, you interpose between the source of the current and the place where it is to be used, a "thing in which there is a loss both in charging and discharging, and a loss in standing"—losses which exhibit an increasing ratio as the battery gets older. On pp. 495, 516, it will have been observed that others are aware of the economical disadvantages of the accumulator; but it may be that in the future some one will discover a means of storing electric energy without waste, or with that minimum amount of waste which would not entirely discount the obvious advantage of the storage battery in the matter of convenience. The storage battery has its legitimate uses, but we suspect that where it is a question of the economical utilisation of energy it will have no place in the system. During the last four or five years, inventions of storage batteries have been almost pouring into the Patent Office, and we have given descriptions of many of the most promising in these columns; but a few months ago rumours began to circulate that Mr. Brush, the inventor of the well-known dynamo, had invented a secondary battery which would prove to be superior to anything else of the kind. We find now that the invention relates not only to processes of "forming" the plates and coating them with suitable deposits, but also to the arrangements of the elements, and to devices for automatically controlling the current employed in charging the batteries, and for measuring and recording the energy spent in the work. The process of forming the battery adopted by Mr. Brush is based on that of Planté—that is, he employs lead plates; but he clearly explains wherein the defects of the earlier arrangements lie. In the ordinary form of secondary battery lead plates are immersed in dilute sulphuric acid, and when a current is passed through, a coating of peroxide of lead is formed on one of the plates, while the other occludes the hydrogen of the water. The exciting current being withdrawn, the two lead-plates will act as the elements of a cell, a current flowing between them, but in this case from the peroxidised plate, or in the reverse direction. The action of the exciting current becomes slower as the coating of the peroxide grows thicker; and if it is withdrawn without a circuit being completed between the plates, it is found that local action takes place between the coating of peroxide and the metallic lead supporting it, and the former is gradually reduced to a lower oxidation until it becomes unable to yield a secondary current, unless recharged or reoxidised. That explains the loss of charge, and also the high resistance of the plates after long standing, for peroxide of lead loses conducting power with loss of oxygen. The charging must be reversed in order to render both plates spongy, so that the hydrogen plate may have a storage capacity equal to that of the oxygen plate. The combination of the hydrogen and oxygen, when the battery is discharging, forms pure water in the spongy coats of the plates, and that also increases the resistance. Further, the production of a coating of peroxide, and its reduction in volume on discharge, causes the lead plate to present alternately a convex and concave surface to the opposite plate, and the result is that in time the coating peels off in parts, while every time the battery is worked sulphate of lead is formed, which exercises a deleterious influence. According to Mr. Brush, these disadvantages are avoided by the use of three plates, or two plates and a metallic cell. Thus two plates are so arranged that they receive a coating of peroxide, while the hydrogen plate is placed between them; or the two plates may be put into a lead vessel, and both may be previously prepared by coating with a layer of oxide of lead, mixed with caustic alkali, instead of the other salts of lead, which are stated to yield non-coherent deposits. Corrugated, ribbed, and perforated plates are well adapted to retain the coating, but they should be prepared by having the hollow part filled with protoxide of lead, either dry or in paste, and then immersing them horizontally in a bath of caustic soda or potash. When the depressions of one side are properly coated, the plate is reversed, and the other side treated in the same manner. Mr. Brush says that plates of other metals than lead may be used—such as gold or platinum, in which cases the peroxide cannot lose its oxygen by local action. Another method of coating the plates with porous metal is to reduce the lead from the oxide and other salts by a reducing gas at a temperature insufficient to cause fusion. Mr. Brush accomplishes that by placing the plates in a chamber in a horizontal position, charging them with lead oxide or nitrate, and passing through the chamber carbonic oxide mixed with nitrogen. The coating thus produced is said to possess properties differing from those of spongy lead, and from those of the electrical deposit of lead, having many of the advantages of the latter while being free from the disadvantages of the spongy lead. Plates may also be made of metallic lead and the oxide, pressed together into a compact and firmly coherent body, the veins of oxide ramifying and extending through it, and forming channels for the passage of the electrical action. Other methods of forming plates are described by Mr. Brush; but so far as we can see, the disadvantages of the storage battery still remain sufficiently numerous and serious to warrant much of the criticism to which it has been recently subjected by Mr. Edison.

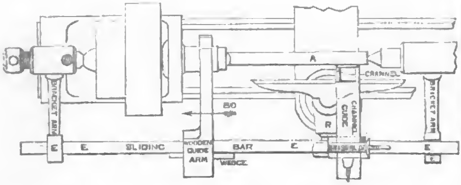
SCREW-MANIA.

I AM now enabled, by the kind assistance of a friend, to send correct working drawings of a device for cutting screws without overhead apparatus or traversing mandrel. Although I have had something to do with it, I do not by any means claim this invention, which, in its principle, is similar to one or two contrivances which have appeared in these pages. But, whereas these were imperfect and experimental in character, the present is a practical and satisfactory arrangement that has been tried and proved. The gentleman to whom I am indebted for the drawings, the same "F. A. M." who cunningly worked out the looped figures of the geared Rose-engine, has had the immense advantage of a mechanical engineer's training, and his opinion upon the merits of this device is, therefore, reliable. To all intents and purposes, the arrangement exactly reverses that of a traversing mandrel lathe. The guides are slipped on to a chuck, and by their action give traverse to a round bar of iron or steel, moving in guides attached to bracket-arms, which are screwed into the near side of the mandrel head and movable poppet. I have lettered the plan and elevation alike, and to the former I have also added distinctive labels to explain the better the several details.

The lathe represented is that to which the apparatus was actually attached, and is of a heavier kind than the majority of amateur's lathes. The bed has, as will be seen, two upright V-edges instead of flats. I have reduced the drawings to half the size of the originals, which, I hope, will enable them to appear without further reduction, as good drawings are sure to suffer in the process of diminution. Possibly these have already suffered deterioration, in spite of the care exercised in copying them. The arms F F may be cast or wrought. After being bored out at the enlarged ends to fit the sliding-bar nicely, one bearing thus made is to be sawn open. The right-hand one is shown thus in the plan-drawing. This enables the bar, with its attachments, to be rigged up or dismounted in a few seconds. No such appliance will be of practical use unless this can be done. Taking a hint from the old-fashioned French lathes, whose merits I ventured to uphold in a recent number, the inventor has used wooden guide-arms, hollowed out to form the ½ nut. Such ½ nut is, therefore, like the Tunbridge ones, only it rests upon, instead of lying underneath, the mandrel and guide-screw. I should be inclined either to replace this wooden arm by metal, with a properly-cut ½ nut, or to make the arm alone of metal, with a frame at the end in which to place a block of wood for the ½ nut. The wooden arm will nevertheless answer as a ready expedient. "F. A. M." has suggested another modification—viz., to have an arm with a slot at the end, in which a circular disc of ½ nuts is to be fitted precisely like those of the ordinary traversing mandrel-lathe, so that any one of the pitches may be turned downwards to fit the screw ferrule selected. This is a capital idea, and in such case one metal arm will, without being changed, furnish in a moment the ½ nut that is required. This plan should, I think, be adopted. The tool-holding arrangement required some little consideration, because the apparatus is intended to be essentially a hand-chasing one, not a machine, and no slide-rest or overhead is required. In the details, B is a slide of brass seen also in the elevation and plan. It fits the bar, and can be clamped at any part of it by a thumb-screw. The upper part of this is made with a slot, marked C in the elevation, and in this slides the actual tool-holder containing a channel to fit the chaser. The holder can be clamped by a side-screw. It is necessary to have some such arrangement as this, owing to the varying size of work requiring the tool to have a power of to-and-fro adjustment to suit each case. The hand-rest forms a support for this tool-slide, and its top should be filed even if it has been much bruised. In the details where A is the work in cross-section, this will be clearly seen. There is nothing here that a workman of moderate ability could find difficult to make. The arms can be forged by any smith, who would also, if necessary, bore the holes for the sliding-bar, and cut the screws. Cast-iron ones would, perhaps, be preferable; but are by no means essential. Preferably, the screw-ferrules should slide on a key fitted to several chucks, as well as on the square-hole chuck, here illustrated. This will not be a work of great difficulty, nor will it need a great deal of time; but the more chucks that are so fitted the better, as the apparatus is meant for all sorts of work, and not only for such as is usually held between centres. For inside work it is considered sufficient to grasp the tool held across the channel-slide gripping the two together; but it is easy, if preferred, to make a separate tool-holder with a channel across it, which is, of course, the better plan when the apparatus is designed as a permanency. It was doubted at the onset whether the ½ nut would keep down on its guide when a strain was put upon it, by the action of the tool upon the work, and means were sought to keep it down by a spring or other device. But on trial the expedient proved unnecessary, and it was found that attention could be concentrated upon the cutting tool, while the guide was left to take care of itself. A little consideration, in fact, will show that the tendency of the work as it revolves in contact with the tool is to press the latter downwards, which tendency is simultaneously exercised on the ½ nut, owing to the communication between them through the medium of the traversing bar. I would caution the experimenter that this bar will be found a matter of absolute necessity. There was a device once in vogue in which the chasing tool and a tracer to gear with the screw, were made as a hand-tool to be merely laid upon the rest. The point of the tracer was to be carried along by the guide-screw, and the opposite point or tool was to trace the thread. The device is simple enough; but practically it failed because attention was required at the same instant at the two extremities of this tool, and as this was impossible, the tracing point generally refused to remain for more than a second or two at a time in the thread of the screw, and of course the tool at once shared in this vagary, and escaped its work. For tracing a screw, in fact, great steadiness is needed in the apparatus, whatever form it may take and the present device, be it understood, is not intended for cutting screws in metal, or in any way taking the place of the orthodox screw-cutting lathe, but only for executing that class of work which is usually done by the lathe with traversing mandrel. It has some advantages which the latter has not, especially in being suited for cutting screws on work held between centres which the traversing mandrels fail to accomplish. It has also the advantage of cheapness, and last, but most important, of being very easy to set up and remove. The arms F F may, as a rule, remain, as they will not be often in the way; and then one has but to put the bar in the left-hand bearing, and drop the other end into the open bearing or the right-hand arm, and all is ready, supposing the right ferrule and ½ nut already selected. As regards the former, it will have been put on the chuck in which the proposed work is to be held before turning is commenced, and it is for this reason that I have suggested fitting the ferrules to most of the chucks in general use—such as the cup-chuck, square-hole, and taper-screw. All these can be turned down to gauge to fit the ferrule, and a little feather (a short screw inserted and filed up square) will prevent the ferrules from turning round. The latter will, of course, have a slot cut in each, after having been bored out accurately to slip over the chucks.







Although, as I have already stated, it was found that the ½ nut keeps down on its guide-screw without special appliance, yet it is quite possible that under the strain of a deeper cut upon a coarser thread there might be a tendency in the arm to rise. If such were found to be the case, or if such defect is feared in the construction of the apparatus, I would suggest weighting the lever-arm, or putting a short pin on the front of the bed at B O (of the plan drawing), and linking over it and over the arm, or over a stud, an indiarubber ring, but so that it shall not tend to drag the arm backwards, so as to resist its traverse, but the contrary, pulling (if at all) in the direction of the arrow. The weight would be, of course, free from any tendency of this kind, and would only bear directly downwards. I should certainly not lengthen the arm beyond the ½ nut in order to hang a weight on there, because the shorter this arm is kept the less will be the tendency to pull out of the perpendicular. It must be remembered that in any screwing apparatus stiffness of the working parts is a very important consideration. Still, in any such apparatus devised for cutting screws in wood, or not in any harder material than brass, we may exercise more freedom in this respect than in devising appliances for such work as usually falls to a self-acting lathe. The present device is in every respect to be judged as a mere handy and cheap substitute for a traversing mandrel.

O. J. L.

WATCH CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 198.)

Horizontal Escapement.

I WILL now give you the full illustrations and workings of the horizontal escapement, which consists of Fig. 66—viz., A is the hairspring collet, B is the top *plug*, C in the bottom *plug*, D is the hollow part of the cylinder, E is bottom jewel hole, F is bottom endstone, G is brass collar, which carries the balance and hairspring collet, as represented, and into which the cylinder is driven; H is balance, I is escape or steel wheel, J is steel wheel pinion, K is escape jewel hole, L is escape bar, M screw, N steady-pins, O is inside of cylinder, P is the top jewel-hole and endstone.

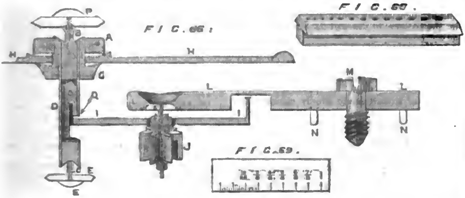


FIG. 66.

FIG. 69.

FIG. 68.

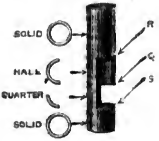


FIG. 67.

The body of the cylinder consists of a small steel tube, which is cut as shown, Fig. 67; the solid part at top holds top plug, the half is where the escape-wheel works, the quarter is cut away to make room for the escape-wheel to pass under the point, as shown by the arrow Q. Now look at Fig. 70: this is the escape-wheel; the half circles which are drawn against the wedges (or pallets as they are called), are intended to represent the working part of the cylinder.

Now, if you follow me from A to O, I will endeavour to show you how the pallets work the cylinder. At A you will see that the pallet is just about to leave the inside of the cylinder, B it is partly out, C it is just out, and D is just ready to drop on to the outside, where it will slide while the balance exhausts the power it has just received from the pallet at A, B, and C. At E the balance has returned, and the pallet is just about to wedge its way into the inside; at F it is partly in, at G it is a little further in, at H it has just dropped on to the inside of the cylinder, where it will ride or slide until it has lost the power it has just received from F and G; the bottom part of the half-circle (see where the arrow points on Fig. 66) passes over the escape-wheel; that is the reason why the quarter is cut away. This is what is called the *detent* side of the escapement, which I will explain further on. At I the cylinder has returned, and the pallet is just ready to work, at J it is forcing its way out, at K still *driving*, at L just out, and M is just about to drop on the other side; N is just dropped on the outside. Now we will return to Fig. 66, and you will see that where the arrow points (Q) just passes clear of the escape-wheel, which allows the point of the pallet to slide on the inside of the cylinder: you must particularly understand that if the cylinder touched any other part of the escape-wheel besides the pallet, the watch would not go; now the two plugs B and C are turned out of a piece of steel wire, and driven into the cylinder—the top plug from the outside and the bottom plug from the inside; the top plug must not enter the cylinder beyond where the arrow points at R, and the bottom plug must not come higher than where the arrow points at S. The rose G is made of brass, and carries balance and hairspring collet. The piece is cut out of the escape-wheel bar, to allow the pallets of escape-wheel to pass free, and great care should be taken to see that the escape-wheel does not touch. Now, if you read this once or twice, and take particular notice of the drawings, you ought to be able to understand the workings of the escapement. We will now go into repairing the escapement: we will first take the escape-wheel bar (L, Fig. 66). First, cut a piece of brass by the old one, as follows:—First, remove the jewel hole from the broken bar, and put it away carefully, so that you will be sure to find it; now remove guard-pins (N, Fig. 66); now soft-solder the broken pieces of the bar to a piece of brass of the same thickness, next drill the holes for the guard-pins and screw, and then mark round the bar. Now unsolder the old bar and cut out the new bar in accordance with your marking; next screw the new bar into its place, and score off and fit jewel as explained in my article on jewel and endstones.

Escape-wheel pinions are very easily fitted, and if you go the right way to work, and take particular notice of the following advice, you succeed. When you make a measurement, prove it, and then prove it again, and while you are cutting keep offering it; it is better to offer it 20 times than to cut off too much. Make yourself thoroughly acquainted with what you are about to do before you begin, and keep your mind on your job. Now, the first thing we have to do is to remove the old pinion from wheel; you therefore place the wheel on a stake (Fig. 68) in a hole nearest the size of the pinion, and with a small round punch drive the pinion out; now put this broken pinion into a pill-box, and send it to a material dealer, with instructions for a new pinion, and enclose 7d. in stamps; in return you will get a pinion already centred and partly made; now take the rose from a pivot-drill, and broach or rimer the hole until you can press the pinion-leaves—i.e., cogs, into it, then with a horsehair bow turn the part down to fit the hole in the escape-wheel, where the old pinion came out; it should be able to enter about half-way, so as to allow for it being driven in, as it is not riveted; now see if it is too long, if so, you must cut back the shoulder until you get the right length. Now make your pivots, next place your new pinion over a small hole in the riveting-stake, put the wheel in its place, and with a hollow punch and a small hammer drive it to the shoulder of the leaves, and it is done. A cylinder is removed the same way as the escape pinion. You must drive out brass plug or carrier G. You must tap lightly, for fear of upsetting the balance, and if it is troublesome, you can fit it in the turns, and cut away the part that is burnished over. There are several different ways to get the length of cylinder. What you require is the distance from the inside of the top and bottom jewel-holes. The easiest way would be as follows:—Remove the "chariott," or bottom cock, and in its place fit a piece of brass plate of the same thickness, minus the endstone, which we will call a "mock chariott"; now drill a hole in the "mock chariott," the same place as jewel-hole in "chariott"; now rimer or broach this hole until the root left at bottom of new cylinder fits in it sufficiently tight to hold it in position; now put escape-wheel in its place; now put the cylinder through the hole, as shown in Fig. 71, and mark it outside the "mock chariott," where the arrow points, with a screwhead file or something similar; now remove the cylinder, and be careful of the escape-wheel; now take a rose from an old pivot drill, and broach the hole in it large enough to slip easily over the body of the cylinder. Now take the rose in a pair of old tweezers, and place a small piece of rosin or shellac over the hole, and hold it over a lamp until the shellac is melted; then slip it over the cylinder as shewn Fig. 72. It is only necessary to get it hot enough to melt the shellac; if you get it hotter, you will probably take the temper from the cylinder. The cylinder thus protected, will not break while turning; now place it in the turns, as shown Fig. 72, with a narrow rest, and hold your graver with the face upwards at an angle of about 45°, and cut off where you marked it. Now turn down pivot, which should be $\frac{1}{16}$in. (see Fig. 69). Now file down the pivot, polish, and round off; now put the "chariott" back in its place, with endstone fitted; now run the rose off cylinder with

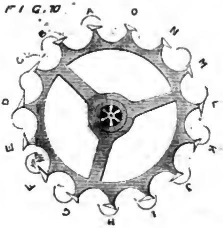


FIG. 70.

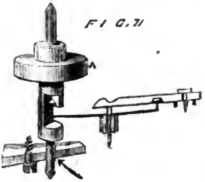


FIG. 71.

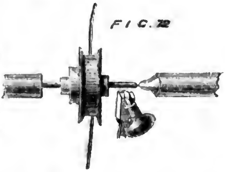
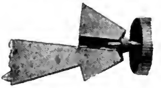


FIG. 72.

a piece of hot wire, laying it in the groove, and sawing it to an fro; next offer it same as Fig. 71 to see if you have got it right. Now mark the brass (A, Fig. 70) nearly level with the top of escape-bar (L L, Fig. 66). You allow about [illegible]in. for the balance to clear top of escape-bar; in some old Swiss watches you would not be able to allow so much. Now replace rose as before, and after putting in a safe centre for bottom pivot (see Fig. 73), you turn down brass rose (G, Fig. 66) for balance (H, Fig. 66), to the mark you have made. It must not be too small; just so as to be able to press it on with the pliers, as you will have to shift it after it is on. Now turn for hairspring collet (A, Fig. 66); now screw the cockbar and charriott in their places, after having removed the endstones, and measure with your calipers the outside of the jewel holes; this will give you the entire length of the cylinder. Now mark off for the top pivot as you did for the bottom, and cut off the same, and make your pivot; now put in another safe centre for the pivot (Fig. 73). Then, with a pointed tool you rivet the balance on while it is in the turns. When the banking-pin stands opposite the banking, the mouth of the cylinder should stand at right angles with the hole in escape-wheel bar. I shall next take the lever escapement.

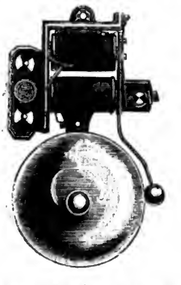
FIG. 73



(To be continued.)

ELECTRIC BELLS.

WE receive so many inquiries about electric bells that we take the opportunity to illustrate and describe one of the best and most perfect forms now made. It is turned out in large numbers by Messrs. Blakey, Emmott, and Co., of Halifax, and, judging from the specimen (a 3½in. gong) before us, leaves nothing to be desired. The parts are carried on a cast-iron frame, as shown, two screws sufficing to hold the bell securely wherever it may be desired. All the brasswork, the gong, and the binding screws, are nickel-plated, while the bobbins are covered with silk-covered wire. The frame being japanned and ornamented with gilding, the appearance is very satisfactory; and the price being low, owing to the parts being made to template in large quantities, these bells find a ready sale amongst large users requiring trustworthy instruments—for instance, they are extensively used by the London and North-Western and other great railway companies. As a matter of fact, the price is so low, that it is cheaper for the amateur to buy than to make. The magnet consists of two soft iron cores, held firmly in the cast-iron frame by one end. Each of these cores is fitted with a boxwood bobbin, on which is wound the requisite number of coils of wire—the junction being made by bringing the two ends out, and soldering them. The hammer is attached to the armature, and the latter is carried by a spring, standing up from the back of which is the contact breaker. In attaching the battery, the wire from the carbon, or positive pole, is taken to the push-button, and thence to the lower binding-screw; the current, when the other wire is connected up, will then pass around the coils of the magnet and through the contact-breaker to the other binding-screw, and so to the zinc pole. In passing, however, it magnetises the cores, which attract the armature, and break the circuit; the magnet being no longer excited, the spring exerts its power, and the armature flies back until the small spring makes contact with the screw, and the magnet again attracts the armature, the bell being thus continually sounded by a series of rapid blows. The push-button is a simple arrangement by which the wire leading from the battery to the bell is interrupted or made continuous. It will be readily understood that by dispensing with the contact-breaker, the bell can be made to give dead beats, as often as the current is sent through the magnet coils. For various methods of arranging bells on circuits, and for connecting them with indicators, we must ask new subscribers to kindly refer to the indices.



HEARING IN SCHOOLS.

THE adoption of compulsory education has brought out the importance of a knowledge of the laws of school hygiene. In France, a commission was appointed a short time ago by the Minister of Public Instruction to study the subject. Its reporter, M. Gariel, published, in the beginning of last year, a very complete and interesting report on the hygiene of sight in schools; but the efforts of the commission appear to have stopped there, and notwithstanding the researches of German and American doctors, it has not taken up that other very important part of school hygiene which relates to children's hearing. An endeavour to fill this gap has been recently made by Dr. Gellé, who, in his position as physician to pensions and large orphan-houses, has had ample opportunity of observing the behaviour of the ear from eight to twenty years of age. He has recently read a paper on the subject (we learn from *La Nature*) to the School of Public Medicine and Professional Hygiene. He demonstrates the great importance of the study by showing what a considerable number of children are affected in hearing, and how serious an obstacle this forms to the progress of their education.

Dr. Weil, of Stuttgart, published in 1881 and 1882 the results of examination of two classes of pupils, and he affirms that 30 per cent. of the children that attend the commercial schools are subject to more or less deafness, due to various causes, and prejudicial to progress. Among the well-to-do classes, the proportion falls to 10 per cent. At the Congress in Philadelphia, Prof. Clarence Blake had already shown the great frequency of partial deafness, and sought that the education of scholars subject to this infirmity should be facilitated. Quite recently, Dr. Sexton, of Washington, had furnished fresh confirmation of the same facts and their troublesome effects.

Dr. Gellé has observed 1,400 cases of deafness in schools: thus the field of his experience is sufficiently wide for the drawings of serious conclusions. He estimates that the proportion given by Dr. Weil is too large, and that the number of scholars whose hearing is weakened so far as to affect their understanding of lessons does not exceed 20 to 25 per cent. (though this, too, is very considerable). The two ears are nearly always both affected.

In the propagation of sound, consonants are the phenomena of the voice which are most quickly extinguished; the vowels are more sonorous. But the word, the phrase, expresses something only by articulation, and the perception of consonants and vowels associated alone renders the sound intelligible.

"The pupil whose hearing is too weak," says Dr. Gellé, "quickly loses the audition of consonantal sounds, and then becomes incapable of comprehending the noise which strikes his ears. One of the gates of intelligence is closed for him. These children, however, if examined in the refectory, or at play, appear to be like their comrades; their hearing is only insufficient for the class."

It will be easily understood how this kind of infirmity prevents teachers from giving them attention, and how in general the children so affected are considered backward, lazy, or even refractory, because they often fall back into the same faults.

Dr. Gellé instituted three kinds of tests:—

(1) Application of a sonorous body on the forehead.

(2) Experiments as to the range of hearing, right and left, measured by means of a rigid metre (say a 40in. rod), which a pupil held at the sides of the subject's head.

(3) Dictation at distances varied from 8 metres (say 27ft.), to that at which the pupil perceived the sound distinctly, and wrote down correctly.

The sounding body employed by Dr. Gellé in the first two cases is a watch. Having tried a tuning-fork, he had to give it up, because the sound emitted by that instrument is gradually extinguished, and the fundamental sound ceases to be heard distinctly, by reason of the repeated blows which give acute harmonics. The author does not, indeed, ignore the difference which exists between the dry and meagre tick of a watch, and the complex, penetrating sound, so full of harmonics, of speech. But it will be understood, he says, that it was necessary to proceed quickly and determine the degree of hearing of each ear, and this is not permitted in the case of speech, which sets both ears in activity without one's knowing whether the better ear is not acting alone. He always used the same watch, so as to have a single base of appreciation.

The dictation was done in the ordinary class, the pupil standing with his back to the examiner, who dictated in a high voice, a very simple phrase, rather than a single word. This last test followed the two others, and the distance at which the perception became distinct furnished the value of each subject as regards hearing.

The results of the whole verified the facts—

1. That the range of hearing for a given sound diminishes outside of the class, and even in covered yard; closed spaces are more sonorous. 2. That the mistakes cease or diminish as the distance of teacher from pupil is lessened. 3. That deafness increases with age.

To remedy as far as possible the inconveniences in the two former cases, Dr. Gellé points out the following as *desiderata*:—

1. As regards the teacher: He should place himself well in sight, so that the attention shall be roused by the motion of the lips; he should articulate distinctly, and rather slowly; and especially he should avoid dictating while walking.

2. As regards the arrangement of the premises: It is necessary, as far as possible, to avoid certain neighbourhoods, such as a noisy street, forges, cab-stands, &c., and to insure the isolation of the classes from each other. The stove should not be placed at the centre of the class, because the ascending current of hot air stops sound, which, according to Helmholtz, is transmitted better in homogeneous air. Beyond seven or eight metres (23ft. or 27ft.) the faults from bad hearing multiply. This limit of dimension, then, should be adopted for the sides of the classrooms, and lectures should never be given in yards even covered.

3. As regards the scholar. On his entrance to the school, the child should be examined carefully as to his hearing in class, and placed more or less near to the teacher, according to his auditive power. On this principle, it would be necessary to depart from the present arrangement, in which the pupils are placed according to their composition. The classes should not contain more than 30 to 35 pupils.

These conclusions appear to deserve the attention of all those who have to do with the inspection of schools.

ON A LITTLE-UNDERSTOOD PHYSICAL PHENOMENON.

THOUGH the law of Archimedes is familiar to every one who occupies himself with physical science, the group of phenomena to which it relates are not, according to Dr. Stammer, of Oberwitz (*Deutsch. Ind. Zeit.*), fully understood. He does not know, indeed, of any complete and satisfactory explanation of the facts observed.

It is commonly supposed that a given volume of a liquid has in all circumstances a determinate weight, corresponding to the specific gravity of the liquid, whatever the shape of the vessel in which the liquid is held. Thus, if 500 cubic centimetres of water be put into a cylindrical vessel, and this on one scale of a balance, a weight of 500 grammes is required to balance it; and if the same quantity of the liquid be contained in a vessel which contracts conically above, the same 500gr. is required to balance it, though in this case the hydrostatic pressure on the (same) base may not be the same; but perhaps twice, thrice, &c., as much. (Of course, this is apart from temperature differences, and change of the nature of the liquid by solution of foreign substances). It follows from this, *inter alia*, that the pressure expressed in *weight*, and the *hydrostatic* pressure on the bottom of the vessel are not of equal significance. This constancy of the weight of liquids, however, Dr. Stammer maintains, is by no means unconditional; but one may, without increasing the volume, *make the weight greater at will.* The 500cc. may be made to weigh also 550, or 600, or 700 grammes, &c.

This increase of weight may be observed, as follows:—

A beaker-glass, containing, say, 300cc. water, is placed on one scale of a balance, and equilibrated. Let a body now be inserted in the water, *e.g.*, a glass rod, a piece of wood, an empty test-tube, or one filled with water, or a globe, or even a finger, care being taken not to make the object touch the sides or bottom of the beaker, and also to have the object externally supported. If the body be heavier than water (*e.g.*, a vessel weighted with mercury), its weight must pull tight the cord with which it is supported outside the balance; if it be lighter (*e.g.*, an empty globe), it should be rigidly supported by a stand outside, so that it cannot exert any pressure on the balance.

By such immersion, the volume of the liquid, and one might also think the weight, is not changed; yet the scale shows, by going down, that there is an increase of weight, and this is greater the larger the volume of the immersed body. For every cubic centimetre of the latter, the weight of the water increases about 1 gramme.

It is all the same, whether the immersed body is heavier or lighter than the water, whether the hollow vessel is empty or filled; all depends on the immersed volume, and the external support. The weight of the immersed body has nothing to do with the result.

That the hydrostatic pressure of the liquid is increased by immersion of the body, follows from the increased height of the liquid column. If the phenomenon be thus accounted for, then equal volumes of water in differently shaped vessels of equal weight, must, by reason of hydrostatic pressure, differ in weight.

One may, even without a balance, make the same observation; placing the vessel on the flat palm of the hand; the differences of weight are easily felt if the immersed body be not too small.

It may be offered as an evident explanation, that the immersed body loses so much weight as the displaced water weighs; consequently, the weight which cannot be lost, must be discovered in that of the water.

In the author's opinion, this is no explanation. For the fact that the unaltered volume of water acquires a greater weight merely through change of its form, is by no means thereby shown to be a thing necessarily to be expected *a priori*. Moreover, the substitute for the weight "lost," as the result of the conditions of hydraulic pressure, appears to be the already indicated increase of the hydrostatic pressure in the water, and so there is no apparent necessity to seek another substitute.

Among the physical textbooks, that of Wüllner (*Compendium der Physik*) is the only one in which the author has found the above matter dealt with, and Wullner says (as above) that the weight of liquid in the vessel in which a body is immersed, must increase just so much as the weight of the immersed body is diminished.

Now Dr. Stammer urges that where the foreign body outside the balance is fixed rigidly to a solid support, and immersed in the water, its whole weight is borne by the immovable stand, and in this rigid connection the body can neither exert pressure nor weight, be the vessel empty or filled; hence it is not permissible to speak of the water bearing part of the weight. Thus the explanation does not meet the case, e.g., where the immersed body is lighter than water; for then the weight of the water may be many times that of the foreign body, and it cannot, strictly speaking, be affirmed that the body loses this weight (which it has not), nor that the water receives that which is lost. In this case, the loss of weight appears rather as thrust upwards, which is fully borne by the stand; yet the weight of the water is increased.

The following instructive experiment (says Dr. Stammer), may serve to exhibit the phenomenon for all cases, and to demonstrate the whole Archimedean law. The ordinary experiments of the hydrostatic balance are performed with two balances instead of with one.

Place the vessel with water on one scale, and balance it. Now arrange another balance so that the one arm which is furnished with a shortly-hung scale and a hook attached to it, is over the vessel of water. Now hang a suitable object, best a glass globe of known capacity, filled with water, or containing mercury, to the hook under the scale, and bring the second balance to equilibrium. When the whole is so shifted that this globe dips in the water of the first vessel, it will be found that this water vessel has become just so much heavier as the immersed body hung from the second balance is lighter. Many variations of the experiment may be conceived.

"The fact observed is deducible thence that the same water, according to circumstances, weighs less or more, and that this weight, with suitable conditions of volume, may rise to one and a half times, twice, or more. But an explanation, in my opinion, is not forthcoming; still less is this fact to be expected *a priori*. For even if I allow that after this increase of weight has been proved by experiment, proof can be had that so it must be, the question still remains unanswered: Whereby and how does this increase of weight take place? What is meant by saying that the water acquires weight? In what way can the process occur of the water growing heavier, requiring more weight to balance it? . . .

"The case is of course quite altered where the immersed body is hung from the same balance beam which supports the weighing scale with the vessel of water. Here the total weight, that is, the pull on the point of suspension, is the same, whether the hung body is immersed in the water or remain free. In my experiment, the body is hung outside the balance or rigidly attached, and cannot, therefore, exert an influence on the balance or objects upon it, and when a second balance is employed instead of the stand, nothing is altered in the reactions; only the difference is made more evident.

"From the whole, it appears to me that neither is the result of this experiment to be foreseen, nor can it be made clear in a simple way how it occurs."

THE SCALE ON WHICH THE UNIVERSE IS BUILT.

THE following is an asbtract of the first of four lectures on the supreme discoveries of astronomy, delivered by Prof. R. S. Ball, Astronomer Royal for Ireland, at the Royal Institution:—The lecturer began by remarking that it is the laws of pure mathematics which present to us truths of the highest generality and principles which must hold good throughout all space and all time. The supreme discoveries of astronomy were those which in this respect must closely approximate to the truths of mathematics. Chained as we were to the surface of the earth and dazzled by the proximity of the sun it needed a special intellectual effort to view the solar system in its true perspective. The first step was to apply as far as possible the principles of rigid measurement. We must attempt a survey of the contents of the visible universe. However imperfect that survey, it would yet yield us information enough to enable us assign to the solar system its true rank among the heavenly bodies. The measurements of that survey depended upon a sure base-line, and the most convenient base was the true distance from the earth to the sun. Various methods had been employed in the determination of this distance; the best known was that found by means of the transit of Venus. So much had been said and written about the transit of Venus that a comparatively brief sketch would suffice for his present purpose. A conjunction of Venus and the earth took place every 19 months. Owing, however, to the inclination of the path of Venus to the ecliptic, it but rarely happened that Venus was actually seen in front of the sun. Such an occurrence, however, took place on December 6th last, but no other would happen until the year 2004. By observing the passage of Venus across the sun from properly chosen spots a difference in the time of her entering and leaving the solar disc was perceived. From the exact measurement of these difference of time the distance of the sun could be ascertained. The practical application however, of this method was beset with difficulties. The atmosphere surrounding Venus and the effects of irradiation made it difficult to catch the precise moment when geometrical contact takes place. There were, however, other methods not so celebrated as the transit of Venus, which might be expected to yield results of a satisfactory nature. He would simply describe the principles of one of these alternative methods, which, taking everything into account, seemed to himself to be certainly free from some of the chief objections to which the other was open. The method to which he referred was based upon the observation of the minor planets, those small bodies which revolve between the orbits of Mars and Jupiter. Last year Mr. Gill, the astronomer at the Cape of Good Hope, invited the co-operation of astronomers in the northern hemisphere in an attempt to measure the distance of the sun by watching the minor planets Victoria and Sappho. It was by methods of this kind, in which the small point presented by a minor planet could be measured in comparison with an equally small fixed star that the distance of the sun could be obtained without our needing to await the transit of Venus. The distance of the sun once known became the measuring rod by which to reckon the distances of the stars. The star 61 Cygni still remained the nearest of all the known stars in the northern hemisphere. The accordance of the measurements made by Prof. Asaph Hall with those obtained elsewhere by different methods had reduced the limits of uncertainty within a very narrow compass. It was further pointed out that in the same constellation Cygnus there is another double star of the same general type as 61 Cygni, which also seemed to be within a strictly measurable distance. The direct measurements of star distances were, however, few and scanty. In most cases the distances of the stars were hopelessly beyond our ken, and to estimate these distances we could only fall back on Mr. Herschel's reasoning. If Vega, for instance, were shifted ten times as far as it is, it would still be visible to the naked eye, if 100 times it would still be visible in a small telescope, if 1,000 times it would yet be seen in a great telescope. The inference was that some of the minute stars revealed by our great telescopes only must be 1,000 times as far off as Vega. In the case of clusters and other still more distant objects, we could not form even a reasonable conjecture as to their remoteness or their proportions.

DYEING WITH ANILINE BLACK.

TO produce a black that will not turn green the Swedish Vanadium Company publish the following simple process in the *Industrie Blatter*: 1,250 parts of white starch and 420 parts of dark scorched starch are boiled in 5,500 parts of water, and after it has cooled to 122° Fahr., 800 parts of aniline oil and 800 parts of hydrochloric acid (specific gravity 21° B.) are added. When the mixture gets cold, 420 parts of sodium chlorate and 500 parts of boiling water are added. At the time of using it, but not a moment sooner, 200 parts of a vanadium solution are poured into this mixture. The goods are left in this bath for *two* days, and then passed through a solution of potassium bichromate (half per cent.), warmed to 158° Fahr., and next soaped as usual.

Instead of adding the hydrochloric acid in these proportions, it is still better to neutralize the aniline drop by drop until a few drops of the liquid impart a greenish-blue colour to a very dilute solution of Paris violet (1 in 1,000).

The vanadium solution is prepared by dissolving 10 parts of vanadiate of ammonia in 40 parts of dilute hydrochloric acid at a gentle heat, adding some glycerine, and then boiling until the solution has acquired a deep green colour and all has been dissolved. It is then diluted with water until it equals 1,000 parts and preserved in well-closed vessels.

LANTERNS AND SLIDES.[*]

(Continued from p. 494.)

WHEN bichromatised gelatine is exposed to light it is rendered insoluble. There are, however, other causes of insolubility at work—moisture and heat. Without moisture there is very little action, and we shall see by-and-by that a certain amount of moisture must be retained in the *dry* tissue. In cold weather this normal amount of moisture does not cause the tissue to become insoluble; whereas in warm weather it will not retain its solubility for more than a day or two (more or less according to the nature of the gelatine with which it has been prepared) after sensitising. Early spring, therefore, is the very best time of year for carbon work. Light is good on the bright days, and if a few dull or wet days should intervene the tissue will keep sensitive and soluble.

The tissue is sensitised and exposed behind the negative. An actinometer of some sort is essential to the beginner to judge of exposure. A *safe* edge having been first secured by strips of black paper round the negative, the tissue is put into clear, cold water till it just begins to curl the reverse way, and then squeegeed down on to glass for developing. It is not necessary for me to enter into details of this part of the process. But take such a print and deliberately waste it, and, instead of squeegeeing it down directly is is ready, let it remain a little longer in the water, and examine its surface. The picture will be in relief, the parts protected from the light by the shadows of the negative being the most swollen. Look carefully, and, unless the safe edge be very opaque indeed, the picture will be distinctly seen, even where thus protected by black paper. This proves incontrovertibly that light has passed through the black paper quite sufficient to alter the chemical character of the gelatine, for one part swells more than another and yet not sufficiently to render it insoluble, for the moment it is put into warm water the part protected by the safe edge will wash away completely. It also proves that there is no hard-and-fast line of demarcation between solubility and insolubility, but that the action of light has really gone much deeper into the gelatine than would at first sight appear to be the case.

In preparing the tissue, therefore, if there be not sufficient thickness of gelatine beyond that required for the formation of the image, this partial insolubilising of the excess is sufficient to prevent the paper from coming freely away. If force have to be used to tear the paper off there is great risk of the softened film leaving the glass; and, even if it do not do so, the print rarely washes clearly and evenly. The real truth is that there is a positive reflex action of the light, which is reflected back again from the paper of the tissue, and so causes a double insolubilising action in those parts. I have frequently found a rough duplicate print of this character adhering to the paper of the tissue, and refusing to dissolve in the same warm water in which the real picture was developing, proving that the portion of the tissue next the paper was actually more strongly acted upon by the light than the intermediate parts between that and the print.

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[*] Extract from a paper by MR. GEORGE SMITH in the *British Journal of Photography*.

The obvious remedy is to use a black paper on which to spread the gelatine, in which case half the gelatine will suffice; for I take it for granted that the amateur will have quite trouble enough preparing his gelatine solutions to desire to make them cover as many square feet as possible. The solutions have to be quite free from bubbles, and it is needless to state that the thicker the solution of gelatine the more trouble it is to get rid of these unwelcome visitors.

If the solutions are made simply of gelatine, colour, and water the tissue so prepared would dry so hard as to be unmanageable. Something, therefore, of a a hygroscopic nature is added so as to retain a certain amount of moisture, which, as I have before said, is necessary for the insolubilising action. Unquestionably the best and safest thing to use is sugar (loaf sugar) one-fourth of the weight of gelatine.

Glycerine requires to be used with caution. It is often impure, and from that cause has at times given me an infinity of trouble. I should, therefore, strongly recommend the amateur to eschew it at first.

In carbon work the principal difficulty to a beginner is the correct exposure. Now, let him take heart. It is not insuperable or even very difficult. He will, of course, have been in the habit of taking prints on albumenised paper from his negatives, and will have learnt that some print much quicker than others, but probably will not have attempted to classify them. This he must now do, and, by the aid of an actinometer, number them according to the number of tints they require. This once established the proportion will hold good for carbon work, too; and, although correct exposure is desirable, the latitude is incomparably greater with carbon than with silver. There is no hard-and-fast line of insolubility. A little longer washing will bring down an over-exposed print; prolonged washing with a little alkali will often save one exposed twice too long; while there are several "dodges" for saving prints that have not been exposed half long enough; so that, supposing a print should have received ten minutes' exposure, if it have had anything from five to twenty it may yet be developed into a good one.

As to the relative time of exposure compared with albumenised paper, no formula can possibly be given. It will depend upon the gelatine, the amount of colour, the proportion of bichromate, and the weather, and also upon when the picture is to be developed. Nothing is more clearly established than the fact that, if a carbon print is to be developed immediately after exposure, it must receive considerably more exposure than if it is intended to keep it for some time before development, otherwise by what is called "the continuating action of light" the picture would be over-exposed. In all carbon-working establishments allowance is made for this. The pictures are all exposed in the morning and developed later in the day, and are therefore under-exposed; but the continuating action brings them up to proper exposure. I fully admit the fact (for it is indisputable), but I am not altogether satisfied that it is due to the action of light alone.

Erratum.—In our "Astronomical Notes for March" on p. 561, by a typographical error, the Declination of Uranus appears as South instead of North, as it should have been.

The Action of Coffee.—Dr. Guimaraes, of Rio de Janeiro, concludes, after many experiments upon animals, that coffee is directly useful owing to its assimilable principles, and is also especially useful indirectly, owing to the large quantity of nitrogenised food which it causes to be consumed. It is probably superior to stimulants such as alcohol, because, taken in even large doses, it leaves a perfect equilibrium between assimilation and dis-assimilation, while at the same time permitting the tissues to be consumed to a greater extent.

Letts's Household Magazine.—We have received a copy of the first number of a new publication to be issued monthly with the foregoing title. The services of some of the most popular editors in their respective departments have been secured. There is a serial story by Rosa Mulholland, illustrated with a full-page plate by Miss Edwards; then follow Poultry Breeding, and their Common-sense management, by Dr. Gordon Stables; Our Housekeeping and Bill of Fare for March, by A. G. Payne; the Work-room, with illustrations by Elise Ollif; a Story for Boys, illustrated by Alfred H. Miles; the Nursery Object Lessons, illustrated by Alice Barnett; a new Song by Josiah Booth; Calendar of Garden Work to be done in March, by William Early; the Fashions of the Month, by Elise Ollif; the Kitchen, its Importance, by J. C. Buckmaster; and a chromo, entitled "The Flower Girl," by Mulready.

SCIENTIFIC NEWS.

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THE discovery of a comet by Brooks and Swift is published in *Dun Echt Circular* No. 69. The news is from Prof. Lewis Swift, of the Warner Observatory. The details are Feb. 23·528 G. M. T., R.A. 22h. 50m.; N. Dec., 28°; motion east. The comet was also observed on Feb. 24·4988 in R.A. 23h. 7m. 23·2s.; N. Dec., 30° 27′ 44″. At the time of writing, the comet is in the constellation Andromeda; but is reported to have a daily motion of 18m. in R.A., and of 2° 35′ in N.P.D.

The place of the great comet (1882) for Berlin midnight, on March 4, is, according to Dr. Kreutz, R.A. 5h. 51m. 8s.; S. Dec. 14° 26·5′.

Mr. J. Birmingham, of Tuam, has been awarded a gold medal by the Royal Irish Academy, for his distinguished labours in observational astronomy.

In a lecture delivered last week at the London Institution, Prof. Ayrton spoke of the efficiency of electric motors. Very small ones could have only a small efficiency, but when large enough to yield several horse-power, it might be as much as 70 or 80 per cent. Small motors, were, however, specially useful, because they could be taken to the work.

Messrs. Ayrton and Perry have obtained a patent (3036, 1882, 6d.), for an invention of a combination of steel and wrought-iron in the field-magnets of dynamos. By this means they find it possible to obtain a constant E.M.F. between the two ends of the outside circuit, whatever the resistance may be; or a constant current in the outside circuit. They are thus able to work lamps or motors in parallel circuit, or in series, so that any one lamp or motor is practically independent of the rest.

Herr Traube says that if platinum (sheet or wire) be shaken with hydrogen, air, and water, hydrogen peroxide is formed in quantity. Palladium, in presence of water and oxygen, oxidises carbonic oxide to carbonic acid, and produces the same hydrogen compound.

One of the German technical papers mentions that the slag obtained in the basic process in that country contains as much as 19 per cent. of phosphoric acid, and it is suggested that the powdered slag would be a valuable manure if spread over the fields before winter, so that injurious matters might have time to oxidise.

It is stated that Mr. D. G. Fitzgerald has recently demonstrated that carbon may be oxidised in the Voltaic cell. He uses retort carbon, or even common gas-coke.

A Mr. Loder, of Leyden, has obtained a patent in this country for a manufacture of "wine" from sugar and glucose, mixed with colouring matter, and subjected to fermentation. The colourings suggested are dye-woods, orchella-weed, and sorrel-paste.

The Naval Engineering Exhibition, which in 1882 was so successful at the Agricultural Hall, will this year cover a wider field by including mechanical engineering generally — thus admitting lathes and machine tools, and the products of the metal industries.

At Turin in 1884 a general Italian Exhibition will be opened. The exhibition will embrace physics and general chemistry, with their applications, and mathematics.

Formic and acetic acids have been often observed in plants. Recently Dr. Bergmann has examined a large number of plants (using a modification of the silver method as test), to determine the condition of formation of the acids and the part they play. He considers these acids occur in protoplasm throughout the whole vegetable kingdom; they are found in the most widely-different parts of plants, and both in plants that have, and plants that have not, chlorophyll. They are probably produced by retrograde metamorphosis. It is also probable that other members of the series of volatile fatty acids (propionic, butyric, caproic, and perhaps the whole series) are very widely diffused throughout the plant world. Volatile acids show an increase when assimilation has been arrested by withdrawal of light, and the state of inanition has occurred. In a plant subjected to a temperature below that of the minimum of growth, and at the same time deprived of light, there is no increase in the amount of volatile acids; thus their formation seems to be somehow independent of the respiratory process. They probably result from a splitting up of the constituents of vegetable protoplasm.

It appears, from a pamphlet published in 1876, that a well-known medical man in Melbourne, Mr. William Thomson, there expressed very definite views as to the parasitic nature of tubercle, anticipating by six years a doctrine which has recently come into favour. In a recent treatise Mr. Thomson shows from statistics that the mortality from consumption in Victoria is greatly on the increase; thus, taking all ages, it has increased from 11·49 per 10,000 in 1871 to 13·90 in 1881. And it is pointed out that this is not to be accounted for by any influx of dying visitors to the colony, but is largely due to an increasing death-rate among Victoria-born persons. Mr. Thomson maintains that phthisis is a specific poison disease, that it is never of climatic origin, nor due to dampness of soil, or depressing circumstances of life—that it has been imported into Australia by invalids from Europe, &c. Its prevalence among servant-girls is attributed solely to the inhalation of the germ-laden dust of the bedrooms they have to sweep out. Sea-voyages are beneficial to consumptive patients chiefly because they subject the patient to a continued inhalation of saline and slightly iodised air, which is unfavourable to the development of the parasites.

The fact, observed by Moser, that a galvanic current arose in amalgamation of zinc was investigated by Herr Obach some little time ago, who found that such currents are thermo-currents, due to changes of temperature produced by amalgamation. Some doubt having been thrown on this explanation, Herr Haga has lately made a new study of the subject, seeking to answer the question whether the difference of temperature arising in amalgamation is sufficient to account for the current observed. The experiments (described in the *Annalen der Physik*), were made with zinc, and gave so good an agreement of the temperature differences of the amalgamation-current with thermo-currents, that Herr Haga is led to assign an exclusively thermal origin to the currents occurring when metals are dipped in mercury.

An interesting case of breeding is reported from Germany—viz., the fruitful pairing at Halle, of a Gayal bull from India with a cow of the long-horned African Zebu race, from the Soudan. The latter belongs to the oldest races of horned cattle, whose forms, as the figures on ancient Egyptian monuments witness, have remained the same for thousands of years. The result shows (as Herr Kuhn points out) that such animals of primitive type, which have been so long subject to the same conditions of life, may, with suitable treatment, prove to be unweakened in their power of reproduction, even when placed in circumstances that differ in the most extreme ways from those of their home.

There are medical cases in which liquids have to be promptly brought into the stomach, but it is impossible or unadvisable to introduce them by the gullet. For such, Dr. Tansini, an Italian, proposes a capillary puncture of the stomach with a thin needle-tube. This he has proved by experiments on animals to be harmless. From his studies on the dead bodies, he believes the method to be practicable, even with the stomach empty and retracted. Dr. Tansini indicates precisely the space where the anterior surface of the empty stomach is directly accessible. He owns that there is some risk of not penetrating the stomach at all, or of penetrating too deeply, and he therefore recommends a slight incision be first made, so that the surface of the stomach may be reached for introduction of the trocar.

The clearance of snow from railways often proves a difficult problem. An apparatus of pneumatic character has been recently invented in America, by Mr. Stock, for the purpose. This apparatus is placed in front of the engine, and contains a distinct steam-engine working a blower. At the front is a sort of funnel, opening forwards, the size of its mouth being regulated by means of a hinged door and toothed sector. The snow is here drawn in by suction, and finely divided into flakes by a wheel with palettes on its covered surface (this is driven by a belt). Then the flakes pass on to the fan blowing machine, which drives them into a horizontal tube above, the carriage, capable of being placed obliquely so that the snow may be thrown off the line. The fan-blower makes 600 revolutions a minute, and is capable of displacing 2,100 cubic metres of air a minute. The escape steam from the engine is directed into the tube just referred to, to increase the draught. Mr. Stock considers his machine will clear the way as quickly as a gang of 500 workmen. (It is described, with figure, in *La Nature*.)

In a recent paper to a German serial Herr Schwirkus deals with the variability, arising from porosity, of weights of cast metal, or material cast and then worked with pressure, and which, in the case of cast-iron weights, may amount to whole grammes, in fine gold-plated brass or bronze weights to hundreds of milligrammes. In a series of experiments by a Government Commission, the evils of porosity were obviated, when the passages from the pores were not very large, by immersion in linseed oil, and heating to combustion of the oil (a like method is adopted in machine-work, for stopping the pores of cast-iron walls against penetration of water at high pressure). A pretty thick galvanic coating also affords protection. Among the recently-proposed materials for fine weights, cast steel offers no important advantage, and phosphor bronze, in general, none at all; on the other hand, chilled cast iron seems to be excellent. The surest proof of porosity is obtained by ordinary water-weighing, and comparison thereafter with a piece, known to be without pores, in air of different pressures on a vacuum balance.

M. Terby has lately communicated to the Belgian Academy some observations of the aurora seen at Louvain on 17 Nov. last year. It was distinguished by the intensity of the red glow, and by the translation of the rays from the east to the west, by the north, being comparable, in both respects, to the aurora of 9th April, 1871. In describing the aurora of 2 Oct., last year, M. Terby called attention to something like a monthly periodicity in many of these phenomena. The aurora of 17 Nov. could not thus be associated with that of 2 Oct.; but M. Terby notes that, on the 28 Oct., a powerful magnetic disturbance was recorded at Brussels Observatory. He gives, in the same paper, a list of some thirty auroræ, which seem to have been separated by intervals of about a month.

Among other points noted by the secretary of the Franklin Institute in a "Summary of Progress in Science and Industry in 1882," is the addition, during the year, of not less than 11,000 miles of new road to the railway systems of the United States. The production of iron and coal, it is thought, will probably be found not to differ much in amount from that in 1881, which was higher than in any previous year. The production of the precious metals shows a slight decrease as compared with 1881. The successful establishment of the beet-sugar industry in the United States appears in the profitable operations of the Alvarado factory in California during the past year. The introduction of the Solvay process for manufacturing soda, commonly known as the ammonia soda process, is an important industrial event. The glucose industry has fully maintained its remarkable rate of increase, and a colossal establishment is about to be put in operation in Chicago. The cable system for tram-cars is now in successful operation in San Francisco, Chicago, and Philadelphia.

A SUGAR-HOUSE is being erected at Chicago for treating 12,000 bushels of Indian corn daily. As each bushel of maize yields about 28lb. of sugar, the production will be, it is estimated, about 50,000tons yearly. The buildings, occupying nearly 25 acres, will cost about £320,000; and the boilers will be of 7000 horse-power.

THE Governmental *North German Gazette* refers reproachfully to the fact that the North German Lloyd Company has ordered from a well-known Clyde firm a couple of steamers, each of 2,500tons burden and 6,000 horse-power. Such conduct, it suggests, is both unpatriotic and anti-protectionist —two very heinous faults in the eyes of the German Chancellor and his accredited organs.

PHILADELPHIA derives an annual revenue of £2,400 from telegraph, telephone, and electric light companies, for the use of its overhead and underground wires. Each company makes a return annually of the number of poles, &c., and a payment of £1 per annum for each mile of wire used for telegraph or telephone purposes, and £3 per mile per annum for electric lighting purposes is required. There are at present about 10,000 miles of wire in the city.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE NEW VALUE OF THE EARTH'S COMPRESSION, AND TABLES FOUNDED UPON IT—THE RECENT ELECTION OF COUNCIL OF THE ROYAL ASTRONOMICAL SOCIETY—θ AND 5 AURIGÆ—ASTRONOMICAL WORK—SEVEN DIALS—JOSHUA COMMANDING THE SUN TO STAND STILL—DIAPHRAGMS IN A TELESCOPE—MERIDIAN INSTRUMENT—SIDEREAL CLOCK—THE GREAT COMET OF 1882—THE INVITATION TO OBSERVE THE ECLIPSE OF MAY 6th NEXT: AND WHAT HAS FOLLOWED IT—TRANSITS OF MERCURY—A SPOTLESS SUN—ENCKE'S COMET IN 1881—THE ZODIAC OF DENDERAH—POWERS FOR A 2¼in. TELESCOPE—THE MERZ POLARISING EYEPIECE—γ CASSIOPEIÆ.

[21117.]—BY far the greater part of the mass of numerical detail with which the *Monthly Notices* of the Royal Astronomical Society are crowded may well be left entombed in their pages, for rare and occasional reference. A very notable exception, however, as it seems to me, occurs in the January number of the *Notices*, in the shape of a paper by our President, Mr. E. J. Stone, which I fancy a good many other working astronomers besides myself would be glad to see reproduced in a separate form. It is on the "Reduction of Latitude and Logarithm of the Earth's Radius with Col. Clarke's Value of the Earth's Compression." At the time when the figure and dimensions of the Earth were computed by Airy and Bessel, their results undoubtedly embodied everything that was then known with regard to the size and shape of our globe. Since that date, however, a large mass of geodetical observations has accumulated, and the exhaustive discussion of them by Colonel Clarke has resulted in a very distinctly more accurate determination of the quantities in question. Every one who has ever been occupied with calculations into which the Lunar Parallax, far example, enters as an element, is familiar with the use of a table for reducing geographical to geocentric latitudes, and for ascertaining the Earth's radius at any given station. The quantities, however, which appear in this table, as heretofore printed (under the headings, "Angle of the Vertical," or $\phi - \phi'$, and log. ρ) have been, of course, derived from the formulæ of Airy and Bessel; and what Mr. Stone has done is to recompute these from Colonel Clarke's more recent and accurate data. If the tabular part of his article could be reproduced in octavo, it could be easily bound up with many of the existing volumes of tables, and in such a form would be very handy indeed.

Mention of the *Monthly Notices* suggests to me to remark, that I find, after all, in my remarks in letter 20953, on p. 451, that I over-estimated the amount of public spirit existing among the Fellows of the Royal Astronomical Society. It really seems as though the wire pullers in our Council, who year after year smuggle fresh names of members of the South Kensington Ring (or their abettors) into the House List, were destined ultimately to convert the governing body of a great and noble society into a mere clique pledged to aid the schemes of the jobbing crew at Brompton. Greatly and sincerely, though, as everyone must deplore the death of Professor H. J. Smith (and, assuredly, no one feels more than I do the irreparable loss that British Mathematical Science has sustained by the removal of that great man), we may yet congratulate ourselves on the return of THE Astronomer-Royal—I, of course, mean Sir George Airy—to our Council. It was simply a disgrace to everyone concerned that his name was ever expunged from the House List at all, while that of his official successor was suffered to remain on it. But, as I began by saying, there is a terrible absence of public spirit among the Fellows of the society. I know personally of three absentees from the annual meeting, all of them men feeling —or professing to feel—as indignant as I do at the gradual encroachment of Brompton jobbery in our governing body, who yet would not take the trouble to come a few miles to give effect to their opinions at the ballot-box. One had another engagement; another (who could come up to London on the previous day on a different matter) "had too much to do"; and the third actually was stopped by the weather! "Ex tribus disce omnes." I have been told of other equally trumpery excuses; but these occurred within my own cognisance. If this apathy continues, the packing of our Council will proceed steadily year by year, until it consists practically of a clique prepared to back Solar Physics Committees, Physical Observatories, and cognate shams of all kinds for putting money into their own pockets or those of their friends. Are, or are not, the Fellows of the Royal Astronomical Society prepared to see it dragged down into the mud in this fashion?

Would "H. S." letter (21065, p. 545) be surprised to learn that I have myself glimpsed the 7½ mag. *comes* to θ Aurigæ quite unmistakably with only 3in. of aperture; as also that of 5 Aurigæ with much greater difficulty with the same instrument? It had a first-class object-glass, by the bye, of very long focus, cut down to the diameter indicated. This was about a year ago, and I have never looked at either star since. For aught I know, one or both of these *comites* may be variable; but that they were visible at the date I mention I have no more doubt than I have that I am writing these lines.

I hope that every incipient astronomer will read letter 21073 (p. 546) through from beginning to end; and having done so, reperuse it straightway. The advice it contains is so thoroughly sound that the student can scarcely fail to profit by laying it earnestly to heart.

If Mr. Lecky (letter 21082, p. 548) will turn to p. 378 of the "Curiosities of London," by the late John Timbs, he will find that well-known metropolitan antiquary saying, apropos of the Seven Dials, "The column and dials were removed in June, 1773, to search for a treasure said to be concealed beneath the base. They were never replaced, but in 1822 were purchased by a stone-mason, and the column was surmounted with a ducal coronet, and set up on Weybridge-green as a memorial to the Duchess of York, who died at Oatlands in 1820. The dial is now (1868) a stepping-stone at the adjoining Ship Inn."

"Lamplighter" (reply 49324, p. 552) could scarcely have quoted a passage from the Bible more corroborative of the theory of the purely poetical character of the narrative in Joshua x. 12, *et seq.*, than that which he has cited from Habakkuk iii. 11. Why, the entire context shows the latter rhapsody to be poetry, and nothing else. What do we read in the immediately preceding verse? "The deep uttered his voice, and lifted up his hands on high." Would "Lamplighter" seriously contend that the ocean had *hands* (to say nothing of a voice) to lift up? The phenomenon referred to in Isaiah xxxviii. 8, of the shadow going back on the sun-dial of Ahaz, may have been caused, quite naturally, by a parhelion; and its alleged prediction have been an *arrière pensée*, or much later interpolation.

"Neptune" (query 49554, p. 556), will find that if he removes the stops or diaphragms from the tube of a telescope, he will get extraneous light in the field, which will give a hazy or nebulous appearance to any object he may be observing. A diaphragm to be effective should *just* permit the entire object-glass to be seen through it, when the eye is placed in that object-glass's focus. An instant's consideration will show that if we have a 3in. object-glass of 48in. focal length, that a diaphragm placed half-way between it and its focus—i.e., 24in. from the objective, should have an aperture of 1½in., while its aperture must be reduced to 1in. if it is to be placed 32in. from the object-glass, or 16in. from its focal point, and so on. In addition to this primary function of cutting off stray light, stops fulfil the further useful purpose of strengthening the telescope tube and making it more rigid.

If "J. J. H." (query 49574, p. 557) will refer to Vol. XVIII. of the ENGLISH MECHANIC, he will find a full illustrated description on p. 541 of the instrument concerning which he puts his question, and which is called a dipleidoscope. He will find further references to it on pp. 21, 37, 94, 95, and 128 (where there is an engraving of it in situ) of Vol. XIX.; and on pp. 429, 462, 510, and 565 of your XXIVth. volume.

The reply to "J. J. H.'s next query (49575, same page) depends a good deal on what he means by a "Sidereal clock." If he intends to ask, Can an ordinary clock be made to keep sidereal time? the answer is, That any clock or watch whatever may be made to do that by simply shortening the pendulum, or balance-spring, as the case may be, until the hands travel round twenty-four hours during 23h. 56m. 4·09s. of mean solar or ordinary time. But, of course, sidereal time is reckoned right round the 24 hours; so that, to adopt a common dial for astronomical purposes, a second set of figures would have to be painted on it: XIII. under (or over) the I.; XIV. over the II.; and so on. In an observatory it is essential that the ticks of the clock should be particularly loud, sharp, and distinct, as all observations into which time enters as an element are made by listening to their beats while the eye is applied to the instrument in use. Hence, some form of "dead-beat" escapement is always used, and the pendulum is of such a length as to beat accurate sidereal seconds. One of the old-fashioned upright clocks, which generally beat seconds, may be made to keep sidereal time by a little shortening of the pendulum. Of course, a compensated pendulum is a *sine qua non* for regular astronomical work. As I have previously said, though, the dial of a sidereal clock must, in some way, be made to show the whole of the 24 consecutive hours.

In redemption of the promise I made to "C. A. B." (query 49355, p. 508), in letter 21064, I have looked into the question of the orbit of the Great Comet of 1882, and it seems to me that his entire difficulty has had its origin in his supposition that such orbit was *direct*. If he will reflect for a moment, he will remember that the Comet was first seen to the west of the Sun by Mr. Finlay; that it travelled up to the Sun's preceding limb, passed across his face into perihelion, pursued its course behind him, and emerged once more at his western limb. Hence its path was, quite obviously, a retrograde one. "C. A. B." knows that the longitude of the perihelion is measured from the ascending node along the comet's orbit. Now a fashion has arisen of dropping out the words "direct" or "retrograde" in giving the elements of a cometary orbit; possibly with a view to saving a word in telegraphing the elements by their computer. The assumption is, that all comets' orbits are direct, and when the computer has to deal with a retrograde one, he gives the inclination as greater than 90°. Thus the plane of the orbit of the comet under discussion made an angle of about 38° with the Ecliptic. This the modern computer would call 142°, as the comet was travelling in a retrograde direction. Within two hours of passing perihelion, the comet moved backwards through its descending node in Longitude 13° 59′. Its longitude has, since then, continued to increase, until it was, on January 6th (as "C. A. B." quite correctly states) 106° It is now increasing very slowly, and in about 350 years—assuming Professor Frisby's estimate of its period to be correct—it will be in aphelion. Its longitude will then be about 130°.

The curtain has risen on act two of the little farce to which I invited attention in letter 20849 (p. 356), and I now learn from the newspapers that the "assistants" of the two members of the (so-called) "Government Expedition" to Egypt last May are to be despatched to the Pacific, at the national cost, to observe the Eclipse of the corresponding month in the present year. Now, I am informed upon authority which I can scarcely question, that one of the most skilled Eclipse observers in England, who is, moreover, our leading authority upon the subject of the history and details of Eclipses generally, did volunteer to go out in response to the free-and-easy invitation given at the December meeting of the Royal Astronomical Society. Inasmuch, however, as his doing so would hardly have tended to the glorification of the gentleman who made such a pleasing exhibition of himself on that occasion, the offer of the able and most competent astronomer to whom I have referred was declined. It is needless to add that he is not a member of, or sympathiser with, the Brompton Ring, and that what he would have done would have been wholly and solely for the benefit of Astronomical Science, and not for that of any member or members of the "Solar Physics Committee" or any cognate sham or kind of scientific quackery whatever. Besides, he would have reduced and discussed his own observations, which the "assistants" will hardly be permitted to do.

A work of the highest theoretical interest has just been issued by the Bureau of Navigation at Washington, in the shape of the "Discussion and Results of Observations on Transits of Mercury from 1677 to 1881," by Professor Simon Newcomb; forming Part VI. of the first volume of Astronomical Papers, prepared for the use of the *American Ephemeris and Nautical Almanac*. While urging every astronomer interested in this subject to procure and read for himself this most recent and exhaustive investigation by the famous American mathematician, it may not be wholly without interest if I indicate briefly the direction in which Professor Newcomb's elaborate researches have tended. Briefly, then, the two chief questions for whose solution he has appealed to the results derived from Transits of Mercury are: first, the possible variation in the length of the sidereal day, in other words, the change in the rate of the Earth's rotation; and, secondly, the discordance between the theoretical motions of Mercury's perihelion and those actually observed. With reference to the first question, the result of an elaborate investigation would appear to indicate the most probable value of the constant indicating a change of rate in the Earth's rotation to be zero; and that, hence, we must for the present regard the Earth's motion as uniform. From this it will be at once seen flows a corollary of the utmost importance, which the author thus formulates. "Inequalities in the motion of the Moon not accounted for by the theory of gravitation really exist, and exist in such a way that the mean motion of the Moon between 1800 and 1875 was really less than it was between 1720 and 1800." While saying this, however, Professor Newcomb is careful to point out that this assumption is very far indeed from being free from doubt; and that, though improbable, it is yet possible that part of this inequality was due to a change in the rate of the Earth's rotation. The question can by no means be regarded as being yet definitely settled. The discordance between the theoretical and observed motions of the perihelion of Mercury is traced, *inter alia*, to the erroneous mass hitherto adopted for Venus. Le Verrier's mass, it is found, must be reduced from $\frac{1}{401847}$ to $\frac{1}{408400}$ to account for the motion of the node of Mercury; or to explain that of his perihelion be increased to $\frac{1}{347500}$. After all, though, we learn that "It follows that the observed centennial motion of the perihelion of Mercury is greater by 43″ than the theoretical motion computed from the best attainable values of the masses of the planets." This naturally brings us to the consideration of Le Verrier's hypothesis, which presupposes the existence of a planet, or group of planets, between Mercury and the Sun; but the author points out almost insuperable objections to this, and only hints, in a hesitating way, that the minute particles composing the zodiacal light might, did their combined mass suffice, just conceivably act as a planet would do in this respect. The work concludes with a table and two large diagrams, by the aid of which the details of every transit occurring between 1600 and 2100 may be found by inspection. I venture to think that few works on physical astronomy of more enduring interest than this last one of Professor Newcomb's have been issued for some time past, and would reiterate my advice to everyone interested in the questions it discusses with such conspicuous ability, to obtain it forthwith for himself.

As we cannot be very far, one way or another, from a sunspot maximum, it may not be without interest to note that, this morning (February 23rd), with a power of 80, the Sun's disc is absolutely free from any trace of a spot whatever.

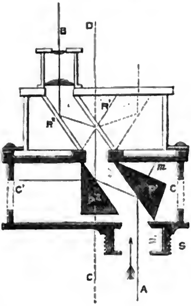
With reference to the remarks made in letter 21095 and 21096, on p. 567, as to what I said concerning Encke's Comet in letter 21064, I may explain that the first supposition of "A Young Astronomer" is strictly and literally correct; inasmuch as I was in a very great hurry, indeed, to catch the post when I penned the words on which he comments. I consulted the indices of Vol. XLI. and XLII. of the R.A.S. *Monthly Notices*, and, failing to find any mention of the apparition of Encke's Comet in 1881 therein, concluded that it had not been seen at its last return to perihelion. Had I been less pressed for time, I should, of course, have referred to other works. On looking at my own Observatory book, I find that I actually observed the Comet myself on the night of September 25th, in the year referred to!

I fear that I cannot help "Spica" (reply 49439, p. 575) inasmuch as I am ignorant of any discussion of the question of the origin of Zodiacs since that of Letronne, in the *Revue des Deux Mondes*, for August, 1837. I dismiss the Rolleston vagaries published in the "Astronomical Register," in 1868. Oddly, I can find no reference whatever to the Zodiac of Denderah in a place where I should certainly have expected to find it: I mean Wilkinson's "Ancient Egyptians." By the bye, "Spica" may consult the article "Zodiac," in the old "Penny Cyclopædia," though, with advantage. This, I should think, is very probably reproduced in the more recent "English Cyclopædia"; but I have not the latter work at hand to refer to. There is a queer little book, too, which he may possibly pick up through a second-hand bookseller, which is not wholly devoid of interest. I copy the title-page for his benefit: "A Treatise on the Circular Zodiac of Teutyra in Egypt, by Mr. John Cole, Purser in the Royal Navy. Sold by Longman and Co., London. 1824."

If the refracting telescope in the possession of "S. E." (query 49599, p. 579), is a first-class achromatic, he ought, on fine nights, to be able to employ a power of 250 with it on close double stars, and 120 on the Moon and planets.

It will save time if, in reply to query 49601 (p. 579), I copy out the description, diagram and all, of the Merz polarising eyepiece which appears on p. 64 of Professor Young's admirable book on the "Sun."

"The light entering at A," says the author, "first encounters the surface of the prism P¹, set at the polarising angle; about $\frac{15}{16}$th of the light passes through the prism, emerging perpendicular to its near surface, and, being rejected, about $\frac{1}{16}$th is reflected and polarised by the reflection. The reflected ray next strikes the surface of the second prism P², and here a considerable portion of the remaining light is thrown away. That which is left is reflected into the upper portion of the eyepiece parallel to its original direction, through an opening in the top of the circular case in which the two prisms are mounted. The upper case is attached to the lower in such a manner that it can be turned around the line C D as an axis. It contains two plane mirrors of black glass placed as shown in the figure. With things in the position indicated, a beam of considerable strength would reach the eye at B—so strong, in fact, as to be painful; and the same would be the case if the upper piece were turned 180°, bringing the mirrors into the position shown by the dotted lines, with the issuing ray in the prolongation of the incident. But by turning the upper piece one quarter of a revolution, the issuing ray can be entirely extinguished; and by turning it less or more than 90°, the intensity of the light can be controlled at pleasure. As no shade-glass is used, everything is seen of its proper tint."



Without being able to give a categorical reply to query 49642 (p. 580), it may interest "Algol" to quote from pp. 21 and 22 of the original edition of the "Celestial Cycle" what Admiral Smyth said with reference to the variability of γ Cassiopeiæ: "H. (Sir John Herschel)," he says, "wrote to me from Slough in October, 1838, that it was then decidedly the chief star in that constellation. On the 28th of April following he again addressed me on the subject, saying, 'In a former letter I requested you to notice α Cassiopeiæ, as then less than γ. It was so, and continued so for some time; but it soon regained its ascendancy. On the 21st instant I again got a positive observation—and α was then decidedly smaller than β or γ. I feel now quite assured not only of the change, but of its periodical recurrence.'" This is the earliest record that I can find of an expressed suspicion of the variability of γ Cassiopeiæ. The odd thing is that it is not included in Sir John Herschel's own List of Variable Stars on pp. 600 and 601 of the latest edition of his "Outlines of Astronomy"; nor does Chambers, usually so full and accurate in all his details, insert it in either of his Catalogues of Stars known, or suspected, to be variable.

A Fellow of the Royal Astronomical Society.

θ AURIGÆ.

[21118.]—With regard to the magnitude of the O Σ comes of θ Aurigæ, alluded to by Mr. Knott (letter 21098, p. 567), it would seem that the estimate given by β in Vol. XLIV. of the *Memoirs* is O Σ's. β observes, in the preface to that Catalogue, "The magnitudes given in the eighth column of the measures are taken from the original Catalogue, in which the pair is first found, with the exception of the O Σ pairs, the magnitudes of which are from Dembowski's 'Measures of the Pulkowa Catalogue'": but it must be remarked that De's observations of θ have not yet been published, and that, though β quotes the result of De's measures of A B in his notes, he does not directly state that the magnitude given by him was assumed from that observer. β's 10·5m. is the mean of two at present unpublished observations at the epochs 1878·840 and 1878·893. ℌ's "excessively minute" *comes* at 293·3° 45·5" is called 10m. by Smyth in 1832 and 11 mag. (in what scale?) by Fl. in 1877; it was certainly smaller than 10m. H. at the beginning of 1875, when Mr. Ward called it 12m. H., with which my estimate of 12¾m. agrees. I presume that Mr. Knott's magnitudes are expressed in A.'s scale extended. The changes in this star and the more distant companion are due to the proper motion of the large star.

February 23. **H. S.**

D'ARREST'S COMET.

[21119.]—"F.R.A.S.," in reply to Mr. Cornish (letter 21064, p. 545), states that D'Arrest's comet has not been seen since 1857. It was *not* noticed, I believe, at its next return in 1864; but was afterwards observed in 1870 and again in 1877.

Feb. 24. **Swithin St. Cleve.**

THE MARKINGS ON JUPITER—TELESCOPES AND ASTRONOMICAL WORK.

[21120.]—ON February 23, at 6h. 13m., the equatoreal white spot on Jupiter was estimated central. It was, however, far less conspicuous than at the early part of the month.

On February 24, at 7h. 30m., the great red spot came to the planet's central meridian. It was certainly very faint. Definition was superb, and I carefully examined the spot with the whole aperture of my 10in. With reflector, and power 212. There was no indication of disruption; the spot preserves its integrity of figure, though its increasing paleness is very evident.

As to the relative merits of refractors and reflectors, they have been discussed over and over again in your columns. The question is invariably left where it began. I think we ought to study the *results* more than the *means* of astronomical work. Certainly, to get good results we want efficient instruments; but it must be admitted that though the latter are abundant enough, there is yet a great scarcity of original work. The fact cannot be ignored that our observers are showing a degree of apathy beyond all precedent.

One is tempted to inquire why little or nothing is done with the many fine instruments in this country? How is it that we hear so seldom of Mr. Newall's 25in. Cooke refractor, from which great things were expected, and which, it was understood, would be placed at the partial disposal of amateurs? Were this instrument in America, we might depend that its great resources would be utilised to the fullest possible extent. Here, in this country, we seem to have relapsed into a state of indolence, and to be the mere passive spectators of the valuable work accomplished abroad.

Your correspondents, Messrs. Gemmill and Franks, have done the right thing in pointing out to amateurs the necessity of applying their energies to certain special departments of observation. It is to be hoped that their advice may be followed, and that hereafter we may learn, as the result of all their writing upon the construction of telescopes and their relative performances, of increased enthusiasm amongst our observers, and that a larger amount of original work is being done.

W. F. Denning.

Bristol, Feb. 24.

SOLAR ECLIPSES ON JUPITER.

[21121.]—IN reply to Mr. H. Broughton (letter 21097, p. 567), I must first say I do not understand his heading, "Triple Eclipse of Jupiter's 4th Satellites," nor can I make anything out from his diagram; but I think he probably is aiming to show some of the circumstances attending the three *solar* eclipses caused on Jupiter by the rapid rotation of the planet combined with the ordinary revolution of the IVth satellite.

The original announcement of these curious phenomena will be found in Vol. XIV., p. 387. In paragraph 0° the word *west* should be *east*. The diagram was incorrectly reduced by the engraver.

The observations were made *after* the phenomena were described. The first is noted by "Linea" (Mr. Ward) on p. 438, same Vol. Here is another by myself in the "Astronomical Register" for 1872, p. 94. The retardation in case of III. is mentioned on p. 92. I think there are a few others, but I cannot just now say where. Mr. B. might like to see other correspondence on this subject, which may be found in this journal, Vol. XIV., pp. 409, 410, 461, 486, 507, 510, and 537.

T. H. Buffham.

TELESCOPE MATTERS.

(*Continued from p.* 569.)

[21122.]—WE now tested a 5in. diam. glass speculum made by Mr. Murrel, of London, for Mr. Vallance, to fit into the tube of No. 5 that we had tested, and of course of about the same focal length. Mr. Vallance had this made to see if a silver on glass speculum of modern make would answer as well as one of metal by the old masters. Now, in this glass speculum I was surprised to find no turning down of the inner or outer edge, its figure was as near a spherical one as possible: this at once set me to work to explain this singular absence of the troublesome turning down of the inner edge. Could it be that Mr. Murrel had cut the centre hole out after the mirror had been worked? This I could not believe anyone in the trade would ever think of doing. In this belief I was confirmed by Mr. Murrel himself, whom I called on in London on my return homewards. He told me that it had been worked in the ordinary way they worked their spherical surfaces, and here, I believe, is the true explanation of the fact that the inner edge was not turned down, which explanation I suggested to Mr. Vallance the morning after this day's testing of the old masters', and Mr. Murrel's glass mirror, having thought it out during the night. The explanation is this: with the short focus, compared with the diameter of the Gre., a great deal of correction or parabolising, as it is called, has to be attempted, and as the old masters worked with the mirror above the tool, the tool had to be not less, but a little larger, than the mirror; therefore, to parabolise, the tool had to be pressed down much at the edge, leaving the middle elevated to wear out or deepen the centre of the mirror faster than the outside; therefore the tool never fitted the mirror, but the mirror rocked on it, so to speak, and thus allowed the comparatively convex tool to sink into the hole in the centre of the mirror, and so in coming out of it, to wear away the edge in the manner I had found from practice, and seen, more or less, in all the old masters' work. Now, Mr. Murrel's mirror was spherical, worked on a spherical tool, and, therefore, there would be no more wearing down of the edge of the hole than the outer edge. This was just as I found the mirror to be. This will be easily understood from Fig. 1, where the tool being convex to the mirror—*i.e.*, being more convex than the mirror is concave; or, in other words, touching at the centre—would have a tendency to sink into the hole A when the mirror was over the centre of the tool, and in coming out of it as the mirror was pushed forward, would round off the inner edge for some distance, far more than the extra supply of rouge would account for, which is further proved by the fact that the inner edge of every Gre. and Cas. I have tested is more turned down than its outer edge. Mr. Murrel's glass speculum had evidently been worked on a tool that fitted the mirror as in Fig. 2, where the tendency to round the inner edge would be no more than the tendency to round the outer edge, the mirror gliding over the tool, or the tool over the mirror, whichever way it was worked, evenly in all positions, no rocking being possible. I have proved that the old masters' secret of parabolising, with a tool as large as the mirror (and this is the only safe way to avoid local inequalities) consists in so working the mirror over the pitch tool that the outer edge is kept pressed down a little below the general level, if I may so call it, of the curve of the mirror, and thus leaving the centre of the tool to press or rock on the centre of the mirror more than the outside, thus deepening the centre of the mirror faster than the outside; thus the ellipse or parabola is formed. Why so much turning down of the inner edge of these old masters' mirrors is found is from the fact that their short focal length, as compared with their diameter, required a great deal of correction, and so the tool had to be very convex as compared with the mirror, and so a greater turning down of the inner edge was the result. It may be well to impress on the mind of the amateur the fact that pitch is not elastic, as thought by some, and to be continually yielding and springing back to the shape of the mirror, for it is evident that two parabolas can only fit when their centres are over one another; now pitch does not keep a fit, by any elasticity, to the mirror in all parts of the stroke; pitch is a yielding substance, and does not spring back like indiarubber to its former shape when pressed out of this shape, but retains the shape given to it by the last pressure; and this property of yieldingness was taken advantage of by the old masters in the amount of stroke they found enough, by the weight of the overhanging metal, to just press the outside so much more than the centre, that it was kept a little lower than the general curve of the mirror, and so left the centre higher to wear the centre of the mirror to the correction required. It is very important that the amateur and the trade should understand this, for all in the trade do not know it; and I want to establish the working of mirrors on a rational process for all, so that certainty may be the result. To this end I have been devoting my attention, so as to master the laws that govern all modes of working, and not merely making one big telescope. That will easily follow when we know all about the laws we are working under, and with a great reduction in their price, too, and a greater proportionate sale, which two things will be better for the buyer and seller, for, as Mr. Browning said to me when speaking to him on this subject in his shop on my return home, he would be glad to be able to reduce the price of reflecting telescopes, as it would pay him better to sell them at one quarter the profit he now has if he could thereby sell 20 where he now sells one. I may just add here that he further told me that Mr. With still made mirrors for him, so of course we cannot expect Mr. With to tell us anything about his mode of parabolising. Mr. Browning further told me that Mr. Common told him only a few weeks ago, when he (Mr. B.) observed to him that he (Mr. B.) supposed he (Mr. C.) could not use even 18in. of his 37in. mirror more than once in three months. Mr. Common said that he (Mr. B.) would have been nearer the truth if he had said once in four months. So from this it appears that even an 18in. in our climate cannot be used on an average more than 3 times a year with the full aperture. It would be interesting to know what the experience of others who have 18in. mirrors is in other parts of the country, as I believe places vary much in this respect. I would here further explain that the difference between the curve of the tool and the mirror in parabolising is as infinitely small as the difference between a spherical surface and a parabola of the same focal length: we cannot measure it, we only measure the effect by the testings. Returning from this digression, it will be seen that the true way to parabolise a mirror with a hole in its centre, is to fill the hole up with the same material as the mirror, and work both as a solid mirror to the curve required, then remove the centre plug.

FIG. 1.

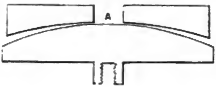
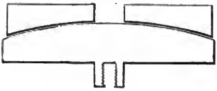


FIG. 2.



I called on Dr. Edmunds, and he put at my service a beautiful 6in. Cas., by Ramsden. This was the most complete and elaborately-finished instrument I have ever seen. It was equatorially mounted, with divided circles, and every accessory for exact measurement. It was evidently made with no regard to expense, and, therefore, I have no doubt, the speculum was as good as the old masters could produce. The surface of the metal was in a wonderful state of preservation, and yet, probably, a hundred years old; the small amount of tarnish would have been easily removed without altering the figure perceptibly. I felt anxious to test the figure, and see if the old turning-down of the inner edge was here, as in all the others with a hole in their centre. I wanted to see the amount of correction in the Cas., as to whether it was considerable or not. Well, I no sooner looked at it than the old turning-down on the inner edge greeted me, as before, confirming all my previous conclusions about the old masters' mode of work and capability. As to the correction, there was a little, about as much as for some of the Gre. I had tested. From all my testings I am convinced that the old masters had no uniform figure for the Gre. or Cas. In fact, they could not judge, except in a rough way, by putting various large and small mirrors together. The question very naturally comes in here, How did the old masters, especially that celebrated one, Short, manage to get such definition as is reported of him? The explanation is very simple, but not very creditable to their power of making good mirrors with certainty. The following quotation from Dr. Kitchener will explain it all:—"Mr. Short used to proceed by first making his large metal as nearly correct and parabolical as he could, and then from a number of small metals, to select, by trial, that which corrected the larger one in the best manner" (p. 92). "Mr. Short turned round the larger speculum till he found the best position" (p. 92). "Mr. Short also frequently corrected the errors of the great by the little metal in another way. If the great speculum did not answer quite well in the telescope, he cured that defect sometimes by trying the effect of several metals successively, by this means correcting the errors of one by the other; for in several of his telescopes which have passed through my hands, when the sizes and powers have been the same, I have found that the great metals, though very distinct in their proper telescopes, yet have, when taken out and changed from one to the other, spoiled both telescopes, rendering them exceedingly indistinct, which could arise from no other circumstance. For this reason, I suppose it was, that he kept ready-finished a great many large metals of the same focal length, so that, when he wanted to mount a telescope, he might, from a great choice, be able to combine those metals which suited each other best. I am strongly inclined to believe this was the case, not only from the above observation, but because he showed me himself a box of finished metals, in which, I am sure, there were a dozen and a half of the same focal length" (from Mr. J. Mudge, on reflecting telescopes from the Phil. Trans. for 1777, quoted by Dr. Kitchener, p. 93).

Now, from all the previous testings and these quotations from Kitchener, I draw this conclusion: that with a considerable deviation from the true figure, a large mirror may be corrected by a small one, and vice versâ. This must have been the case with nearly all the mirrors I have tested, for they varied very much in the amount of correction they had, and to be brought up to the definition these old masters would only rest satisfied with, the exact though varying amount of correction for each large mirror, must have been given by the small one. I am inclined to think that a good Cas., with a spherical small mirror, could be made by correcting the large mirror to it so as to obliterate the aberration, for I judge that the definition of the old masters was more the irregularities of the figure of one mirror being corrected by the opposite irregularities of the other mirror, than the aberration of the one mirror being corrected by the aberration of the other. I am confirmed in this by the fact that the spherical Murrel glass mirror referred to before, performed almost as well as the Adams or Short metal one, which had much correction, though not reaching the parabola perhaps. I believe a spherical convex for the Cas. would be as easily made as the flat for the New., and if this would correct, without any irregular residuum of error, a spherical or elliptical large mirror, then the shortness of the telescope would be much in its favour; this I felt as I examined the short Cas. of Dr. Edmunds, equatoreally mounted. I could not help comparing it with the size of my 6in. New., the only disadvantage being the constrained position in observing; but this, with the German mode of equatoreal and a proper observing-chair, would be greatly lessened.

We should all feel obliged to Mr. Royston Pigott, mentioned by Mr. Calver, in letter 20805, for what he finds, from theoretical investigations, to be the best proportions of curves and sizes of the mirrors for the Cassegrain telescope.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

[21123.]—Our friend "O. V." wishes I had kept extracts of the paper I mentioned. I thought the first two (of Airy's) were well known, and the third useless. The former two certainly are valuable, and I wish I could get them in a cheap form, though whether they would pay our editor to reprint I cannot say; possibly an extract by "O. V." would, though most of us would prefer them *in extenso*. I remember the general line of reasoning and the results; but am not equal to filling in the details just now, but I can do something. Mr. Elger, who contributes occasionally, lives at Bedford, and is on the committee of the Library, in which are the 4 vols. of the "Cambridge Transactions," and he could supply copies or perhaps obtain a loan of the originals. The articles are "On the Achromatisation of Eyepieces," "The Spherical Aberration of Eyepieces," and on "Gregorian Telescopes with Silvered Glass Mirrors." In these same volumes there is Airy's article on a frictionless escapement, reproduced in Denison's "Clocks and Bells," a paper on a compound microscope with Coddington lens for objective, and sundry other curious articles besides the ones I have mentioned. In a back volume "F.R.A.S." quoted the results of Airy's article on spherical aberration of the Huyghenian eyepiece in a controversy as to the best focal lengths of the two lenses, and some time back Tydeman offered these improved eyepieces for sale.

In the Bedford Library were many back volumes of the "Philosophical Transactions of the R.S.," containing Mudge's (and others) investigations; I fancy a description of Hadley's (?) reflecting telescope, the first of any size on Newton's plans. If I ever spend any time in Bedford I will unearth some of these, with the Editor's permission.

Mr. Bradbury on the object-glass is delightful; I have wanted his articles for years, and trust he will go on until all the results of past workers shall have been reproduced in these papers, preserved for ever like the flies in amber, then it may be possible to have the whole reprinted in one handy volume. Will he please check the following summary for me? The double object-glass requires two lenses of different kinds of glass, shaped to satisfy two conditions:—

C. 1.—The dispersions of the lenses must be equal and opposite.
C. 2.—The spherical aberrations must be equal and opposite.

To satisfy these we have the power of varying three things:—

1. Ratio of focal lengths of lenses.
2. " radii of crown lens.
3. " " flint "

Therefore there should be an infinite number of ways of solving the problem, many of which in practice are inadmissible, for various reasons, as the limited supply of kinds of glass, the necessity of moderate curves, &c.

Since writing the above, I have read "Prismatique's" remarks, which have started me thinking. Surely, with moderately-long focal lengths, mathematics say we can have good results with spherical results; and, surely, they do not lie. Yet "Prismatique" (I wish I knew him) seems to imply that spherical curves *never do*, even when ground to correct radii.

Is this so? Is this the explanation? I offer it as a novice with all humility. To destroy primary colour, the focal length must be in a fixed ratio; but having settled this, many sets of spherical curves should theoretically destroy spherical aberration. But are they all equally good? and is it not possible that the least suitable produce more secondary colour and more spherical aberration than the one most suited to the peculiar glasses used?—so much more that "retouching" becomes a necessity? Moreover, may not the fact of most glasses needing it go to show that we generally use the least suitable spherical curves?

But still many are open; and it is only by introducing a third condition that we become limited to a single set of *spherical* curves (spherical or approximately spherical). This condition has been decided on by the investigator, thus: Herschel takes that the aberrations be correct for near and distant objects—(is this so?); Barlow that the ratio of surfaces of flint equal some value (which he varies for different kinds of glass); others take coincidence of internal surfaces (not always possible); or that no refraction takes place at last surface; or (as "O. V." thinks should be considered) the curves likely by inclination of surfaces to best correct the secondary spectrum. It might be that errors of workmanship produce least resultant aberrations; and if this could be attacked directly, would produce cheap and good five-pounders, and apparently Barlow's method does allow considerable latitude.

If the central zones are ground correctly to the exact radius decided on, they cannot need retouching; but I expect this is seldom the case, and that the retouching includes the correction of this: perhaps "Prismatique" will tell us. If the surfaces are ground to the radii decided on, I still see that the retouching would improve many curves fairly correct, but not the best. But if the best spherical curves be chosen and ground correctly, does "Prismatique" insist that a practically perfect objective can be produced with these? I ask because certain amateurs have been apparently successful without retouching. Also is the retouching aimed at secondary colour or aberration.

Lastly, if spherical curves won't do, is it possible to settle the character of the curves at which we are to aim, or must we work empirically? It should be possible to settle it for spherical aberration by mathematics, and then choosing first the best spherical curves for secondary colour ("O. V.'s" idea) alter them to obtain the perfect glass.

This is a long letter—perhaps of interest to no one but "O. V." I cannot send it him, though in his county, not knowing his address. I have one thing more.

"L. L. L." says, a mirror of Herschel's is at Stoneyhurst. I hope he does not quote me. I doubt the correctness of my information, and mean to ask again. I did hear this from one who should know. "You are replacing your object-glass by one by Dallmeyer," &c. "We thought of doing so: he wanted us to have a 6in." "But Cooke has improved his machinery, and had ours back again to retouch." "With good results?" "I believe so." "Prismatique" is corroborated; also "F. R. A. S." who said he had heard Dallmeyer guarantee 6in. perfect, but not more.

Bow.

CASSEGRAIN AND GREGORIAN TELESCOPES—SIZE OF FLAT IN NEWTONIAN.

[21124.]—In working out the details of a proposed telescope of either the Cassegrain or Gregorian form, there are certain points to be considered on which I would appeal for help to Mr. Calver, "Orderic Vital," or Dr. Royston Pigott, if he should see this.

First, as to the ratio of foci between the two mirrors, and the best proportion of magnification to be allotted to the eyepiece. In all old telescopes there were (except for the smaller sizes) at least two small mirrors in order to vary the power. What was the object of this, when apparently the same end could be obtained by deeper eyepieces? What is the *best* arrangement on the whole? Suppose we have a large mirror 6in. diameter and 36in. focus, would 6in., 4in., and 3in. be good foci for small mirrors with eyepieces of, say, 1½in., ¾in., and (*as an extreme* ½in.) equivalent foci.

How can the *exact* position of back focus of small mirror behind the vertex of large mirror be determined when its focus only, and not its radius of curvature, is known? And where would it be situated in the case of the three small mirrors of foci as stated?

At what point in the cone of rays should field-lens of eyepiece be fixed so as to bring the already converging rays to a focus at the right place within the above eyepiece. Doubtless opticians have some method or rule obtained by practical experience, which the makers follow, and which they find sufficiently exact.

Lastly—It has always been stated in our columns, and I have myself always assumed it was correct, that the focus of the small mirror should coincide in position with that of the large mirror; but in an article on the Gregorian, which I lately came across, it is stated that "in the best reflecting telescopes the focus of the small mirror is never coincident with the focus of the great one, but a little beyond it (with respect to the eye), the consequence of which is that the rays of the pencils will not be parallel after reflection from the small mirror, but convergent, &c." Now I cannot understand how the rays could be parallel after reflection, unless the small mirror was a *parabola*. If, therefore, the writer is correct, the curve employed by the old makers, (the book was published over 50 years ago) must have been neither the ellipse, as it theoretically should have been, nor the sphere, as has been generally supposed, but the curve I have mentioned.

Starting, therefore, with a parabolic small mirror, what curve was the large mirror?

A. S. L.

THE SEVEN DIALS.

[21125.]—I fear that the pillar, &c., mentioned in the *Builder* cannot be that to which I referred, as the latter was certainly standing *in situ* within the last thirty years. I thought the date 1773 might be a misprint for 1873, but it is correct as in the *Builder*, and I feel pretty confident that the pillar was removed prior to the latter date. The pillar was, to the best of my recollection, about 10ft. high, and the dials were on the faces of a heptagonal prism, say 18in. every way, with projecting gnomons, which gave it a very singular appearance.

Robt. J. Lecky.

SIZE OF FLAT IN NEWTONIAN TELESCOPES.

[21126.]—I am much obliged to Mr. Vallance for his description of the moon, as seen through his 15in. mirror with 14¼in. disc, and 1½in. flat, from which it is evident that at least some of the rays which find their way to the mirror, outside the disc, are reflected to the small flat, and are sufficient to give an image of the moon in the eyepiece. I tried a similar experiment with 12½in. mirror, 10in. disc, and 1¾in. flat, with the same result.

Mr. Vallance thinks, also, that there was as much light with the 1½in. flat as with the 2in. This I must leave to those experts among your correspondents who can calculate where this marginal zone of light would be reflected to, from the mirror.

I would point out, however, that there are two problems which await Mr. Vallance's solution.

The first of the marginal light in the mirror is, so far, solved as we see above. The second is: what is the nature of the reflection of the moon when seen in his 15in. mirror? Do the rays come to a *point* at his focus, 8ft. 4in., as he assumes them to do, when he says, "Taking away the eyepiece, I see the outside rim of the mirror," &c.? "F.R.A.S.," "A. S. L.," "F. M. C.," Mr. Calver, and Mr. Bell say, No. They have a measurable image, and they are all prepared to prove it, both by theory and experiment.

A friend of mine, well versed in optics, wrote me a short time ago as follows. "I waited to reply to letter till I could test by observation with my 8½in. mirror, 6ft. focus, the statements put forth. I find—1st. That the apparent size of the sun at 6ft. distance is ¾in. 2nd. That the focal image of the sun at 6ft. is ⅝in. 3rd. That the cone of rays from the 8½in. mirror as a base to the ⅝in. focal image, is larger than my 1½in. flat at the point at which it intercepts it, 5ft. from mirror. 4th. That the 1½ flat receives the whole of the cone if focussed to a *point* at 6ft., and has space all round in excess, sufficient to take in all the rays from a field of 15′ or 20′. So much for observation or practice. Mr. Vallance may be assured that true theory and true practice will not contradict each other.

"F.R.A.S." gives a formula which shows that the focal image of the moon, at 8ft. 4in. focus, taking it at 32′ ang. dia., is ·9308in. This being so, the rays from the mirror which terminate in this focal image *must* form the frustum of a cone whose base is 15in., and smaller dia. ·9308in. At 10in. from the focus, which is about, I think, where Mr. Vallance's flat is, this cone measures 2·3377in., or rather more than 2¼in. diameter. Now how is it possible for a flat of 1¾in. to intercept all the rays of light forming this cone? The fact is, it does not do it, and Mr. Vallance only deceives himself when he thinks it does. His flat for this object should be 2¼in., and if he could view the full moon with a shaded eyepiece through his 1¾in., and then 2¼in. flat, either in his own or another instrument, he would see the difference in the light, and be convinced that it is so.

Fordingbridge. **T. Westlake.**

RATIONAL DRESS.

[21127.]—In virtue of being the "enthusiastic gentleman" who wrote the "humorous pamphlet" from which your correspondent, "Testycrumbs," obligingly derived so much "amusement," may I be permitted to second his request for a discussion on the subject of rational (which will be found synonymous with artistic) dress for both sexes? I have explained, in the *Building News* of Feb. 16, that the Rational Dress Society, though formed in the interests of women in the first place, is not indifferent to those of men, and that the hon. sec., Mrs. King, of 34, Cornwall-road, Bayswater, desires to have men's reformed costumes on view at the forthcoming spring exhibition of women's ditto. And it has been proposed, in the next number of the same paper, that a men's branch of the society should be formed. The ladies being so well disposed towards our attempt, I trust all of us will give them a generous support in their own still more desirable reformation. My convictions and practical proposals have been pretty vivaciously expressed in the pamphlet referred to, which can be had for a sixpence of Mr. Starkey, Oxford-street, Reading. Speaking from more than six months' experience, I can assure "the timid ones" they have nothing to fear in the way of detriment or ridicule consequent on dressing in an improved style. One feels nervous and uncomfortable for a week, and then it is all over. I believe ladies might reform with equal impunity, if they had the courage. In their case I am convinced this reformation would be of more benefit to the human species than almost any known to history.

Wm. Simmons, Architect.

Blagrave-street, Reading.

[21128.]—I AM pleased "Testycrumbs" (21106) has brought forward the subject of dress. Male dress wants reforming quite as much as does female attire. Top hats, frock coats, and shoes with pointed, narrow toes are an abomination. Rational male dress could be made very simple, and to consist of a few articles: such as a close-fitting jersey to cover the arms and body, and coming down to the middle of the thighs; a pair of warm hose attached to the jersey, and reaching to the feet, which should be covered by some easy-fitting moccasin-like covering. Underneath the jersey would be a shirt of some kind of material which could be changed as often as desirable. The stuff of which these things are to be made must be light, warm, and semi-elastic, so that it will give freely. Narrow-toed shoes and high-heeled boots are neither pretty nor healthful, and ought to be abolished. For head-gear a Tam O'Shanter, or some like loose covering, is best. I envy the Blue-coat School boys who go about bareheaded.

The rule in dress should be to dress warmly, but not to have anything tight or heavy. Too many clothes beget great debility. If a person wears many clothes and takes much exercise he quickly gets hot and perspires freely; and the pores of the skin not being cooled and closed by the air, a delicate habit of body is often induced. We all know how athletes reduce their surplus flesh: they dress very heavily and take violent exercise, and in a short time pull themselves down in weight many pounds.

Clothes were meant, in the first place, for ornament; now they are also used for decency and warmth. That "Nature unadorned is nature best adorned" I see every day. Patients when in bed look regular aristocrats; but when up and dressed they are every-day folks. Again, men in the Turkish baths look handsome when in a simple white sheet drawn round them, and on their heads a white towel.

The "Rational Dress Society" at present confines itself to ladies' attire; but Mrs. King, 34, Cornwall-road, Bayswater (the present secretary), is desirous of forming a society in which both sexes may be represented; so if anyone would like to communicate with her, she will be pleased to hear their views.

"Ventilator" (21110) can easily test if sewer-gas escapes into his house. Procure a small bottle—say a drachm or two—of ether, pour this down the w.c., and let any friend be stationed where it is expected that gas escapes. If he can smell the ether, which is very penetrating, he may be sure that sewer-gas escapes. To test the presence of sewer-gas, get a little acetate of lead from the chemist's, make a solution of it, dip in the solution pieces of white blotting-paper, and hang near the suspected place of escape. If the paper is darkened, an injurious gas—sulphuretted hydrogen—is escaping, the black colour being due to sulphide of lead.

I do not like trespassing on Dr. Edmunds' grounds—I should rather prefer to write generalities to set people thinking, than to answer ordinary questions. There is this drawback: one cannot see the patient, and so judge by appearances, &c. Let "H. P." (49597) give his daughter oatmeal porridge and milk for breakfast, or bread-and-milk; potatoes, vegetables, and a little gravy for dinner; milk-and-water or cocoa at tea-time, with a little toast and preserve of some kind. Knock off cod-liver oil and all drugs, give a lukewarm sponging of the body daily, and let her have plenty of fresh air and exercise. The best plan to get children to exercise is to give them a hoop, ball, or skipping-rope. If the latter, give them a halfpenny for every fifty skips they can skip continuously. When they can skip forwards well, make the condition that they skip backwards, and so help to expand the chest.

Feb. 26. **T. R. Allinson, L.R.C.P.**

TRICYCLES.

[21129.]—As I can add some 18 years to C. Calvert's 25 of experience as an "Amateur Mechanic," I am not likely to question the merit of "direct action" as an abstract proposition; nor do I desire to detract in any way from the somewhat profuse laudations which have been, just of late, heaped on one particular machine, through the medium of "our journal." As a devotee of the tricycle I would say, All honour be where honour is due for any step that may aid in perfecting our iron steeds. But as one of those who think we have not yet seen the best machine that could be put on the road, I am always rather sorry to see any particular pattern held up as the embodiment of every perfection, because it possesses some one good point. It is always well to keep in mind that the best tricycle for general work must necessarily be that which effects the compromise between a variety of considerations, any one of which, if taken alone, might seem to be of such importance as to outweigh all others. The duties of the tricycle are not like those of the locomotive which runs at high speed on a road purposely laid to suit it; nor like those of the traction engine which has to take all roads as they come, but which is never required to travel *fast* on any. The tricycle must be fast on the flat, steady in rapid descent, and powerful on the ascent; while it is highly important that the arrangement of all working details and the adjustment of the weight it carries, should be such as to secure to the rider that consciousness of personal comfort and convenience under every varying condition of town, street, or country road, which is almost as essential to safety and effective work as any mechanical detail of the machine itself. Thus the machine which may ultimately bear away the palm for combining all that is essential to satisfy so many different requirements, is bound to be more or less of a compromise; and it seems to me that the best interests of the tricycling fraternity are more likely to be advanced by discussing desirable points of construction in their relation to each other, than by trying to explain away all the drawbacks in any one particular machine, because it may happen to possess some one special merit which is neither original nor peculiar to itself. And so, seeing that whatever the recent Stanley Show may or may not have proved as to the comparative claims of different machines, it was yet the most undeniable testimony to the very wide-spread and growing interest in the tricycle question, I venture to offer a few of the impressions left after some 12 hours spent in different visits to the Exhibition at the Albert Hall. Possibly some such general reflections may prove useful to those intending purchasers who have not yet given very careful attention to the subject; and for my own sake I hope to provoke some blows from the hammer of criticism for which "our journal" is so famous, and which are always the most wholesome means for knocking any private ideas into sound and useful form.

First, then, as to general form. The open front must be allowed the advantage of greater convenience in mounting and dismounting, and of less risk of injury in the event of accident. It is also clearly the best arrangement for hill-climbing and heavy roads, as it is always easier to *drag* than to *push* a small wheel. The drawbacks are, that, if made too short, it is difficult to adjust the weight upon it without either throwing so much weight on the hind wheel that it becomes a drag in heavy roads; or so little, that the hind wheel is not reliable as a rudder. Thus all *short* open fronts may be suspected of skittishness under high speed (especially down-hill), or of dragging in heavy ground if the kicking-strap of weight binds down their tails too heavily. But a proper length between the axles of the drivers and that of the steering wheel (say about 45in.), and a careful adjustment of the weight in proper portions between the rear and driving wheels, will make an open front safe anywhere and at any speed, in fairly competent hands. The rider should, however, learn to sit well back when shooting hills, and under all conditions likely to promote an accident. It is not difficult to trace much of the favour which is just now being bestowed on front steerers to the growing fashion of what is called "Vertical action." For when the rider is so placed that he is immediately over his pedals, he is not only in a position where his own weight is much more liable to be jerked forward by any sudden check to the machine, but that position deprives him of the power of leaning back to any great extent without the risk of his feet slipping off the pedals. Thus, for those riders who like very vertical action, and who feel a suspicion that they might go over even a horse's head if he happened to kick up, there can be no doubt that the perambulator type of machine is safer of the two for avoiding such a catastrophe; though the front hamper would become a disagreeable trap for the legs, if the accident did occur. Still in this case, any craning forwards puts the weight on the rudder instead of taking it off. The form of the front steerer, however, affords another advantage which I believe has far more to do with the favour it has lately met with from bold and capable riders, than the fact of the steering wheel being in front. Such riders are fond of "making hay while the sun shines" in the way of taking every advantage of gravity in hill-shooting, and this raises the question of the rival claims of "differential" and "independent" double driving. I may, of course, safely assume that there can be no question about the relative merits of the "single" and "double" driving. Admitting that some single-drivers may be better than some double-drivers, the question here is one of principle, and there cannot be a moment's doubt that the best double-driver is better than the best single-driver. The present question is, Which is the best form of double driving—"differential" or "independent"?

And here we come at once to a question of compromise, for the "independent" plan is clearly best for hill-climbing and rough roads, while the "differential" must carry the day for high speed. In the "independent" system, the fact that that wheel which meets with most opposition will also receive most force from the tread, while the reverse is the case with the "differential" gear, may be tested by the simple experiment of laying a brick or other obstruction on the ground and driving one wheel over it at a slow speed. The "independent" double driver will not reverse, but the "differential" driver is almost certain to do so a little, if the rudder be not touched. But when a machine is running at high speed, another force—that of momentum—is imparted, and now it becomes of the first importance to couple the driving wheels so that neither can outpace the other; which is the objection that the "independent" double driver is open to when running free, in common with the ruck of single-drivers when both wheels are of the same diameter and one is a loose wheel. That the very undesirable trick, commonly called "skidding," is really due to one wheel outpacing the other rather than to the skidding of one of them, may I think be proved by the superior way in which such machines as the "Excelsior" and old "Coventry" will shoot hills at high speeds, as compared with single-drivers having wheels of equal diameter. Of course, in both these instances the greater safety is partly due to greater length, and to the fact that the inherent defects of the single-driving principle are very much corrected by giving the driving wheel an intermediate position between the loose side wheel and the steering wheel. But I am convinced that the exceptionally good qualities of these two types of single-driver under high speed, are very largely due to the difference of diameter in the side wheels. Every mechanic knows that it is much easier to contend with some known and constant influence of disturbance, than with one which is perhaps much slighter in itself, but which is variable and uncertain. Now according to the laws of motion the large wheels of the two machines named above would very much overpace their smaller companions, when the machine was running free. But the error here is too decided and constant to admit of any change from side to side, and oscillation is corrected by the different sizes and positions of the wheels. Thus the rider has no change of conditions to deal with in steering. But the case differs when wheels of the same diameter and on coincident axes are running free. Then there is no telling on which side the skid or the overpace may occur, and when once oscillation is set up, the only way to stop it is by connecting the two wheels by the brake, which at high speed down-hill requires a very well-fitted brake and some judgment and experience in its use on the part of the rider. But though "differential" gear is the worst for hill-climbing and slow speed, its good qualities are shown in hill shooting and high speeds generally. The principle may be simply shown by blocking up any differential machine so that both drivers are clear of the ground. Moving either wheel will move both in the same direction provided the pedal crank be left free to revolve. But if this be held still, moving one wheel in one direction will turn its fellow-wheel in the other. Thus it is apparent that when both wheels are on the ground and neither can turn back, the same principle which causes one wheel to do so when running in the air, will make it act as a drag on its fellow-wheel if that tries to overpace it when both are running under the influence of momentum. So that as a matter of fact, the check which each wheel imposes on the other is increased by the force of momentum in exact proportion to the risks arising from the same cause when the two wheels are running quite independently. Now in the front-steering pattern it is very simple to apply the differential connection, as the necessary shafting does not interfere with the rider's legs. Nor is there any difficulty on this account in machines of the "Humber" type. But with the ordinary hay-fork open front a shaft passing from axle to axle of the two driving wheels would come in the way of the rider's legs. Hence a problem which is, I think, well worth solving—viz., some simple method of applying differential gear to the old convenient pattern of open-front machine—only made a little longer in the backbone than usual. I must here notice a most laudable feeler in this direction exhibited at the Stanley Show, by Messrs. Rucker, where the differential principle was applied through the pedal crank. I may do this without appearing to be puffing the machine in question, because the complexity and unsightliness of the arrangement as carried out, would effectually prevent a machine from becoming a popular favourite. But any effort in this direction is too laudable to pass unnoticed while on the question of the "reason why" for the growing taste for front steerers. I believe the real cause of this is supplied far more by the fact of the facility with which differential gear can be applied to the front-steering type, than to any other advantage or safety furnished by the perambulator pattern, which cannot compare either in smartness of appearance or in many more sterling recommendations, with good patterns of the open-front type. It is certainly rather curious, but I think it is a fact, that the great merit of Starley's balance gear is generally supposed to consist in the way it enables the machine to turn, rather than in the steadying effect it exercises in keeping the two driving-wheels at uniform speed under the influence of momentum. It is of course theoretically better for turning than any other form of double driving. But where the pedal-crank has a free backward motion (as in the Devon, Cheylesmore, Rucker, &c.), there is such a total absence of any practical objection in the matter of turning, that this point alone becomes one of positive indifference. This leads directly to the relative merits of the fixed or free pedal crank; that is to say, of having a crank which will, or which will not, back-pedal. Here, too, there would seem to be a very narrow view of the practical utility of the free pedal-crank; and even the advertisements of makers treat it rather as a question of convenience in the way of supplying foot-rests, than as a question of constant practical importance for utilising all the power the rider exerts. The great merit of the independent pedal-crank is that it deprives the rider of the power of back-pedaling when the machine is running: and there is not perhaps one rider in a hundred who does not do this more or less by allowing the pedal-crank (and consequently the driving-wheel, when the pedal-crank is fixed), to lift his rising leg. This question may be tested in a very simple way. Let any old rider who has been accustomed to the fixed crank, mount a machine with a free pedal-crank. If he can ride a mile without any consciousness of hitch in the pedal-crank, he may congratulate himself on having acquired the art of pedalling to such perfection that the *convenience* of the free pedal is all he need think about. But if, on the contrary, he finds that the free pedal-crank now and then refuses to come over cleanly, or sometimes even falls back and hits him on the shins as the machine runs on, it is proof positive that he has hitherto been depending on the momentum of the driving wheel for lifting his rising leg; and, if so, he has been practically back-pedalling. For every ounce of momentum used to lift a leg is so much off the momentum which plays such an important part in the progress of the machine. Now it would be extremely difficult, and it is open to question whether it would be desirable, to deprive the rising leg of all aid from the falling foot. There is much to be said on this point, for it is clear the leg could not be lifted without the expenditure of some muscular power on the part of the rider; and whether each leg has to lift itself or each is alternately helped by the other, cannot perhaps affect the conservation of the rider's general power very much. Thus far the question is simply one of convenience, so long as the rising leg does not exert any downward force while being lifted; and so far, the fixed and free pedal cranks will act in the same way and afford precisely the same amount of convenience. *But any help beyond this must come out of the momentum of machine;* and thus, any rider who finds he cannot use the free pedal off-hand as comfortably as he has used the fixed pedal, has proof positive that he has hitherto been more or less interfering with the momentum of the machine; or, in other words, wasting some of the power he has exerted. And this is unavoidable so long as the pedal-crank is fixed, unless the tread be absolutely perfect, which all old riders know to be a most rare accomplishment. But the great advantage of the free pedal-crank is that, while it leaves either leg to help the other in its rise just as much as good or bad treading may require, it makes it impossible for the worst treader to waste his power by interfering with the momentum of the machine. The universal acknowledgment of these facts is impressed by the very objection raised against the free pedal-crank—viz., "You cannot back-pedal." And of course, if this incapacity, which is so very desirable in actual running, could not be removed for the occasional need of practice, there would be some ground for arguing against the purchase of constant advantage by the sacrifice of occasional convenience. But there is now in the market an admirable and perfectly simple and safe arrangement for instantly fixing the free-pedal whenever back-pedalling is needed. The Coventry Machinist "Imperial" affords an excellent example of this. It must be admitted that a back-pedalling clutch on an open front "independent" double-driver is open to objections which make it undesirable in any hands but those of experienced riders, as its use locks the machine on one side. But the "differential" double-driver, such as the example just named, removes every possible difficulty and objection. In concluding my remarks on this special point, I venture to say that it is very difficult to over-rate the constant practical value of a pedal-crank having a perfectly free backward motion. Of course, like everything else of real value, it may prove awkward at first in inexperienced or incompetent hands. But a week's riding should make any one who aspires to the name of a tricycle rider perfect master of this pedal motion and the use of the brake, on which, of course, the rider must now depend for the ordinary control of the machine. Brakes are now so perfect and efficient that any risk on that score may safely be classed among those which every one who moves about on a machine (or on his own legs for that matter) must run. I would only point out this: with free-pedal action, the handy position of the *brake handle* becomes a matter of the first importance as regards *convenience*. Nothing is more annoying than having to move the hand for every trifling touch of the brake. The handle in this case ought to be placed so that the *fingers* of the left hand can work it without removing the hand itself from the steady handle. This is most important as a matter of convenience. I cannot leave the free-pedal crank without a testimony to its great value as a trainer in treading properly. The little hitches which may be felt on first using it, are the very best proofs of how much such training is required. With the free-pedal no one can tread very badly without being at least told of it by the hitchy motion of the crank. But a fixed crank gives no notice on this point, and the rider may go on for ever wasting his power. It must be a hopelessly awkward rider who cannot acquire the art of using the free-crank; and, its use once learnt, it is difficult to make a false step with it. Apart from its great service in preventing interference with momentum, its conveniences are too many and various to enumerate. But among these may be mentioned its handiness for mounting and dismounting, and starting at full stroke, or recovering a stroke; and for propelling gently by short light strokes, or getting through difficulties by short strong strokes taken with the crank at full power, while the great advantages of being able instantly to stand still and attend only to the steering, while the machine runs on through any difficulty, or after any severe jolt in night riding, or when there has been a slip of the foot in wet weather, or from a muddy shoe, can only be appreciated by those who have learned from experience what the comfort, safety, and many conveniences of the free pedal-crank are, in addition to its constant economy of power in making involuntary back-pedalling impossible, and teaching the best kind of treading. The only drawback to its use is that the rider who has become accustomed to it can never again feel quite safe on any machine with a fixed pedal-crank. **D. H. G.**

(*To be continued.*)

BRAKE FAILURES.

[21130.]—In the first place "Auto. Vac." (letter 21063) is evidently labouring under the false idea that the figures which I gave are merely theoretical calculations. I tried to state as plainly as I could in my letter, page 455, that this was not the case, but that these figures were taken from *indicator diagrams* made with Clayton brake apparatus. I would ask "Auto. Vacuum" to read the first paragraph of my former letter again. At all events, for his benefit, as also for that of all interested, I will state that those figures are thoroughly practical. It is remarkable that he does not deny the truth of them. I may say that it is of no use to do so, as they are a stern *fact*, and a fact that he cannot get over.

Very few drivers know that 10in. of vacuum is of no service. Neither "Auto. Vacuum," nor myself, nor anyone else would expect a driver to bother himself about what happens in the brake-cylinder. He would and does naturally expect that 10in. on the gauge means 10in., and nothing else, and not 1½in., as it does.

I maintain that 20in. of vacuum is above the average; 15, I believe, is the usual minimum amount allowed by the company. Many drivers run with less than this *in order to keep up the boiler pressure*, and because the brakes are easier to release.

"Auto. Vacuum" mentions the cylinders fitted to the carriages. This cylinder is not quite so satisfactory as he says. The stroke is far too short, but it cannot be made longer for two reasons:—1. When there is a longer stroke, the air remaining above is much more compressed, and there is a much greater loss of power, as I said in my last letter. 2. Owing to the low pressure obtainable, a high leverage is necessary. To obtain this leverage with such a short stroke, the brake blocks have to be fixed close to the wheels, or they would not touch the wheels at all, and this necessitates a very frequent readjustment for wear. So it will be seen that the real amount of brake-power *must* be taken into consideration.

The pressure in the boiler *often* goes down from 140 to 100, and even to 90 when the large ejector is applied. The drivers find great difficulty in keeping a good pressure up when the small ejector is constantly in use—not to speak of the large one. I will give an illustration. On Sunday, Feb. 4th, engine 1409, with a train from Carnforth, ran into Leeds buffer-stops from this very cause. The driver could not make steam with the ejector constantly blowing, and so he shut it off in order to keep time. Hence, when running into Leeds, there was no brake power. This is an example of the *satisfactory* (?) nature of the brake.

Still another instance. Some time ago a driver was suspended for running past the signals at the north end of the Normanton Station. The engine was 1330, and the train was a special express from London. Here again the brake showed its very *satisfactory* nature. The driver maintained the vacuum up to Cudworth, although the steam fell to a low pressure. On going up Cudworth Bank, however, the driver found that the engine would not work well, and that he could do nothing with it so long as the "ejector" was blowing. So, in order not to "stick" on the bank, the ejector was shut. On arriving at the south end of Normanton Station the signals were "off," and the driver, thinking the signals at the south end were interlocking with those of the north, ran through the station, but found the north signals against the train, and having no brake-power, ran past them. The case would not have been known; but a fellow-driver had the courage to take up the case, and write to the engineering papers about it.

Respecting the "little narrative," as "Auto. Vacuum" calls it, I may tell him that the affair has happened from the very cause referred to, although the consequences were not disastrous; but ended in overshooting a station platform. This latter proceeding, by the way, is a "sort of weekly occurrence" at Bedford, and the crowded junction of Kentish Town.

With respect to coal-consumption, on an average (calculated from various coal-sheets), *2lb. per mile are consumed by the ejectors.*

With reference to the fining of drivers for not keeping time, I may possibly be wrong as to this; but I know that they are severely reprimanded when it is of regular occurrence.

"Auto. Vacuum" says that all bad mistakes are made through the driver not first bringing his train under control. I question very much whether a driver *can* bring a train under control down a heavy bank, with a brake leaking-off all the time; and it is for this reason that a driver re-creates another vacuum, to have a *new* supply of power, as mentioned in my last letter.

Drivers are *not allowed* to make comments to their superiors with respect to the brake. They are told: "The brake is there for you to work, and you are not required to make remarks about it." Therefore, to avoid getting into "hot water," the drivers say, "I don't know." to any question the answer to which is not favourable to the brake.

If the brake is satisfactory, why do the drivers condemn it? Why did an express train run up the Market Harborough bank, with the rear part of the train hanging by side-chains only? Where was the automatic action in this case? Engine 1473 ran the 3.30 p.m. train from St. Pancras, between Bedford and Leicester, with the hose-pipe not properly put on the plug at the rear of the train. Why did not the automatic action prevent this train from starting until the pipes were properly coupled? What did Colonel Rich say about the Portskewet Pier accident (G. W. R.)? That "the collision was caused by the vacuum brake failing to act when it was required." **Meteor.**

[21131.]—Your correspondent "Automatic Vacuum," (21003, page 527) has expressed his desire to see and read the opinions of "some other practical man" on the various points touched upon in his letter. I say *touched upon* advisedly, for much as he lays stress upon the *theoretical* composition of "Meteor," his own lacks even that qualification, and does not go far to defend the appliance he has so kindly, but albeit so weakly, endeavoured to champion. With your permission, Sir, I will give "Automatic Vacuum" my views as a practical engineman of nearly 20 years' experience (which is long before the brake question became the important one it now is). First of all there is a vein of mystery running throughout "Automatic Vacuum's" letter which *practical* men are not slow to detect; it savours too much of one who would say something if he could, but has either not been supplied with the proper materials, or has forgotten the better part of what he has been told. I should like your correspondent to be placed where he could hear his effusion discussed by a body of engineers. I fancy he would go away a "wiser, if not a sadder man." I will not argue every point with him, but just sufficient to show how little he must really know of his subject. He says he has "never heard of, or seen any account of a M.R. driver being fined for losing time, *especially* when there is a sufficient cause to put the time to." What a field of knowledge he possesses! Let me tell him a secret: I have never known it either, but if he ever does lose time, if he ever does (now don't tell this to everybody), let him shelter himself behind some pet invention of an official if he has the chance, and *ergo* he will have sufficient cause, &c., ad libitum, ad infinitum.

Then mark the standard by which he measures the quality of drivers—namely, the "consumption sheet at any large loco. station." How the drivers will laugh at this. Why surely he does not mean this except as a jest. If not, I will inform him that taking those sheets as a general rule they may be read like compositor's type; that a difference exists none can deny, but it is not to be detected in the manner described, which is as trustworthy as the "Brake Returns" referred to.

Again "Automatic Vacuum" creates a difficulty for his pet, for which his superiors will hardly thank him—namely, the vast amount of intelligence and information required on the part of the drivers before they can "thoroughly understand it." I think its patent should have been taken out by "Lord Dundreary" as one of those things "no fellah can understand," and how can it be, when according to "A.V.'s" account the M.R. men do not know even of the existence of atmospheric pressure. If "A.V." will only institute a science class where these men might receive a course of lessons on the subject, to enable them to learn that it is air they breathe and not coal, or water, then *you see* the brake might be understood, and by all means let "A.V." be a student.

"A.V." says "if the leakage past the piston can be stopped, &c." Now if he knew the slightest of what he is speaking, he would know that it *was stopped* at first, for the hole never existed, but the hole was made and patented because certain inconveniences (which I cannot detail now) existed without it, and those inconveniences have been replaced by others now the hole is there, which if stopped again, will only be again, in turn, replaced by the former ones. When "A.V." says that perhaps his letter will account for some of the omissions in the Board of Trade returns, it reminds one of the fable of the bull and the frog. One word to "Meteor" and I am done. Your letter is an able exposition of the *true* state of affairs, and greatly admired by practical men.

Ne Sutor Ultra Crepidam.

CONTINUOUS BRAKES ON THE LONDON AND NORTH-WESTERN RAILWAY.

[21132.]—IT is now two years since the serious collision took place at Dalston Junction, which gave the *coup de grace* to the Clark and Webb Emergency Brake.

Since that time it has been frequently stated that the Company intended to adopt an efficient system.

It will be remembered that on the 2nd of April, 1881, a secret so-called conference was held at Euston Station, to which only the advocates of the vacuum principle were invited. Of course under those circumstances it did not surprise any one that the meeting was in favour of vacuum brakes.

A year ago experiments were made with a non-automatic vacuum brake, known as the Webb-Gresham, and with the Clayton hose-pipes.

At the half-yearly meeting held at Euston last week (February 17th) the chairman informed the shareholders that they had resolved to fit their through trains with the vacuum brake, the reason given being that it was used by neighbouring lines.

For many years the North-Western Company has persisted in fitting its vehicles with the chain brake, and an enormous sum has been spent upon it. Now, it seems a perfect waste of time and shareholders' money to remove this "chain brake" simply to replace it by an *inefficient* vacuum system, which does neither fulfil the Board of Trade conditions, nor work satisfactorily.

The most important "through trains" upon the North-Western are those running between Euston and Carlisle in connection with the Caledonian line and all parts of Scotland.

It is very essential that companies who exchange rolling-stock should adopt the same brake. More exchanges are made at Carlisle than at any other station on the North-Western system, or, perhaps, in the kingdom; here we see the Glasgow and South Western, Caledonian, North British, North Eastern, and Midland trains, also the Lancashire and Yorkshire through vehicles, and the Midland Scotch Joint Stock, all fitted with the Westinghouse automatic brake. When the North Western has gone to the expense of taking off the "chain brake" and putting on the "vacuum," it will be seen that the vehicles will be no more interchangeable than they are now. This company also exchanges much rolling-stock with the Brighton, North-Eastern, and Great Eastern Railways, all three of which have adopted and fitted the Westinghouse brake. It is absurd that at the present day any company should adopt a brake which does not fulfil the necessary conditions.

Clement E. Stretton.

Saxe Coburg-street, Leicester.

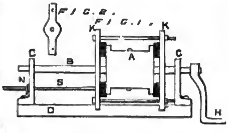
THE BLACKWELL ACCIDENT.

[21133.]—IN my letter, p. 549, I gave details of the recent accident at Blackwell, and the committal of the signalman for manslaughter. Your readers will be pleased to hear that this poor man has been tried and acquitted. I trust this accident may tend to an alteration being made in the amount of telegraphic work performed by signalmen.

Clement E. Stretton.

BORING CYLINDERS.

[21134.]—IN reading the articles on "Tools for Amateurs," by Mr. Brown, I am reminded of a method of boring cylinders shown me by an engineer. As he was a practical man, and used the machine drawn for boring pump-barrels and cylinders of larger bore than that given by Mr. Brown, the method may be worth describing; but of that you must be judge. It seems to me to contain a hint worth having, as, beyond a boring bar (true and parallel), there is nothing that requires a slide-rest.



Referring to Fig. 1, A is cylinder, B the bar turning in bearings C, which are screwed down to a wooden slab D. The cylinder is held by two bolts between two flat pieces of iron, which are of shape given in Fig. 2 (the central holes sliding without shake on the bar), blocks of wood, shown by the shaded portions, being interposed to enable one to get at the cutter, which is wedged or otherwise fastened in the slot in the bar. The feed is given by a screw-bolt S, fastened to the bar K, and drawn through a hole in the standard C by a nut N, which was turned by hand or, in some cases, automatically by a star feed or pair of cog-wheels, one being placed on the bar B, the other attached to the nut N. As the boring is done by turning the handle H, the cylinder is prevented from revolving by the end of K resting against the edge of D, along which it slides. I see no reason why a slot should not be cut in K to enable one to get at the cutter more easily. Obviously the bar must be more than twice the length of the cylinder.

Mr. Brown mentions the case of a fixed cylinder, with cutters fixed in a boss travelling along the bar; this seems a converse.

Bow.

MANDREL-NOSES AND CONICAL FITTINGS.—III.

[21135.]—I HAVE one other suggestion to make, and it is that an experiment should be made, by some society perhaps, to find out whether or not chucks can be made interchangeable. Let a mandrel be made to Dr. Edmunds' pattern, or after the plan I have suggested, or some other, if a better can be found; and let some chucks be ordered from another maker, giving only the dimensions and the cone gauges in my case; and then let the chucks be tried on the mandrel. Now that *nose-ology* is to the fore, let us by all means try to make some progress.

I was glad to see another letter from "Mechanicus," and hope he will continue to give us the benefit of his ripe experience.

F. A. M.

[21136.]—I HASTEN to relieve "F. A. M." (letter 21085) from his fear and trembling by telling him that his proposal is not so very audacious as he supposes, as I saw, thirty years since, several lathes at work in the shop of an ingenious mechanic in St. Martin's-lane, W.C., one Belmer by name, who told me it was his own idea, and that his object was that one chuck should run true on any lathe in the shop; the said lathes were all made with double bearings, solid steel mandrels, hardened first and turned up after; the two collars fitted into conical holes in the mandrel frame, slit through, with two screws to force them in to the said conical holes, so as to compensate for wear, and the mandrel kept steady by having a V-groove turned in the mandrel, and a feather screwed to the frame to fit it; the mandrel frame was longer than usual, and the mandrel drilled right through for wire; the foot-boards of the treadle were made so that they would oscillate, or rock, to a certain extent, to follow the motion of the foot in treading. The only fault of these conical shoulders was that the chucks would occasionally jam up tight. I myself require some hundreds of different size screws to run true in my lathes: these I make with conical fittings, so that one set will serve for several lathes.

T. J. B.

[21137.]—No doubt the cone-nose, illustrated on p. 549, "E.M." is a good plan for keeping chucks true; but they will stick very tight, and require special means to get off. Perhaps "F. A. M." has got some means of easily unscrewing them, and will favour us with his plan.

Ex.

ORNAMENTAL LATHE-SCREWS.

[21138.]—DR. EDMUNDS (letter 21102) is quite correct in his supposition that my "attention has not been called" to what he speaks of as the "matter at issue." Indeed, I told him myself that I had not read any of the letters on the subject. Dr. Edmunds uses the dictionary-spelling of "mandril" which the dictionary-makers would probably alter if they knew the derivation of the word. I altered it in every case in the proof of my letter, but the compositor failed to take note of my having done so.

Has the making of H. and Co.'s threads ceased, or have they ceased to be used for the purpose for which they were originally intended? One of these two conditions is necessary to render a thing "obsolete." If the former is the case, Dr. Edmunds's labour is ended, and might have ended before it began. Cicero understood Latin very well, but I fancy his English was shady, as that even in newspapers is now and then.

I never attempted to defend any one of H. and Co.'s threads, except the 9·45, and that one on one ground only, as Dr. Edmunds will see if he looks at line 23, *et seq.*, of my letter on p. 499. It was by him condemned as "incommensurable with the inch," and I showed that it is not so. It is true that among H. and Co.'s ordinary set of 15 wheels there is no multiple of 7, which, as I pointed out, is what is indispensable for cutting 9·45, and the want is equally felt if you desire to cut 7, 14, or 21 to an inch.

I never use H. and Co.'s threads myself. Although I have about 100 sets of screw tackle, I have not more than a single tap of their make or thread, and only seven pairs of their hand-chasers, which I keep by me in case of a broken screw wanting replacement. I do not think that I have anywhere a screw cut with one of their tools, with the single exception of an adapter-chuck, for taking an oval-chuck that I now and then borrow from a friend.

I have sent to Dr. Edmunds the settings for all H. and Co.'s threads, most of which I can cut with accuracy; and as I have all the prime numbers up to 150, I can match very closely any thread that happens to be put before me, and I have a set of cylindrical plugs with threads of every number, from 20 to 54, cut on them, so that I can very readily determine the pitch of any screw that may be brought for me to match. With these threads, however, it is absurd to stickle for any great precision, as the greatest length ever required would probably not much exceed half an inch.

Dr. Edmunds reminds me of something I said last April. If I did say that I should not dream of putting any but a Whitworth thread, still I did not say which of Whitworth's pitches I should use for a certain diameter. If I were to start making a model mandrel for a 5in. lathe I should very likely make the nose ¾ diameter, and use a 7 to the inch screw; certainly nothing finer than 9 to an inch; in fact on referring I see that I there recommended even a coarser thread.

From a series of experiments that I have been making recently with screws of particularly quick pitches, I have come to the conclusion that if all Dr. Edmunds and I know about screws were written in a book, and all that we do not know were put in an appendix, there would be more to be learnt out of the latter than the former.

People—that is, some people—talk of Whitworth's "threads" being too coarse for putting nice work together. What they mean to say is that Whitworth's ordinary bolt-screws are of too coarse a thread for that purpose. But what is to prevent taps being made say ¼in. diameter, with 24, 25, 28, or 32 threads upon them. I have ¼in. taps of all those threads, and very nice sizes they are for different purposes. So also I have seven different sizes of taps 14 to an inch and five of 12 to an inch. I consider for all-round purposes there is no thread superior to Whitworth's of 55° with depth ⅔ of pitch.

J. K. P.

SCREW-THREADS.

[21139.]—As a member of the Amateur Mechanical Society, I should like to make a few remarks on the subject of screws. Firstly, very few amateurs cut the screws in their chucks in a screw-cutting lathe, and that, for the best of reasons, because they have not got one, but use the taps and chaser which ought to accompany every lathe. Then for repairing or making a new screw, such as a bolt for the face-plate or the traversing-screw of the eccentric cutter, the only way to do it open to most amateurs is taps and dies, and the hand-chaser, and the difficulty at present is that one can only get these tools at two of the lathe-makers who use them, and then only by paying the price which is the result of smallness of demand and absence of competition. I quite agree with Dr. Edmunds that it is very desirable that the pitch of all screws should be commensurate with the inch, and this advantage his system shares with that of Whitworth, and the shape of the thread proposed by him has no doubt advantages; but these advantages would, I think, be too dearly bought. As there is very little chance of his screws being universally adopted by engineers, the taps, dies, and chasers would still be made by only one or two firms, and would be as expensive as those at present in use. If Whitworth's thread is adopted, and I want to make a new screw to replace a broken or damaged one belonging to my lathe, I can probably borrow the tools, or, at any rate, I can buy them at the price caused by large demand and great competition. I do not wish these remarks to be taken in any controversial spirit; but solely as aiding to clear up the subject. I was much interested in the report of the discussion at the Society of Arts, and am anxious to know how a screw can be cut absolutely up to a shoulder, as I do not understand what becomes of the shaving. Is it broken off? and if so, how is the ragged surface that would be left, finished? Of course, if a small hole is bored, the shaving can be cut clean off—is this the case?

While on this subject, I may add that excellent screws can be cut on wood, and with care, even on metal, by using tape bands and wooden wheels, instead of the usual cogwheels. A chuck carries a wooden wheel, and beyond that a false nose, on which the lathe-chucks can be screwed; by using an adapter they will run true, and a wooden wheel is put on the end of the slide-rest screw. The tape can go direct from one to the other if the slide-rest has a cradle, and by getting the tape as tight as possible and using the lathe-band as loose as possible, very good screws can be cut; in the event of anything sticking, the lathe-band slips. I have a screw cut in boxwood, 7in. long, which is, I believe, as accurate as a wooden screw can be.

Arthur B. Price.

Down Lodge, Epsom.

ECCENTRICS IN REVERSING GEAR.

[21140.]—Under the above heading, in Letters to the Editor, Feb. 9th, will be found an outline engraving that the writer says he has seen somewhere, but is uncertain as to its successful action. I beg to refer him to pp. 33 and 174, in Vol. III. of the "E. M.," and p. 28, 64, and 77 in Vol. IV. for further details.

I should like the opinion of several competent correspondents as to which method is a success when put into practice, for the writer in Vol. III., p. 174, says that given on p. 33, Vol. III., is not at all satisfactory, and a later writer says they are all to some extent faulty. Would it not be cheaper and better to have double eccentrics if there is room for them?

M.M.I.Sc.S.

PORTLAND CEMENT.

[21141.]—So many inquiries relative to various cements induces me to make a few observations on one of the uses of Portland cement, that I think is not generally known or thought of, that is the arresting of decay in woodwork, &c. I have for some years used it for the above purpose in my conservatory and hot-house, the woodwork in which is very subject to decay from being always damp. A beam in conservatory was so much decayed about five years ago, I could have put my hand in. I picked out the decayed part and filled it with cement. To all appearance it is as good now as when it was done, and with many other smaller defects it has been equally successful. Watering-cans in a few years begin to leak at the bottom; a quarter of an inch of cement on the bottom will make them last a few years longer. In this and small jobs I use pure cement, for gate posts, and other larger work half cement and half coarse clean sand will do; but Portland cement is so cheap it as well to use it pure. In a week or so it may be painted over, and if carefully done the repair will not be observed.

W. Grimshaw.

MEDICAL REPLIES.

"Fix upon that course of life which is best; habit will render it most delightful."—Pythagoras.

[21142.]—Singing in Head (49618).—Refer to former notes by me on ear diseases.

Nervousness and Sleeplessness (49623).—Eyelids (49639).—Querists must get personally examined by a competent doctor, so as to ascertain the *causes* of their ailments. The former should study what I have already written upon diet and hygiene in the English Mechanic.

James Edmunds, M.D.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[48696.]—**Saddles.**—I am sorry to inform "Saddler" that I cannot give him the required information and full particulars, such as would enable him to make the kind of saddle he wants. Making brown saddles is a separate branch of the trade, and are made by men who seldom touch anything else; therefore, I would advise "Saddler" to buy one rather than try to make one, as I feel confident he could not turn one out to his satisfaction, at the same time costing him more in tools and material than the finished saddle would cost ready made to order.—J. S. Saddler.

[48823.]—**Roman-Candle Stars**—"J. F. E." on p. 528 "cautions" pyrotechnists against the use of the star-pump described by me. I maintain, against everything that "J. F. E." may say to the contrary, that it is not waste of time to make stars by this method, for they can be made in sufficient quantities by a single pump to supply the demand of any amateur; 1,000 an hour being an easy performance, representing about 2⅞lb. weight. Apart from quantity, we have the satisfaction of having all the stars of the exact size and weight—about 20gr.; and surely this is far better than adopting the filthy, wasteful method, employed so often by amateurs, of soddening the composition with shellac solution, flattening it out on a slab, and then scoring it into cubes with a spatula. These cubes will do very well for shell purposes when any large quantities are required, but then proper appliances are used for rolling the proper thickness and for scoring correctly. If star compositions are saturated with shellac, the colour is greatly impaired; hence the desirability of using the least possible quantity of solution, which the star-pump enables us to do, by consolidating the star through pressure on the board. Again, referring to quantity, I may add, that if 1,000 stars per hour are insufficient, a compound pump, will easily turn out 35,000 an hour—surely enough for anyone! "J. F. E." asserts that the star produced by the pump is unsuitable for Roman candles—in this he errs, as I shall presently point out; but he does not give my querist an idea as to the way the perforated stars advocated are made. All that is necessary is to insert a metal peg of suitable length at the bottom of the pump, former, or handles, and it will be obvious how the perforation is effected. The object of the perforation is to insure the immediate ignition of the powder-charge below the star, by filling the cavity with quickmatch. Were no quickmatch used, the fuse composition would only ignite the star, and the charge below, would take fire from the expiring star. To secure the perfect ignition of the star, and almost simultaneously the charge below, professional pyrotechnists have recourse to a far more expeditious, and equally certain, method than the perforation of the star. The star is of the same size in relation to the case as I have described, and quite solid, and upon the powder-charge the star is dropped, a scoopful of dark-fire is poured down the side of the case where it occupies the whole space between the star and case; consequently when the fuse reaches the star, the dark-fire burns rapidly to the charge below, insuring at the same time the perfect ignition of the star. Thus it will be seen that the same result is obtained, without the trouble of priming stars. In conclusion, I may add that, perforated stars do not repay for the trouble expended upon them, especially as the same result can be obtained by the method I have given.—J. S. Rochard.

[49053.]—**Oil-Sheet Dressing.**—Will "S.M." kindly give the proportions of driers and boiled oil, and say if it requires heating or only mixing. Also if he can suggest a black colouring which will improve the appearance of van covers without having the disadvantages which "Pax" complains of in vegetable black.—Carter.

[49072.]—**Use of Marine Glue.**—In melting your glue you will require a heat of about 250° F. To obtain which, I use a round iron pan, and into which the glue is placed; the pan is then inserted into the head of a small furnace, and heat applied. In application, you cannot fail if you follow my previous directions. I prefer the small (and warmed) spatula to a brush, for the latter, after being once used, is *useless*.—A. E. B. Smith.

[49143.]—**Painting and Lacquering on Tin.**—For this purpose use Brunswick black mixed with turpentine for the lacquer, and for the painting use an indiarubber stamp and gold bronze-powder, but the bronze must be prepared in a particular way.—J. Poulson.

[49183.]—**Show Cases** (U.Q.)—Try the cement recommended for emery bands, Reply 49562, page 578. That will answer your purpose.—J. Poulson.

[49194.]—**Salt in the Fire.**—Would "Aziola" try the experiment first, with ammonic sulphate; secondly, with ammonic carbonate; and thirdly, with ammonic chloride. If the CO theory be correct, all these salts should give similar results. I think he will only be able to get the blue colouration with the chloride. It would be interesting to report results.—M. M. S.

[49199.]—**Burnishing Electro-Plated Articles.**—You will find many replies in back Nos. Look at p. 171, No. 761, for instance; or refer to Mr. Sprague's articles, some volumes back; or Gee's "Silversmith's Handbook." You should dip your Britannia metal into nitrate of mercury, very weak. Look on p. 73, Vol. XXX., for a lot about silvering Britannia metal—which is not worth doing, by the bye.—T. P.

[49201.]—**Analysis of Pig-Iron.**—Recent papers and letters will have answered this querist, I suppose; but "better" would depend much on the purpose of the analysis.—S. O.

[49208.]—**Paint for Model Boilers.**—Mix your paint with japanner's pale copal varnish, and thin with turpentine, if necessary. You can stove the article if you like. Of course you can paint the article first, using turpentine in excess, so as to get thin coats, and then varnish over; but I believe most loco. painters prefer to mix the colour with the varnish. Can polish it in half an hour, if varnish is good and weather suitable.—T. P.

[49218.]—**Plain Malt Spirit.**—On p. 485 it is printed "the alcoholic liquid obtained by distilling a mash of malt." "In trade 'plain malt spirit' should mean alcohol obtained from malt alone." I don't think the querist or any one else has been misled by what I said, and the use of the word "should" may have helped to enlighten some. On same page I also wrote, "distillation and rectification are *often* two distinct trades," and I used a "dictionary meaning" because the querist obviously asked for information. If he wishes for anything further he will find a Coffey still illustrated in Vol. XI. or XII.; but if he can refer to Payen's "Industrial Chemistry," he will find not only a Coffey, but many other forms of distilling apparatus. A few of the same illustrations appear in Ure's Dictionary.—Nuw. Don.

[49218.]—**Plain Malt Spirit.**—I have always understood that a spirit made from malt (with no unmalted grain) was termed by the trade "all malt whisky." And as the so-called "malt whisky" of commerce, often means a spirit distilled from mashings containing from 50 per cent. to 75 per cent. unmalted grain, I am inclined to think that "plain malt whisky" is one and the same article. Of course "plain malt spirit" cannot mean "raw" or "rectified" spirit, as no English distiller would use more than 25 per cent. malt to make it; his object with malt being simply to saccharify the rest of his materials mashed, and which might be often effected with only 8 per cent. or 10 per cent. malt. "Plain British spirit" is an Excise term, and signifies a spirit to which no foreign flavouring matter has been added. Whisky is included under this heading. I cannot agree with your correspondent "Rera" that flavour is imparted to the malt when on the drying kiln, the finished spirit having the same flavour, believing that the processes of distilling have much more to do with the flavouring than malt-drying. If malt were dried with a peat fire I can understand a flavour being imparted to it, but this is very seldom practised, and I can assure "Rera" that distillery maltsters generally endeavour to dry their malt with as little smoking as possible, and that no other flavouring matter is used. Three distinct and exceedingly careful distilling operations (in different stills) are requisite to obtain the delicate flavour and aroma so searched for in good qualities. These distillations and great expense are undertaken in order to extract the ethers and flavouring matter of the malted and unmalted grain, and a nice study of the temperatures at which they are volatile and condense, is illustrated in the different forms of "pot stills," and the great care necessary in working them. May I also inform your correspondent, "Nun. Dor.," that re-distillation in a distillery does not mean "rectification"; the latter, as he is no doubt aware, meaning literally a thorough cleansing and separation of all oils, essential ethers, and impurities, with the object of obtaining a spirit as free from them as possible—tasteless, "silent," and strong. This treatment would ruin a whisky, depriving it of both flavour and aroma; and to what use would (if rectified) serve the expensive malt mash made expressly to give quality? as the cheapest maize and 10 per cent. malt would produce a "silent" spirit of quite as good quality if well rectified. In conclusion, I am briefly of opinion that "plain malt spirit" means "whisky," though whether it be all malt or not, Irish or Scotch, is quite another question.—Cygnet.

[49223.]—**Ventilation.**—I am afraid if people adopt "Auld Reekie's" suggestion they will be sadly disappointed, and that their first step after going to the expense of knocking their ceiling about will be to paste up the aperture they have made, to avoid the unpleasantness and danger of the inevitable down-draught which will pour upon the heads of those who venture to sit under or near it. I have given this subject some little study, and have made a good many experiments, and am prepared to recommend the following plan as at once the most scientific, the simplest, the cheapest, and the most efficacious. Make a hole in the outside wall by knocking out a brick or so as near the *floor* as the wainscot will permit, or through the wainscot if preferred. Have a plain zinc pipe made in the shape of the latter L, either round, square, or oblong, with apertures of about 12 to 25 sq. in. (a fourinch round pipe answers very well), the length of the shorter arm to be rather more than the thickness of the wall, and the other to be about one-third of the height of the room (say, 11in. and 36in., respectively, for an ordinary room). Insert the shorter limb in the hole in the wall, so that the longer portion stands upright in the room about 1in. from the wall, and make good with mortar or cement (the pipe will require no other support or fixing if made of stout zinc with a proper-elbow joint), and paper the pipe to match the paper of the room, when it becomes almost unnoticeable, especially if a chair or some article of furniture is placed in front of it. It may be placed in either of the corners, or anywhere along the outside wall; but no curtains, or anything, not even a picture, must hang *above* it to interfere with the free passage of the air from the mouth of the pipe to the ceiling. No grating must be put over the mouths of the pipe, either inside or out. From the moment this pipe is fixed, a stream of fresh air continually pours into the room, and yet it is impossible for anyone seated in the room to perceive it in the shape of a draught. Its action is perfect, and it has numerous advantages. For example, it greatly diminishes the draught underneath the door, so unpleasant to the feet on a cold night, and it is perfectly automatic and self-regulating. The hotter the room, the more rapid the current of fresh air. The only time I ever find it necessary to interfere with it is when there is dense fog outside, when I just put a book over the top. One friend, amongst others who have adopted this plan, has recently made a perfectly uninhabitable room wholesome, and I have never known it fail. In my own living-room, we can have a good fire, burn two jets of gas, and have a party of smokers without any inconvenience; and I have often demonstrated its usefulness by closing the pipe for a short time, when the room rapidly becomes unbearable. This plan is based upon the principle that a current of air conducted through a cylinder acquires force sufficient to enable it to cut its way in an unbroken volume through the atmosphere into which it enters for a considerable distance in a direct line with the cylinder. Thus a 3ft. straight pipe will send the current of cold air straight up to the ceiling, 7ft. or 8ft. above it, and with force enough at the impact to break up the current into spray, which permeates the heated atmosphere in the upper part of the room, and is lost in it: a draught is, therefore, impossible. The vitiated air passes out by the chimney if there is one; if not, by some other outlet. If a room is heated, come in the fresh air will, and the bad must go out somewhere to make room for it.—Libertus.

[49234.]—**Locomotives.**—"E. M. P." asks for the nominal horse-power of G.W.R. engines. The rule given by Molesworth is $(D^2 \sqrt[3]{S}) / 15{\cdot}6$; D = diam. of piston in niches, and S = stroke in feet. But nominal horse-power is never applied to locomotives, and is seldom used now except by builders of stationary engines. The usual way of getting at the power of a locomotive is to work out its tractive force, by the well-known formula $(D^2SP) / W$. But if "E. M. P." will be content with the actual horse-power, I will do my best to accommodate him. The rule I have employed is as follows:—(Speed in miles per hour × diam. of piston² × length of stroke × mean effective pressure in cylinder) / (Diam. of driving-wheel in feet × 45.000). Presuming that by an average G.W.R. goods engine "C. M. P." means those with 5ft. drivers, and 17in. × 24in. cylinders, at a speed of 30 miles per hour, and with an average pressure of 100 per sq. in. in the cyls. H.P. = 924·8. It appears to me a little vague to ask for the horse-power of an engine with a 7ft. driving-wheel; however, if we supply the cyls. as 18in. × 24in., the speed as 45 miles an hour, and the mean eff. pressure as 100lb. per sq. in., H.P = 1,110. Now as regards the largest G.W.R. engines; the largest to my knowledge are the broad gauge "Iron Duke" class, running between London and Bristol, having 8ft. drivers and 18in. × 24in. cyls; assuming that at 60 miles an hour they would mantain an average pressure of 80lb. per sq. in. in the cylinders, they would be exerting a power equal to 1036·8 horse-power.—Motion Plate, U.S.A., Feb. 3rd.

[49241.]—**Belting.**—Have you tried pale glue, used thin with sufficient bichromate of potash to give a decided yellow tinge when first mixed? To be used very thin, more like sizing than anything else, so that it soaks well into the outer surface.—Nun. Dor.

[49251.]—**Microscope**—To Mr. Lancaster.—The fine adjustment is to be put on the side of body, which is 1⅜in. tube 8½in. long. The instrument is of the Jackson form with the body sliding in planed bearings on the arm. There is a bracket put on outside the body with a lever worked by a milled head and fine screw. There is a spiral spring inside, which protrudes the part to which the objective is screwed, against which the lever is supposed to act. What is the fulcrum of the lever? I have no means of examining an instrument, only the figures in the catalogues, and they seem to me to work the lever the wrong way. I shall be very glad if you will give me the necessary instructions, and perhaps a sketch. I have made a plain rotating stage, and am about to make an object carrier (not mechanical); how is it fastened to top plate of stage? Would it be sufficient if the two surfaces are fitted together with a surfacing plate?—Solus.

[49253.]—**Marking-Ink.**—I should say there is not; but for what purpose is it wanted?—T. P.

[49257.]—**Overhead Motion.**—Get Vol. XXII., and look at pp. 187, 211, 290, 341, 493, 624, 651.—T. P.

[49259.]—**Evaporation of Steam.**—Do you mean condensation, or what? It seems to be a question of the dryness of the air—the drier it is the more readily it absorbs moisture; but, I suppose, if sulphurous acid, for instance, were present, it would seize on the "steam," or water-vapour.—Nun. Dor.

[49289.] — **Speculum.** — Mr. Lancaster, in answering this querist, has apparently forgotten to tell him where to place his eyepiece. This depends on position of back focus of small speculum (see my letter on "Gregorian Telescopes" in this number); and if Mr. Lancaster would give us the rule by which opticians fix this point *in practical working*, I for one should feel much obliged. If the querist uses an eyepiece of 1½in. focus, which is the usual one for such a telescope, the field lens should be placed with its convex surface ⅜in. from the inner (*i.e.*, the polished) surface of his large mirror.—A. S. L.

[49295.]—**Cement.** — Try the cement recommended, emery-bands 49562, page 578.—J. Poulson.

[49298.]—**To Mr. Lancaster.**—Thanks for reply; if you will give me directions for taking the sun with a 2in., I shall be much obliged. What kind of plates must I use? Will your slow ones do? About the moon, perhaps I was not clear in my query; but one of the telescopes in question, the 4in. Dollond, has attached to it a good clock, which would keep the moon in the field for a long time, so I might be able to succeed with that. Also, what development is best? I use the alkaline pyro. for ordinary work.—C. J. R., Ventnor.

[49323.]—**Dyeing Rabbit Skins.**—Well treat the skins in the manner prescribed by "Jack of All Trades," and then put them in a bath of aniline brown. If you have a quantity you had better obtain an ounce of the dye in crystals, at a cost of one shilling, equal to 288 sixpenny bottles.—J. Poulson.

[49324.]—**Joshua and the Sun.**—I am obliged to those correspondents who have noticed my query; but may I point out that what I really require is the opinion on the passage held by Jewish scholars? My reason for asking is a rumour that the Old Testament revisers have omitted or materially modified the passage.—Nun. Dor.

[49324.]—**Joshua and the Sun.**—A misprint—"xxviii." for "xxxviii."—has made our valuable "Sigma's" reply to resemble my lamps in a fog, rather hazy. I spoke of a "reference" in Hab. and a "parallel case" in Isaiah—i.e., the going back of the shadow on the dial of Ahaz. I hasten to gratify courteous "F.R.C.S." The ancient records of the Chinese report that in the reign of their Emperor Yao, the sun did not set for the space of ten days, and they feared the world would be involved in a conflagration. Yao, according to Martin, was the seventh emperor of China, Fohi being the first, and as he computes from the first year of Fohi's reign to Yao's are 587 years, Fohi reigned 115 years; Xin-num, 140; Hoang-ti, 100; Xaohaon, 84; Chuen-hio, 78; Cou, 70; and next to him Yao, who reigned 90 years. The first year of Fohi's reign was A.M. 1891 and 587, and the first year of Yao will be A.M. 2479. The year in which the sun stood still in the days of Joshua was A.M. 2554, in about the seventy-fifth of Yao's reign. The Chinese records are said to report that the sun did not set for ten days; but we suspect our European writers have not here exactly hit the meaning of the Chinese annals, and that the word they have translated days may perhaps rather signify a space of time little more than one of our hours. If so, the sacred historian and the Chinese annals agree minutely in their time of the duration of this miracle. In Herodotus we may have a clear and undisputed testimony to the same effect. The priests of Egypt showed him a record of a long day (*vide* "A Commentary on the Old and New Testament," by Rev. Joseph Sutcliffe, A.M., London, 1834).—Lamplighter.

[49332.]—**Colouring Steel without Heat.**—Dissolve 1oz. of aniline blue in methylated finish, and apply with a sponge or brush, or float it on the article.—J. Poulson.

[49343.]—**Crystoleum Pictures.**—The articles necessary for commencing the work are prepared paste, convex glasses (a pair is required for each picture), a wooden squeegee, broad at each end and tapering in the middle, some sandpaper, fine and coarse, oil-colours in tubes, three camel-hair brushes, one No. 1 size and two No. 2 size, a bottle of poppy-oil, and a photo. The photos. I have been using are the penny ones bought from barrows in the street; they are excellent for the work, and besides, being cheap in the event of spoiling a few, which I daresay the beginner will manage to do. Having obtained a photo.—a good-sized head and shoulders is the best, and one should be chosen that has a well-opened eye—you immerse it in boiling water until it will come off the card. Do not hurry this operation or you may tear the paper, and it is then useless. While the photo. is soaking, you take one of the glasses, and having cleaned it, spread some of the paste on the concave side, then take the photo. from the water and remove superfluous wet by placing between blotting-paper, and lay on the pasted side of the glass; press it down as smooth as possible, and place a piece of brown paper over the back, and commence to squeeze out the paste with the wooden squeegee; scrape from the centre towards the edges, holding the photo. face upwards, then you can see if you get it all extracted. The photo. will, no doubt, get dry before all the paste is out; in that case it must be soaked in warm water for a minute or so, and again squeegeed until all the paste is removed, which will be known by the surface being clear, and not containing any silver streaks. It is now laid aside to dry; when perfectly dry, the back is gently sandpapered until the light parts begin to show through; then it is covered thinly with poppy oil to make it transparent—I generally oil mine in the evening, and allow them to remain with the oil on them until the following morning (about 12 hours); by that time they are thoroughly transparent—wipe off superfluous oil, and it is ready for painting. The hair, eyes, collar, jewellery, lips, and all prominent parts are painted on the photo. itself; when this is done, the second glass, previously cleaned, is laid on the first, and kept in position by being fastened with gummed paper at top, bottom, and sides; on the back of this glass is painted the complexion, dress, and background. Those readers who understand painting will be able to turn out more artistic work, as it is the mixing of the colours that is the drawback to those who, like myself, know very little about colouring. The following is a list of colours that will be found most useful—cobalt, Vandyke brown, Naples yellow (No. 2), vermilion, burnt sienna, carmine, Indian yellow, flake white, rose, madder, and ivory black; and for those who do not understand the mixing of colours, I append a few combinations for hair, complexion, backgrounds, &c. *Complexion.*—Fair—white, Naples yellow, and carmine; dark—white, Vandyke brown, carmine, and Indian yellow; child—use vermilion instead of carmine, and make the cheeks slightly warmer than the other parts. *Hair.*—Golden—white, burnt sienna, and Naples yellow; auburn—burnt sienna and Vandyke brown; brown—Vandyke brown and Indian yellow. *Backgrounds.*—White and blue, white and black, white and red. Most photos. look well with cobalt and white. *Eyes.*—Reflected light—white; white of pupil—Naples yellow and white, mixed; iris—cobalt for blue, cobalt and black for grey, burnt sienna for brown, Vandyke brown for black.

Rose madder, cobalt and white, as lavender or grey is a splendid colour for dresses that look white in a photo. Any colour put on wrongly can be removed by moistening it with poppy oil, and wiping off with a piece of rag. After all the painting is finished, a piece of cardboard is placed at the back of the glasses, and the whole kept together by being bound round with a strip of gummed paper.—ROJAM SEMAJ.

[49358.]—**Locomotive Boiler.**—To G. SUMNER.—I send "J. S. M." particulars of boiler: Firebox, 5in. square inside; water space, ¼in.; length of barrel part 10in.; diam., 4in., with five ⅜ brass tubes; funnel, 1¼ diam. The engine exhausts up chimney. I have tried starting with hot water. I can work the boiler with spirits, but coal and charcoal are a complete failure. I am making another, to have the outside appearance of portable boiler, but different inside, which I feel sure will be satisfactory. I will give a description of it soon.—G. SUMNER, Hough, Grantham.

[49361.]—**Cement to Resist Moisture.**—Try the cement recommended for emery-bands, query 49562, page 578, ENGLISH MECHANIC. This is a most useful and valuable cement; it will stand heat and water.—J. POULSON.

[49409.]—**Froude on Resistance of Fluids.**—To "SWINDONIA." The answer to this query on page 553 is printed incorrectly. The words resistance in pounds + speed in feet per second, &c., should be:—Resistance in pounds × (muld.) speed in feet per second ÷ 550 (i.e.) omit the decimal point.—SHIPWRIGHT.

[49438.]—**L. S. W. R. Engines.**—Although unable to supply all the information required, I answer querist as fully as I am able to. No. 375 weighs about 50 tons; 147 weighs 47 tons; 355 weighs 42 tons; the water capacity of 355 is 2,300 gallons, coal three tons. 38, Vizier, is a 6-coupled goods' tender engine, with 17in. by 22in. cyls., and 5ft. wheels. The axle-boxes are placed inside; there is no brake on the engine wheels. 55, Medusa, is one of the small passenger tender engines, six in number—viz., 55, Medusa; 56, Mentor; 57, Meteor; 67, Æolus; 78, Hecate; 107, Gem. The cylinders, outside, are 17in. by 21in.; the wheels are either 4ft. 6in. or 5ft. in diameter; built about 1860. 82, Sultana, is a 6ft. 6in. 4-coupled tender engine, with outside cylinders, 17in. by 22in., and inside frames. She belongs to the class which was formerly the standard type of passenger engine on the L. S. W. R. This class are now being fitted with the vacuum brake; only two are fitted with the Westinghouse automatic, and it is to be taken off them. The names are Tartar, No. 2, and Herod, No. 81. No 90, Sibyl, is a 4-coupled passenger engine, with 6ft. wheels, and 17in. by 21in. cylinders, like Sultana, but on a smaller scale. No. 93, Cyclops, is same as Vizier, No. 38. No. 106, Panther, is a very old 6-coupled tender goods engine with outside bearings, the wheels are 5ft. 125, Norman, is an old 4-coupled tender engine, with outside cylinders, 16 by 24, and 5ft. wheels. 129, Albion, is same class. 147 is one of the new passenger bogie tender engines, having cylinders 18 by 24, and 6ft. 7in., 4-coupled driving-wheels; the bogie-wheels are 3ft. 4in. diam., the cylinders are outside, and the engine is fitted with steam and vacuum brake apparatus; some new engines are expected in a month or two similar to above, but with 7ft. wheels. 150 is a 6-coupled saddle-tank shunting engine, stationed at Exeter, built 1882, wheels about 4ft. 6in. diameter. 155, Cressy, is an old outside-cylinder 4-coupled tank engine, 5ft. wheels, 15 by 21 cylinders. 159, Castleman, is 7ft. coupled express engine, with outside cylinders, 17 by 22, the frames are inside. 167, Atalanta, is similar to No. 82. 170, Cupid, same as 82. 174, Naiad, has curved frames, otherwise same as 82. 246 and 248, 4-coupled 5ft. 6in. wheels, outside cylinder tank engines, working suburban traffic. Numbers of 394 class are 282, 283, 284, 300, 301, 324, 393, 394; of 355 class, 348-367 inclusive.—CLYDE.

[49439.]—**Zodiac of Denderah.**—"Spica" will find a pretty full account of this in the "English Cyclopædia" article, "Zodiac," accompanied with a plate. A larger plate (12in. diam.), with a brief account, is contained in a work called "Mazzaroth" (Rivingtons, 1862).—G. J. W.

[49439.]—**Zodiac of Denderah.**—I am not quite certain I understand what kind of information "Spica" requires concerning the Zodiac, but I may inform him that he will find a quantity of useful information condensed into about a column of the "Penny Cyclopædia" of the S.D.U.K. (See p. 393, No. 516, Vol. VII., art. "Denderah.")—A YOUNG ASTRONOMER.

[49443.]—**Canoe.**—Mahogany is the best wood, and should be ⅛in. in thickness, or a trifle less if possible. When covering mine last summer, I found it best to remove old covering, and instead of putting it on all in one piece, to have a close well-made joint down the centre covered by a lath 1/16 thick, securely fastened with marine glue and small panel pins. After turning down and securely fastening in position, the wood can be more safely cut to shape than if in one, as less liable to split.—W. A. M.

[49460.]—**Chemical Atoms.**—The positivity of "Sigma," on p. 554, is about on a par with that of "Experimenter"; but the subject really admits of argument on both sides. As "Sigma" shows, the modern view rests upon considerations of volume and specific heat; but while both these factors are utter weakness for the purpose, it may yet remain that by far the strongest considerations are wholly in favour of O = 8. Volume and atomic heat, like some other factors in relation with atomic weights, are pre-eminently subject to multiple variations, whereas electrolysis is always the same under the most varied conditions. Mercury is 2 vols., hydrogen 1, and oxygen ½, yet all three have a strictly functional chemical unity, and the weights 200, 1, and 8 must ever be the unvarying ratios of electrolysis, and what is more, these initial anomalies are in most cases lost in the resulting compounds, just as is similarly the case with initial variations of atomic heats. Ammonia and phosphonia are normal 2-vol. hydrides whose volumetric and chemical characters are of the very closest character, yet N is 1 vol. and P is ¼. The atomic heats of potassium and barium chlorates are equal, while the initial value of K and Ba are as 1 to ½. H and O in their volumes are initially related as 1 to ½; but in addition to the broad and cogent facts derived from electrolysis and the general considerations of chemism, it also follows that in very many cases where O or Cl replace H, or are equivalent to H, that both functional and volumetric characters are strictly similar. It is thus that the 1 vol. radical methyl (C_2H_3) may become (C_2O_3) or (C_2Cl_3), and among a host of strictly similar derivatives, we only refer to their normal 2-vol. hydrates. It is thus that the urea constituent $(CO)_2$ may be $(CCl)_2$, or the radicals formyl and acetyl $(C_2H_1O_2)$ or $(C_2H_1Cl_2)$, and $(C_4H_3O_2)$ or $(C_4H_3Cl_2)$ in either case are strictly 1 vol. representatives of one H. If space permitted, a large array of facts might be cited, where O = 8, replaces one H in ammonia and many other compounds, where both function and volume go strictly together.—ECLECTICUS.

[49461.]—**L. and N. W. R. Engines.**—The following are a few of the goods engines which have 5ft. 2in. drivers, and cylinders 17in. by 24in., and the number of the shed in parentheses placed after each:—9 (13), 66 (24), 73 (14), 76 (21), 80 (30), 84 (23), 114 (10), 115 (14), 118 (5), 121 (23), 129 (14), 130 (10), 182 (19), 190 (13), 192 (8), 216 (5), 224 (10), 237 (10), 261 (10), 278 (10), 283 (18), 293 (20), 345 (10), 377 (14), 378 (10), 397 (10), 398 (10), 399 (10, 400 (1), 410 (30), 421 (14), 422 (1), 428 (30), 437 (23), 438 (19), 439 (20), 442 (19), 450 (1), 452 (5), 453 (9), 451 (1), 455 (1), 457 (10), 458 (10), 463 (14), 471 (19), 474 (10), 476 (10), 475 (10), 493 (10). The engines of this class are, one by one, having their funnels shortened and their boilers enlarged. Of the above engines, 190, 191, 421, and others have already had their boilers enlarged and their funnels shortened. No. 476, &c., have had their funnels shortened only.—PROMETHEUS.

[49489.]—**Lead Pencils.**—The cutters are held by end-pressure between collars containing suitable recesses. The diameter of steel cylinder should be about 5in., to give the correct speed of cutting edge at the velocity of spindle I named.—W. J.

[49494.]—**Chemical.**—When writing my answer to this query, I read the question too hurriedly, and did not notice that there was only about a pound of sodic iodide to be recovered; otherwise, I should have recommended the same method as "Lux"—namely, using H_2S, for it would not be worth "Meddler's" while to use the other method on so small a quantity as a pound. I think "Lux" has hardly been explicit enough in his directions. I hope he will excuse me for suggesting a modification of his plan. "Meddler" had better rub his mixture down in a mortar, and add about 20oz. of water. This will just dissolve the sodic iodide and iodine, and will leave the bulk of the carbonate undissolved; then filter, add another pint of water to the filtrate, and proceed to pass H_2S through the solution until the colour is discharged; then heat to expel the excess of H_2S, and filter to get rid of the precipitated sulphur. The solution may then be evaporated as "Lux" advises, and the result will be sodic iodide, possibly contaminated slightly with carbonate, but pure enough for all ordinary purposes.—E. G. T., Plymouth.

[49514.]—**Comets, &c.**—My authorities for the period (79·1 days) I assigned to the variability of *a* Cassiopeiæ were Webb (page 265), Chambers (page 577), and Breen's "Practical Astronomy" (pp. 284-5). I ought, perhaps, to have mentioned that Schmidt states he cannot find any trace of variability. Had I remembered Mr. Baird Gemmill's letter when I penned my reply, I should assuredly have quoted it; but not yet having the index to the present volume, I failed to come across the communication.—A YOUNG ASTRONOMER.

[49518.]—**Eggs and Chickens.**—I am not aware that among physiologists there is division of opinion as to above. The future animal is developed from the yelk, and in this manner: Within the yelk, and situated originally in its centre, but coming more to the surface as the ovum maturates, is one minute cell, called the germinal vesicle. This is the starting-point, for upon the commencement of incubation, changes immediately commence in the portion of yelk surrounding this. The process of cleavage begins. It divides into 2, then into 4, and then into 8, and so on, and this goes on till the yelk presents a uniform cellular appearance. The most external cells now arrange themselves and develop into a kind of membrane—the blastodermic membrane—which then lies within and next to the original membrane surrounding the yelk. This at one point thickens and splits into 2 layers, and then into a 3rd, and here the embryo is developed, hence it is called the germinal area. From the outer of these layers are developed the nervous centres, skin, &c.; from the middle the locomotive organs and circulatory system; while from the internal arise the internal organs of the digestive and respiratory systems, &c. In the case of the bird, nutriment for the embryo is obtained entirely from the yelk, and this is the reason of its very large size in comparison with the ovum of mammalia. It is all-sufficient to support the growing chick till the period of its liberation. At an early period (about the third day of incubation) blood-vessels commence to be formed, and gradually extend all over the yelk surface, by which means the oxygen of the air passes through the porous shell, and is thus conveyed to the tissues of the growing embryo. In birds, as the yelk-sac is emptied of its contents it is drawn in through the umbilical opening, which then closes; but in mammalian animals its functional activity ceases at an early period, as other means of sustenance are provided for the embryo, and it then shrivels up, remaining outside. The albumen or white of the egg does not therefore originate the chick, and it feeds it only indirectly by replenishing ing the yelk as it becomes exhausted.—HENRY F. LANCASTER, M.D.

[49520.]—**Stain for Stone.**—Malachite green, also a little ponceau, Bismarck brown, and scarlet mixed together for the red. These are all aniline dyes, and they will answer your purpose.—J. POULSON.

[49521.]—**How to Black Hammers.**—Get some aniline dye called Nigrosin, and dissolve in spirits, and apply with a brush or sponge.—J. POULSON.

[49522.]—**Collotype Printing.**—Your failure, I should say, was owing either to the gelatine used being too soft, or else the ink too thick, and causing too much adhesion between the gelatine and the roller. If the former, try the effect of adding a little chrome alum to the solution—say 5 per cent. of the weight of gelatine used.—W. ROBINSON, JUNR.

[49529.]—**Raising Water.**—There is no plan you could devise that would not be open to serious objections, unless you were to set up an engine and cistern, which would be costly. Working a pump from a depth of 20ft. or so is not easy, and from 80ft. it would be very hard work. Most persons would prefer instead to carry water in buckets. The compressed air you had best not think about: the labour of working would be awful, independent of the expense of tubing &c. If the ascent does not rise suddenly in any part, you may perhaps use a hand water cart, and pump for filling, but it would be little advantage over a yoke and pails.—J. SUTCLIFFE.

[49534.]—**Gas Supply.**—The quantity of gas (of sp. g. ·4) which will be discharged through a pipe 10ft. long = $\sqrt{d^5} \times \sqrt{p} \times 1{,}172$cub. ft., where d = diameter of pipe in inches, and p = pressure of gas in inches of water. For pipes 100ft. long, quantity passed would be $1 / \sqrt{10}$ or ·3162 of above.—C. W.

[49535.]—**Engraving on Brass.**—"F. W. S." may do a lot of work with very few tools. The first and most generally useful is a common graver, used with a hammer. It is made from a piece of square bar cast-steel, about ⅜in. diameter, 5in. long, or a little longer if you prefer it. Draw it down a little at both ends, and hammer down the angles for comfort in use. File the cutting end to an exact square; file the end to shape of graver; harden and temper to full straw. If you do not quite understand this, ask anyone with a lathe, either professional or amateur, to show you a "graver" used in metal-turning. This is used to cut the outline of all work; and for many odd jobs no other tool is required. Try and cut a continuous chip, like a carpenter with his hammer and gouge, and not like a stonemason. Two or more half-round gravers will be required for name-plates. They are also about 5in. long. To save expense of diagram see No. 922, Nov. 24, 1882, page 274. Make one like the broadest in Fig. 2, and the other broader. Note.—Gravers for cutting brass should be ground at a more acute angle than those used on steel; in other words, should not be so dumpy at the point. With these last you can cut all the work you have deeply outlined with the first tool. If your work now looks rough and amateurish, make a square hand-graver with mushroom handle (out of the same steel), about 3½in. long, handle included. With this touch up and improve the outline. Now make the plate hot enough to melt black sealing-wax, and see that you use enough to quite fill the engraved parts. When it is quite cold, rub off the superfluous wax with pumice-stone and fine-sifted sand used with plenty of water; thoroughly wash away every trace of sand, and with a flat-faced piece of pumice and water go all over the plate diagonally to remove all scratches. Again wash carefully, and rub the plate lengthways with "water of Ayr-stone" and water until all scratches made by pumice are removed. This leaves a beautiful surface, very easily polished if required. For a common polish get a piece of cork or large bung; sift some fine pumice powder on the plate, pour on a little oil, and rub the cork lengthways on the plate until all marks (fine scratches) made by the water Ayr-stone are obliterated. Finish with rotten-stone and oil on a cloth rubber, using circular strokes. For mathematical work, or where a good polish is indispensable, get a piece of charcoal from a toolshop or from the makers of engravers' copper-plates; use this with water to remove the grain left by the water of Ayr-stone; finish with rotten-stone carefully, and you will have a good and flat polish, very different to that where pumice powder is used.—Gamma.

[49637.]—**Microscopical Mounting.**—The varnish I always use for above is made in the following way:—Put a thin layer of Brunswick black about ¼in. deep into a saucer and let it remain for several hours in a warm place, stirring two or three times. At the end of the time it will be quite hard, and when cold pour upon it a layer of gold-size the same depth; let it stand for twelve hours without heat, stirring again two or three times. The thick mixture must then be diluted to a convenient thickness for working by chloroform or benzole. I like the above, as it dries well, and is not too brittle; but many other varnishes are used—sealing-wax varnish, dammar varnish, and other preparations of Brunswick black. The great difficulty which probably "Novice" finds is getting rid of air-bubbles in mounting objects in shallow cells in balsam, and getting the objects also in a good position. I take it for granted that he has thoroughly prepared his specimen by getting rid of all moisture and air in the tissue itself by soaking it successively in absolute alcohol and oil of turpentine, or oil of clove, before introducing it into the balsam. If this be not done, no success will follow. The cell must then be well filled with balsam again, carefully avoiding introduction of air while dropping it in, and the object placed in position. The cover-glass, scrupulously cleaned, must then be gradually and slowly let down, and probably all will be right. But if such should not be the case, it may be often dodged right by a little tact and care. Considerable experience is required to mount successfully many objects in balsam: others are easy enough; and "Novice" will find patience and perseverance will overcome much of the difficulty. Benzole is used as a solvent for many purposes, but not as a medium for mounting. I would advise "Novice" to get his hand in by mounting in glycerine at first, as it is easier to manipulate; he can then pass on to balsam or dammar.—Henry F. Lancaster, M.D.

[49587.]—**Lantern Projection.**—This effect is produced by a lantern arranged with reflectors, and which used to be sold, some half-dozen years since, under the name of the Aphengoscope. I have not seen them lately in the shops, but presume they are to be got. "Glen" should see one.—F.R.C.S.

[49540.]—**Adhesive Substances.**—The only substance which possesses the properties named that I know of is indiarubber dissolved in benzol or bisulphide of carbon; but whether it retains its properties for any length of time after being laid on I do not know.—W. Robinson, Junr.

[49541.]—**Organette.**—I am afraid that "Progress," who replies to this query on p. 577, has never seen an organette—an instrument which is so powerful that the inventor has a modification called the melopean, in which pipes or tubes are placed over the reeds to soften the sound. The orguinette is a different make to the McTammany organette, which is not yet on sale in this country.—Gray's Inn.

[49546.]—**Catgut.**—If "C." has a hook and eye on his band, he will be able to tighten it up by unhooking and twisting the gut in the same direction in which it is laid, and then hook together whilst held twisted. A very little twisting will make a great difference.—W. M. S.

[49560.]—**Collodion.**—If the sample you have does not dry perfectly bright and clear when spread upon glass, it is bad, and there is no remedy that I am aware of. I have no experience of the use of collodion for the purpose named, but I imagine it will be used much more dilute than in photography. —W. Robinson, Jun.

[49571]—**Electrical Resistance.**.—It is not true that the softer the metal the better its conductivity: hard drawn wire conducts better than soft wire; but if the hard drawn wire is annealed by heat until permanently soft, the diameter is increased and the length decreased, it then conducts better owing to its greater thickness. If soft and hard wires have the same diameter and are the same kind of metal, the hard wire conducts best. The increased resistance by heating a wire is another matter, and cannot be accounted for until more is known about electricity. You had better see an account of the experiments made by Planté in heating wire with his secondary battery.—J. Sutcliffe.

[49577.]—**To "Os."**—I have not tried Bennett's battery for general electro-plating purposes. If I were to do so I should try it on pewter or Britannia metal—that is, if I had anything of the kind to do, which is somewhat improbable, as I think that electroplated pewter ware is rubbish; but I am inclined to think it would suit that class of work, but not for brass, copper, or German silver. But why does not "Novice" try it himself? The cost is a mere nothing, and any way he will gain a certain amount of experience. I have a battery of six cells ready made, which I intend to try on the first opportunity: they are made from old salt-jars, which cannot be distinguished from ordinary round battery-cells; they are lined inside with pieces of tinplate cut from old meat-tins. The iron turnings I had given me from an engineer's shop. These are best wrought iron, as cast iron comes off too fine, and makes, in my opinion, too compact a mass. Either round or flat porous cells will do; the size and shape of the zinc depends on that of the cells. The soda solution I explained some time since. I don't think the cells cost me more than about 8d. each.—Os.

[49578.]—**Electro-plating Bath.**—Any close-grained wood will do; it should be tongued and grooved, and also bolted. I have made them of mahogany, and have filled the pores of wood and the joints with paraffin wax. I do not recommend wooden vats; with all the care possible, they are apt to leak, and they also absorb a quantity of solution. The best tank to have is one made of slate, and although it may cost more at first, will be found cheaper in the end.—Koenig.

[49582.]—**Dyeing Oil.**—Aniline dye called Nigrosin, added to oil, will do what you require.—If you cannot obtain it, advertise your address.—J. Poulson.

[49587.]—**Lantern Projection.**—If "Glen" will refer to No. 796 (June 25th, 1880) of your paper, he will find a letter (17467) directly bearing upon the subject. If he should desire more information than is contained in the letter referred to and will give his address in your advt. column, I shall be happy to assist him.—W. Hall, Smethwick, near Birmingham.

[49588.]—**Electro-Chemical Telegraph.**—(1) Iodide of potassium, 1 part; starch paste, 20 parts; water, 40 parts. (2) Prussiate of potash, 80 parts; nitric acid, 15 parts; hydrochloric acid, 5 parts. Soak the paper in either of these solutions and hang up to dry. Before using, moisten with dilute sulphuric acid.—R. Hannen.

[49590.]—**Whitening Dial.**—I have seen this done by first removing the varnish and old surface with fine emery paper, and then rubbing on a damp mixture of powdered chalk and silver chloride; wash well, dry, and varnish.—M. M. S.

[49590.]—**Whitening Dial.**—Well cleanse the dial with soda-and-water—no soap—to take all the grease and smoke off; then get some dammar varnish, and thin it with turpentine, and brush it over the dial. Then get 1oz. of silver bronze-powder, and put it in a pepper-castor, and shake it over the dial, covering every part; then place it in the cool to dry. Then take (after it is dry) a very clean, soft brush, and brush all the surplus bronze off; you will then have as good as a new dial. You do not say anything about the figures. If you are going to write them afresh, I might suggest that they will have a very handsome appearance if written in with ruby bronze-powder, made into a liquid.—J. Poulson.

[49593.]—**Painting Bicycle.**—The spokes may be cleaned, if rusty, with glass-paper, and varnished with Brunswick black, or some of the special paints or enamels advertised for bicycles.—F.R.C.S.

[49593.]—**Painting Bicycle.**—I should strongly advise "Cyclist" to enamel his spokes; it looks much better than paint, and is not liable to chip off. "Cyclist" will find an enamel sold under the name of "Welch's," and which I believe is 2s. 6d. a tin, fully answer his purpose.—W. Scotland.

[49593.]—**Painting Bicycle.**—Wash the spokes with soda and water, so as to remove every particle of grease; then varnish with Brunswick black, or, if you prefer it, black Japan. The first-named black will dry in about two hours; but the black Japan will take 24 hours to dry; but it will be more durable; also be very careful where you procure the black, as there is a lot of very queer stuff being sold under the name of the genuine article.—J. Poulson.

[49594.]—**Firebox of Traction Engine.**—"Engine Driver" had better put a patch on if he wants to keep his box dry. Cut all your bad out outside of the stays—I expect four—with a cross-cut chisel, or he can drill holes round; will be better to cut out cut heads of stays outside of box. Drill stays in thickness of plate. Keep clear of your threads, and you will get same size stays in. If you want more particulars, advertise your address; I will help you.—Ex-Traction, Stockton-on-Tees.

[49594.]—**Firebox of Traction Engine.**—No doubt the cracks or fractures are due to overheating, which may be due to water-spaces not being clean; to repair, cut out the fractured part and apply a new patch plate as follows: well bed the patch to its place, drill the holes and tap them with patch in position, and secure the patch with snap-headed studs which have been turned and chased in the lathe; screw them tight up, cut off the square snug, and caulk gently round. Unless you have had some practice in this class of work you will find this a difficult job, as you cannot get to rivet the patch on, and bolted joints are objectionable, especially in a fire-box, so to apply the patch with studs is your only course.—Boswell.

[49595.]—**Patching Boiler.**—"Young Wheelwright" had better cut his old patch off and put a new one on, same size as old one, if all his holes are good in his tube; if holes are bad, he will have to cut bad out, and put larger patch on.—Ex-Traction, Stockton-on-Tees.

[49595.]—**Patching Boiler.**—Cut out the fractured part and apply a patch plate, and secure it with rivets, as follows: cut all the bad part away, lay on patch, drill through, remove patch and clean it and replace it, and rivet it on with ⅝in. rivets, put the patch on water side, and let it be 1/16in. thinner than furnace plate.—Boswell.

[49595.]—**Patching Boiler.**—I should advise "Young Wheelwright" to cut out a round patch, about 8in. diameter, and fit new plate on the outside of tube, inside of boiler. I should advise you to have a 1¼in. flange riveted on patch to screw the plug in. I am afraid "Young Wheelwright" would find some difficulty in making job tight himself. Better call in a practical boilermaker, who would do the job for him as advised for about 25s.—Platen.

[49596.]—**Boiler Query.**—Take my advice, don't try cast iron on any account, unless you are desirous of meeting with an accident. Your best plan will be to get some respectable firm to make you a small vertical one, of Lowmoor iron, ⅜in. thick, and about 36 by 14in. diameter. From your query, I should say you are not well up in the construction of the above, and a badly-constructed one is a very dangerous toy.—Engineer.

[49596.]—**Boiler Query.**—By all means have a wrought-iron boiler, riveted (not brazed), using plate ⅛in. thick, and secure chimney pipe to shell crown. 2ft. × 15in., with ⅛in. plate should carry 50lb. if well made; but test it first by loading safety-valve to 200lb.; fill quite full and place on slow fire until valve lifts, unless it begins to leak; if so remove it at once, make leakage good, and work at one-fourth pressure which caused leakage. Plenty large enough.—Boswell.

[49599.]—**Refractor.**—Your telescope would bear well a power three times as great as the one you mention. You would also find a third eye-piece, magnifying about 110, extremely useful. These three powers would be pretty nearly all you would require—60 for comets, clusters, and nebulæ, 110 for the moon and planets, and 150 for double stars.—A Young Astronomer.

[49600.]—**Clear Varnish for Fretwork.**—Why not use white spirit varnish?—Albert Smith.

[49600.]—**Clear Varnish for Fret-work.**—Use white hard varnish in a warm room. You can purchase it cheaper than you can make it, of Jones and Co., Viaduct-street, Bethnal Green-road.—J. Poulson.

[49602.]—**Lathe Bed, &c.**—In reply to "O. V.," I have written to the manufacturers who make these lathes to ask for details. I do not know whether they will deem it expedient to furnish them, but as a rule I have found great liberality in this respect among our leading lathe-makers. The general arrangement can be readily understood by reference to their published catalogue.—O. J. L.

[49603.]—**Gear - Wheels.**—In answer to "O. V.," I should say, without doubt, the involute form of teeth is by far the best for gear-wheels of all sorts where a wheel sometimes drives and sometimes is driven. In the particular case mentioned by "O. V.," viz., the back-gear of a lathe, it may be said, as a general rule, that the pinion invariably drives the wheels; but even here it is advisable to have the power, at least in case it may be wanted, of making the wheels drive the pinions. Were it not so, the epicycloid form of tooth with rounded faces and hollow flanks would be equal to any, and as Sir Edmund Beckett points out in his book on "Clocks, Watches, and Bells," the tops of the teeth of the driven wheels might just as well be cut off down to the pitch-line, because they never come into contact with anything. Hence, we may at once make the assertion that the ordinary depth of the teeth of epicycloid wheels is nearly, if not quite, twice as much as is needful in the supposed case of any particular wheel being always a driver, or always a driven wheel. Now take the involute form of teeth. Quoting from Professor Unwin's "Elements of Machine Design," 1877, p. 178:—"Involute teeth have two remarkable properties. All involute wheels whose teeth have the same pitch, and the same obliquity of the line of contact, work well together. A pair of involute wheels may be drawn a little further apart without the accuracy of action of the teeth being impaired, though the arc of contact is diminished. Involute wheels cannot be made with very long teeth, because then the obliquity of the line of contact must be great. Hence, their centres cannot be moved much further apart than their normal distance without too much reducing the arc of contact. But this property of involute wheels is a valuable one, as it neutralises the injurious effects of wear of the supports of the wheels. With the angle of obliquity given above (74½° with the line of centres), the smallest number of teeth in an involute wheel should be 25. With fewer teeth the arc of contact is too small. The obliquity of action is ordinarily alleged as a serious objection to involute wheels. Its importance has, perhaps, been over-rated." Now, as to depth of tooth. We have taken it as a demonstrated fact that one-half of the usual depth of epicycloidal teeth is sufficient as far as driving powers are concerned; and, therefore, a like depth will be sufficient for involute teeth, which are not troubled with the infirmity that besets the epicycloid ones—viz., their incapacity of driving except with the *tops* of their teeth, or that portion of the teeth which is outside the pitch line. Be it remembered, that the pitch-line of involute teeth is at the base, and not half-way up, as in the epicycloid, and that the pitch-diameter is proportionate to the number of teeth, and hence, so to speak, involute teeth are all *tops* without *flanks*. Now the usual way of gauging the diameter of a blank wheel before cutting is by means of the Manchester wheel-gauge, which gives, on a series of scales, the diameters of wheels of any particular *gauge*, or number of teeth per inch of diameter; thus, on 10 gauge, there are 50 teeth to 5in. diameter, and on 14 gauge there are 140 teeth to 10in. diameter; remembering always that an allowance or *addendum* of two spaces at the commencement of every scale is already made for you for the *top* of the tooth, or portion outside the pitch-line—viz., one at each end of the diameter. In the last set of wheels that I cut, which is the first in which I have introduced the involute form, I made the teeth of the ordinary length, and as the pitch-line is at the base of the teeth, I had to allow not two, but four, spaces for the full diameter. The result is, as Prof. Unwin points out, it does not do to make a wheel of a smaller number of teeth than 25. I mean, however, to try the effect of cutting off the top of the teeth, and cutting the teeth themselves over again with a thicker cutter, but of the same curvature. I shall then have the angle of obliquity reduced, I hope, considerably below 74½ degrees, and be able to get a wheel as small as 20 teeth, if not a lower number. Nothing can exceed the smoothness and noiselessness of involute teeth, and the cutters are very much more easily made than those for epicycloidal teeth, familiar acquaintance with drawing and necessary tools presupposed. The Manchester gauge, too, will do for either sort indifferently then.—J. K. P.

[49604.]—**Stamping on Velvet**—The process is a trade secret. But if "Omega" will advertise his address, I will give him a little of the preparation, if he will pay postage; cost about 6d.—GOLD STAMPER.

[49609.]—**Dynamo-Machine**.—To "SIGMA."—I never like to advise in such details, because I have not sufficient personal acquaintance with the subject; and to calculate these matters out, means more work than I can spare time or inclination for. But it is pretty certain that 8 divisions in the armature will not be enough; the probability is, that altering the armature will destroy the balance of the machine. Besides, the "intensity" alone is not enough to consider, as the size of depositing-surfaces must be taken into account in arranging the suitable machine.—SIGMA.

[49613.]—**Boiler**.—Why not try a set of large Bunsen burners, or a burner something after Fletcher's burner, used to boil kettles, &c.—ENGINEER.

[49616—49617.]—**Red Colour and Flavour for Preserves and Confectionery**.—We have seen a great deal lately about preserves and jams which have been made from pulped turnips. Now preserves don't want any colouring. The natural colour of the fruit is the proper colour, and although "J. T. T." says he wants colour for preserves and flavour for confectionery, still, if his jam wants colour, it will also want flavour, and I hope, for the public good, that no one will instruct him in the art and mystery of improving the colour and flavour of mashed turnips.—Os.

[49616.]—**Red Colour for Preserves**.—You had better use cochineal; aniline is sometimes used; but be careful.—A. SMITH.

[49616.]—**Red Colour for Preserves**.—A little aniline dye called Eosine. If that is not deep enough, then add magenta.—J. POULSON.

[49619.]—**Tonite**.—I understand tonite to be guncotton compressed into cartridges. Tonite will explode when mixed with gunpowder and tamped in the usual manner.—M. M. S.

[49620.] — **Carbon in place of Copper**. — I should not platinise carbon myself, because I do not think the gain would be worth the expense; but it is said to be an advantage, and not to polarise so easily. In fact, my own opinion is, as I have often said, that carbon is a mistake, and platinum the best in the long-run. I have no doubt about it, for medical batteries, which need only such small surfaces. It is a question of first cost against wear and tear, with a residuary value.—SIGMA.

[49624.]—**Lot's Wife**.—It has been suggested that the occurrence might have been produced by a shower of melted sulphur, or other material, from the volcanic erruption which, perhaps, was at the time destroying Sodom and Gomorrah, having overtaken and incrusted Lot's wife.—F.R.C.S.

[49624.]—**Lot's Wife**.—The true explanation of this apparent miracle is this:—In the Hebrew language the word *as* is often to be understood. Gen. 19 and 26th will then read, "she became *as* a pillar of salt," for brimstone and fire, we learn from the 24th verse, fell upon her out of heaven (or the atmosphere). Examples of this use of the word *as* may be found I. Saml. xxv. 37. "Nabal's heart died within him, and he became *as* a stone." The *as* is in italics, and consequently not in the original, but our translators were obliged to insert it to make sense, for in the next verse we learn that he died in ten days after. Other examples will be found I. Kings iii. 7, "I am *as* a little child"; 11th Psalm, 1st verse, "Flee *as* a bird"; 12th Psalm, 6th verse, "Pure words *as* silver tried in a furnace"; 14th Psalm, 4th verse, "Who eat up my people *as* they eat bread." The reader will perceive that the *as* in all these places is left out in the original, but is to be understood.—A. C.

[49626.]—**Centrifugal Pump**.—Your pump cannot draw the water from a depth of 30ft.; to do this you would require very nearly a pure vacuum, even if you lower your pump to the water's edge. I don't think you will meet with success. For my own part I should not attempt it.—ENGINEER.

[49630.]—**Spirit Varnishes**.—These are made with methylated spirit of wine. Spirit of wine 60° to 63° over proof, contains a comparatively large proportion of water, and this would cause the iron, of which the tins are made, to rust, and perhaps spoil the varnish, or, at all events, the tins.—Os.

[49630.]—**Spirit Varnishes**.—I do not know of any chemical action of spirit varnishes acting upon tin. They should, if pure, be made from the shellac or gum and naphtha or methylated spirit. I do not know of anything detrimental to tin in these compounds; but I have always known them to be sent out in stone vessels.—J. POULSON.

[49631.]—**Thinning White Hard Varnish**.—If your varnish is a spirit varnish use spirit; but if, as you say, it smells of turpentine, then use turps. ALBERT SMITH.

[49631.]—**Thinning White Hard Varnish**.—Use methylated spirits; but if your varnish has got a white film upon it or in the bottle, throw it away, as it will be useless to you.—J. POULSON.

[49631.]—**Thinning White Hard Varnish**.—All these varnishes are not made with turpentine. Some are made with methylated spirit. The difference in the odour of each one is so distinct that no mistake can possibly be made.—Os.

[49631.]—**White Hard Spirit Varnish** cannot be thinned with turpentine; it must be thinned with methylated spirit. "F.R.C.S." has evidently got paper varnish: hence the smell of turpentine. This is useless for his fishing-rod, as it is too soft, being made from gum damar.—PETRO.

[49632.]—"**Drop**" **Measurement**.—A drop cannot possibly be measured with scientific accuracy: it depends on the size of the bottle, personal manipulation, viscosity of the liquid, bottle full or nearly empty, &c. A minim of distilled water weighs 0·91 grain according to the British Pharmacopœia, and a fluid ounce weighs 1oz. avoirdupois, although I was under the impression that a minim was equal to a grain, and that an ounce of water weighed 1oz. troy, as there are 480 minims in the fluid ounce and 480 grains in 1oz. troy. The British Pharmacopœia is the most recent authority; but if the London Pharmacopœia differs, they cannot both be right, as the fluid ounce has not been altered.—Os.

[49632.]—"**Drop**" **Measurement**.—A drop is no scientific measure at all, and its quantity depends partly upon the substance to be dropped and partly upon the mouth of the bottle from which it is dropped; consequently it is variable. On the other hand, a minim is a definite quantity of measure, being the sixtieth part of a fluid drachm, and the measure of 0·91 grain of water according to the British Pharmacopœia. In a table before me of the number of drops equivalent to a fluid drachm of various liquids, I see the extremes are 45 drops in the case of water, and 150 drops in the case of sulphuric ether—a considerable difference. For purposes of accuracy, the "drop" ought never to be used, and I hope the day is not far distant when all our old-fashioned and unscientific weights and measures will be superseded by the rational and convenient metrical system.—HENRY F. LANCASTER, M.D.

[49632.]—**Drops**.—A drop is never measured scientifically—a minim is. A minim is the sixtieth part of a fluid drachm: there are eight of these latter to the fluid ounce, and there are twenty fluid ounces in an imperial pint. The bulk of a drop depends on two circumstances—the thickness of the lip of the vessel from which it is dropped, and the consistence of the fluid itself. Thus, a drop of tar or treacle from a bottle with a thick lip may be three or four times as much in quantity as a drop of spirit or of water from a bottle with a very thin lip.—F.R.C.S.

[49633.]—**Scent Fountains**.—The empty cases are sold at a shop in Lambeth-walk at about 3s. 9d. or 4s. per gross, so that this querist will see it will be to his great advantage to purchase them empty and fill them himself.—J. POULSON.

[49642.]—**Gamma Cassiopeiæ**.—When, where, and by whom was "Algol" informed that this star *is* variable? No mention is made of it in any catalogue of known or suspected variables to which I have access. Webb says nothing about it, and it is not included in the list of "suspects" which was published in the last volume of the ENGLISH MECHANIC.—A YOUNG ASTRONOMER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, J. Poulson has replied to 49183.

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THE importation of tin-plates into the United States has increased in a remarkable degree within the last few years. The imports in 1870 were 1,507,000 boxes; in 1875, 1,920,000 boxes; in 1876, 1,800,000 boxes; 1877, 1,140,000 boxes; 1878, 2,160,000 boxes; 1879, 3,120,000 boxes; 1880, 3,380,000 boxes; and in 1881, 3,600,000 boxes. There are about twenty boxes of common tin-plate to the ton. Two of the chief causes of the increased demand for tin in the United States are found in the enormous canning industry and the growth of the tin roofing business.

QUERIES.

[49646.]—**Valve for Air-Pump.**—I am desirous of making a small single-barrel air-pump about 6in. in length, and would like information as to the construction of the valves. I have access to a lathe.—R. C.

[49647.]—**Polariscope.**—What is a quarter undulation plate which converts plane into circular polarised light?—MICRO.

[49648.]—**To Mr. Wetherfield.**—My assessment has been raised this winter to £20 for house and garden. I am also, for the first time, charged with house duty. The garden being included in the £20, please say if I am liable to house duty, and if I can let it run on as it is until February 1885, and then claim repayment of three years' duty, or must I send in my claim at once?—BRICKS AND MORTAR.

[49649.]—**Portland Cement.**—Can any practical chemist who understands manfacture of above give me information as follows?—Must clay employed contain alkaline salts of necessity? How long should burning of mixed limestone and clay take? Should a moderate or fierce white heat be employed? Also, what is the best method of testing quality of cement on small scale?—Any information will oblige.—ASSAYER, Trinidad, Colo.

[49650.]—**Wood-Pipe Making.**—I have a quantity of cherry wood, which I should like to make into smoking pipes. Will some kind reader give me instructions how to proceed, and what sort of a tool is used for boring the stems?—AN OLD SUBSCRIBER.

[49651.]—**Wood or Coal in Engine Furnaces.**—Will some fellow subscriber give me some information on the value of wood as fuel for raising steam, against Newport coal? Wood as cut in the forest, mostly oak, green and dry, and for size from 4in. to 8in. or 10in. dia. How many cubic feet of this wood as measured in the stack ought to give the steam of a ton of coal? Boilers specially constructed, one for coal and one for wood, former double flued Cornish, with Galloway tubes, and other of same make, but with much more furnace space built in front.—ARBOAO.

[49652.]—**Galvanic Belt.**—Would "T. P." kindly say if the zinc and copper are to be riveted and the cloth together, and what width and length are the strips to be, and if the belt is to have a fastening around the body completely or not? He gave some instructions in No. 925, reply 48451, and as I have been waiting a long time, too, for the same thing, I should feel exceedingly thankfull if he would give the required advice.—ONE WHO SUFFERS.

[49653.]—**Sleepless Child.**—To DR. EDMUNDS.—Our only child, aged 11 months, is apparently well formed and thoroughly healthy (been brought up by hand), but very sleepless, and has been for the last three months. He goes to bed about seven, and wakes every two hours at most; sometimes every half-hour throughout the night. He wakes with a start, cries, and invariably stands up in his crib. During day he sleeps about two hours, with the like restlessness. He is lively, good-tempered, appetite good; feed him on milk, and farinaceous foods only; has a warm bath every morning, and fluid magnesia for medicine; bowels regular, but urine stains very very much—a bright yellow; teeth five, and, I presume, cutting others. Kindly inform me your opinion of sleeplessness. Any advice would be gladly received by—AN ANXIOUS MOTHER.

[49654.]—**Humming of Telephone Wires.**—Could any of "ours" tell me an effectual way to stop the noise a telephone wire fastened to a chimney makes?—J. M.

[49655.]—**Varnish.**—Will Mr. J. Poulson kindly inform me how I can make an indiarubber varnish? I have tried various means of reducing the rubber to its proper state, but have always found that it won't dry properly.—FAILURE.

[49656.]—**Spirit of Turpentine.**—Having read in "ours," of Feb. 9th, that spirit of turpentine is made from sawdust, extracted by a sweating process, I should feel greatly obliged if you would give me some information on the sweating process.—SAWDUST.

[49657.]—**Battery.**—To MR. LANCASTER.—I wish to make a battery of 12 quart Bunsens. (1) Ought I to get compressed carbons, and how should I copper them? I have three of Mr. Bennet's tin-pot cells—can I copper them with those? (2) Would the nitric acid in the porous cell require renewing every time, or only filling up for evaporation? (3) How long would the zinc last (to be cylindrical, and used once a week, four hours at a time)? (4) What sort of a lamp should I require? Would an arc lamp, or an incandescent lamp, be more economical? I have seen it somewhere, I think, that a certain number of cells will work five incandescent lamps as well as if one only was in the circuit. My science teacher advised me to consult you through the columns of the "E. M." before proceeding further than I have already done.—A READER.

[49658.]—**Broken Gazogene.**—I have a gazogene in which the glass tube, which separates the generating chamber from the lower one which contains the water to be aërated has got broken. I propose to place a larger tube over the remaining portion, and cement it there. Will anyone tell me what to use to fill up the annular space between the two tubes so as to be water-tight, and which will not be acted upon by the tartaric acid and carb. soda used to generate the gas?—H. G.

[49659.]—**Extraction of Bismuth from Copper.**—Will Mr. A. H. Allen, or any other gentleman, kindly inform me how bismuth is got out of the copper in the Welsh process of copper-smelting from copper pyrites? I believe it must be got out in the regulus, that is to say, before the copper reaches the condition of blister copper. I have consulted various works on the subject, but cannot see that in any of them.—METALLURGIST.

[49660.]—**Electric Accumulators.**—I have the electric light on the premises. Can any of your readers inform me as to the best accumulators, with directions for making the same?—J. MELHUISH.

[49661.]—**Street Coil.**—Would any of "ours" kindly tell me why, in a street coil, the iron core is drawn out to increase the power? Also, what is the central division in large intensity coils for?—S. W. WILLIS.

[49662.]—**The Expansion Valve.**—This was a query asked by me in Vol. XXXVI., No. 930, and addressed to Fred. Walker; but receiving no answer, and also seeing no correspondence since, from the above-named gentleman, I therefore presume that he has dropped corresponding with the "E. M." I therefore ask liberty, Mr. Editor, in asking the question again. I should like to see an explanation regarding the expansion valve. In what position is the eccentric placed relating to the common slide eccentric? Also, whether there is any lap or lead given to the common slides when expansion valve is used?—SHAW.

[49663.]—**Tasmania.**—Could any of your readers inform me whether fairly good land, free from timber, is to be had in Tasmania, and the upset price per acre? Also, whether the Government still gives land free to those who pay their own passage out, and whether they give the forest or cleared land? In the case of having forest land, would it be possible to sell any of the timber as it stands, the buyer to fell and remove it within a given time?—ASTON.

[49664.]—**Fret-Saw.**—Will some one say what are the proper sizes of fret-saws to use for walnut or holly boards, ⅛, ¼, ⅜ thick, respectively?—W. M. S.

[49665.]—**Railway Carriage Tires.**—Can any of our correspondents inform me how the railway carriage tires are rescrewed on the wheels with wood centres, and fastened with Mansell's rings?—A. Z.

[49666.]—**Watch Stopping.**—Will some kind reader give me information as to the cause and remedy of Geneva watch stopping when it is laid on its back: it goes well in any other position. I have cleaned it well, but the fault is still uncured?—TALL.

[49667.]—**Hardening Plaster of Paris.**—Can this really be hardened (in the substance of the plaster) by any admixture? I have tried additions of various salts, and mixing the plaster up with their solutions, also soaking cast, likewise boiling in said solutions, which last seems to have a tendency to obliterate the fine impressions. Likewise boiling and soaking in oils, sugar, glue, &c. (sugar is the best I have succeeded with, but burns out in casting from, and softens if the weather is damp). All these have, more or less, the same result, a certain hardening of the surface, but internally the substance of the plaster is quite as soft, or perhaps, softer, than plaster with no admixture, and, strength for strength, certainly weaker. I may mention that I require the mould for casting a number of small objects of a rather intricate pattern in metal. A practical answer would greatly oblige. I have but just tried marshmallow as a hardening agent, but with no better success. It was recommended by a surgeon dentist in Vol. XV., page 261, as a specific for the above defect, and greatly superior to alum, salt, &c.—E. NASEN.

[49668.]—**Glass Painting.**—I wish very much to become acquainted with this art. Could any reader kindly give instructions, hints, list of colours, and other materials employed, and, in fact, any information whatever would be most acceptable; as beyond the fact of being a fair draughtsman and colourist, I am entirely ignorant on this subject. Is it possible to paint on glass in water-colours as well as in oils? Must the glass be baked afterwards?—WOULD-BE ARTIST.

[49669.]—**Siemens' Armature.**—I have a Siemens' armature driven by a toothed wheel vertically. In fact, it is part of a magnetic generator for telegraphs. The current is taken off at present from the bearings—i.e., the bottom bearing is insulated from the armature, and runs in an insulated centre. This takes, say, the + current. The other current is taken off from a circular iron plate attached to the top of armature uninsulated, which is rubbed by a spring continually as it revolves, so there is no break in the continuity of the circuit. Now I want to know first, if this arrangement will do for alternate currents as well as the two half-circles of copper generally seen on Siemens' armature and as on Cuttriss' motor; or must there be a break (for instance, would two complete circles of copper attached to an insulated ring, and having one wire joined to each, answer as well as the split ring)? Secondly, how can I arrange to get a current from my armature in one direction? as I wish to charge the field-magnet with it, and so make it independent of a battery. Thirdly, size of armature being 3½in. × 2in., and wound with 18 silk-covered, what current may I expect—equal to one Bunsen, say?—W. J. GUTCH.

[49670.]—**Boat-Building.**—I have in view the building of a boat for both sea and river use (chiefly sea). Will some informed reader kindly give me a description of one that, with being tolerably expert, one alone could manage? I thought a small cutter or boat with sliding gunter. Are these beyond one hand's capability? I thought, too, of putting a small engine, say 1, 1½, or 2h.p., on board to be slightly independent of calms. With such an engine, about what would speed be? I should want capacity for four or five to sleep on board, with a little roughing it.—PAX.

[49671.]—**Threshing Machine becoming Clogged.**—Can anyone suggest a remedy for the above? The machine is an old-fashioned one, in which the straw is fed between two longitudinally grooved metal rollers, engaging with each other, the lower of which is driven by a belt passing over a pulley, keyed on its spindle. The journals of the upper roller work in two vertical slots, which allow it to rise and fall according to the feed. When the straw is long and damp, an almost unavoidable matter in these wet seasons, it becomes wound round the lower roller, causing much delay and trouble in cutting it away. I inserted a query in the "E. M." about two years ago, asking how to prevent the belt which drives these rollers from slipping on its pulley, and received several answers, one of which recommended a strap to be riveted round the face of the pulley. I tried this plan with complete success, and hope to be equally fortunate this time.—WAR.

[49672.]—**Telephone Connections, &c.**—I want to rig up between a summer-house in my garden, and a room in my house, a set of telephones, transmitters, and bells. I have made the telephones and transmitter myself, but I cannot manage the connections. I want to use only one wire between the stations, using the ground as the second wire. I shall have a battery, a bell, a telephone and transmitter at each end, and would feel greatly obliged to anyone who would give me a sketch of the proper connections. The telephone and transmitter are in a box 10in. square, and the bell on top. I want to have a push for the bell and the batteries out of action, when not in use.—NO NAME.

[49673.]—**To Mr. Stearn.**—Should Mr. Stearn see this query, would he kindly furnish me with the following particulars concerning the modified Leclanché cells for lighting microscope lamps? I want them for lighting a 5 candle-power Swan lamp. (1) How are they constructed? (2) How many will be necessary to light the lamp? (3) How long do they last before polarisation point is reached? (4) In what time do they recover fully from polarisation? (5) How often will the solution require renewing, using the battery three hours a day on an average. Should any other readers be able to answer the above queries, I shall be much obliged if they will do so.—SEAWEED.

[49674.]—**Battery Construction.**—I am extremely obliged to "Sigma" for reply to my query, and apologise for troubling again so soon. As inferred, the 40 or 50 cells are intended for use as a constant-current medical battery; but my chief anxiety is in reference to the best form of battery for working a portable medical coil, in which the elements need not be removed from the solution, the Smee and the bichromate, therefore, being inadmissible. I have at present fitted in case of coil, and used with excellent results for some time past, 2 pint size improved form of Leclanché, with the agglomerate blocks, the daily applications sometimes extending to 30 minutes, without apparent decrease of power. This induced me to ask the query respecting platinum for negative element, thinking the extra E. M. F. therefrom, would give still more satisfactory results, but in doubt as to greater constancy. The reply, however, contained in last issue of "E. M." that "the battery is not fit for working a coil," from such reliable source, dispels the hope I entertained. Still I would ask, whether the form of cell in question—i.e., pint size, the zinc rod being contained in porous cell, with strip of platinum in outer cell, and packed full with manganese and carbon, would be any improvement upon the Leclanché agglomerate. What height from the lower end should the strip of platinum be cut into ribbons, and how can the pieces of carbon be firmly attached to the platinum as advised in reply?—THERAPEUTIST.

[49675.]—**Delivery of Feed Water into Boiler.** Allow me to invite experience on the above question—that is, its effect on the deposit or scurf in boilers. Some advocate delivery above the furnace, others below. In my own case, the delivery is above furnace, by a length of pipe within boiler to beyond the furnace where the two furnaces open to one chamber, with cone tubes. Now the tubes nearest the end of feed delivery pipe have a scale bare ½in. thick, and I need scarcely add, it is difficult of removal with scaling hammer on account of dia. of tubes. Now would the delivery of water below furnaces keep the deposit down on bottom of boiler, or is it the water which must be operated on? The water has 16·5grains of carbonate of lime per gallon. But what is most mysterious, is that boilers fed from the mains in the town make no scale,—a month's work can be swept off with a brush.—J. O. E.

[49676.]—**Mining Query.**—Would "J. H. W.," or some of your able correspondents, answer the following questions? I have a shaft in which there are two seams of coal. The cages at present are working the lower seam, which is 660ft. in depth; the other seam is 390ft. in depth. I want one cage to stop at the first seam, and the other to the lower seam, the diameter of drum is 9ft., what will be the size of drum required?—NON VALEO.

[49677.]—**Geneva Watch.**—I have a Geneva watch, bar movement, which stops occasionally through the centre bar binding against the centre wheel. My difficulty lies in not knowing how to remove the centre bar after the screws by which it is held in position, have been taken out. It is a good time-keeper when going, but I cannot much depend on it, as it stops now and again. Any information of practical value will be thankfully received by—G. FRYER.

[49678.]—**The Link-Motion.**—Would "Milverton" kindly explain one or two points in connection with his letters 20698 and 20877? He speaks of "coincidence of curves with straight lines," and of "length of contact." Does this mean that portion of the curves are actually straight lines? If not, how could there be contact at aught, save a single point? Again he says in his former letter, "The condition for these curves" (i.e., those having said coincidence) "is $d^2 = l\,(l + r)$." How can this condition be deduced directly from the general equation to the locus? Finally, is it possible to give a definite reply to my original query, viz.—Given d and r, what value of l most nearly fulfils the requirements of the parallel motion? Is $\frac{1}{2}\,(\pm r + \sqrt{4r^2 + d^2})$ a correct answer?—A. J. SMITH.

[49679.]—**To Dr. Edmunds.**—In a letter some little time ago Dr. Edmunds said that rupture was sometimes caused by riding with a long stirrup and bumping the saddle. Would he kindly say whether any precautions could be taken against this? Would wearing a suspender or any kind of belt be of service? And would Dr. E. say whether, in his opinion, riding in a cavalry saddle (which rises in front and rear) would be more likely to cause rupture than riding on an ordinary saddle?—DRAGOON GUARD.

[49680.]—**Book on Horsemanship.**—Could anyone recommend me any book on horsemanship, more especially on the more difficult manœuvres, called, I believe, the *Haute école*? I should like to know publisher and price, if possible.—DRAGOON GUARD.

[49681.]—**Maxima and Minima.**—The following problems have occurred to me in setting out railway curves, and as the results are somewhat difficult to check, would any of "ours" like to try them?—(1) What is the shortest circular curve which can be drawn from a given point to touch a straight line? It will be sufficient to give the angle subtended by the arc, which angle is independent of the radius. (2) What is the shortest circular curve which can be drawn from a point either within or without a given circle, to touch the circle? An equation from which the angle subtended by the arc could be found is what is required. I make the answer to the first question 133° nearly. Is this correct ?—M.I.C.E.

[49682.]—**Electric Bell.**—How can I lessen the noise of a 4in. bell arising from the armature striking the magnet, which is powerful, as there are long and short circuit lines to the bell ? If I had only a short circuit, or only a long one, less battery intensity would, I find, obviate the difficulty.—R. HANSEN.

[49683.]—**Mandrel-Nose.**—Would some one please say whether a conical or straight nose is best on mandrel? A neighbouring mechanic has told me the conical is best; his mandrel is conical also. It is a traversing screw-chasing mandrel, of very simple construction.—J. T. NEWBURN.

[49684.]—**Model Engine Boiler.**—Will any of your readers kindly oblige by saying what ought to be the dimensions of a boiler for a model steam-engine, the size of cylinder (in the cast) being 2¼in. in height, diam. of bore ⅜in.—ALPHA.

[49685.]—**House Modelling.**—I will feel much obliged for any information on above subject. Scale in at about inch to the foot. What materials for plastered, cemented, brick, or stone walls, slating, ground, paths, and flower-beds ?—COMPETITOR.

[49686.]—**Scurvy.**—Can any of ours, or Dr. Edmunds, tell me the best home treatment for scurvy in a grown-up person, who has not been affected for the last six years ? Now it suddenly appears at the eyes, elbows, and knees in numerous blotches. Any information as to diet or treatment will oblige—BOSWELL.

[49687.]—**Watch Repairing.**—To "ALFOJOE" or "FELLOW WORKMAN."—Would the above-named gentlemen kindly inform me what tools do I require to let me know when the staff of balance is upright ? I am told if I make use of calipers I will then see whether the wheel is true. This I have done, and yet I fail to get the wheel true. What is the cause of lever watch losing time when nearly run down ? I am informed that the main spring is not set right. This I fail to understand. To what part of verge watch does the word follower apply ?—A WORKMAN.

[49688.]—**Safe Detector.**—Would some reader give me a hint how to frustrate tampering with an iron safe ? I have thought that possibly a battery placed in some way so that when the key is inserted it will complete the circuit, and give a powerful shock to the intruder. Should the battery be outside or in the safe ? Which is the best to use ?—PERPLEXED ONE.

[49689.]—**Commutator.**—Would Mr. Tolman, or anyone, kindly explain how the commutator is arranged in connection with a Siemens armature for such a small dynamo described by him in "E. M." for June 23 last ? Being a novice in these matters, I do not quite understand the description there given. Are the two opposite currents induced in the armature at each revolution taken up by the one brush and sent in one direction ?—J. C. L. M.

[49690.]—**Shrinking Fit and Measuring Instruments.**—How much smaller must a hole be bored in iron and in brass to shrink on to a 1in. mandrel ? What is the difference between a sliding and a driving fit ? Could these measurements be taken by means of a vernier caliper measuring to one thousandth of an inch, and if not, how can such exact outside and inside measurements be taken ?—F. A. M.

[49691.]—**Wheel-Cutting Machine.**—Could any subscriber inform me how to divide a division plate for a wheel-cutting machine for cutting any number of teeth, from 8 to about 200, upon wheels from 6in. diameter and under ? If a sketch of such a machine in detail could be given, it would, no doubt, be valuable to some of our amateur friends.—A YOUNG SUBSCRIBER.

[49692.]—**To Mr. Lancaster.**—It is said in last week's "Scientific News," p. 565, that M. Spring finds yellow light gives various shades of green when combined with the blue of water. Does not this prove Mr. Calton to be right ? It is allowed that there are shades of every colour in every part of the spectrum, and that those shades cannot be removed from their place. Does then the fact that the green of the spectrum cannot be resolved into two (or more) other colours prove that it is not made up of, at least, two colours ?—F. L.

[49693.]—**Dynamo.**—To MR. LANCASTER.—I am making a small dynamo something of the Wallace Farmer style, with this difference: that instead of having two pairs of F.M.'s, I have only one pair, the discs with the small electro-magnets being placed at each end. The F.M.'s (of soft iron) have cores 3in. long, and 2½in. × 2in. thick. The discs (of brass) have each eight small magnets 1¼in. long, and ⅝in. diam. I have all the parts made, but have not yet wound them. I propose to use three layers of No. 14 cotton-covered for the F.M.s', and ten layers of No. 20 silk-covered for the small magnets, to join the wires for tension, and carry the entire current (from both discs) round the F.M.'s. Do any of the above sizes or quantities require altering to obtain the maximum current from the machine, and what candle-power should that current be equal to, working 800 revs. per minute ?—E. N.

[49694.]—**Engineering.**—Will "M.I.C.E.," or any other of "ours," kindly answer the following ?—(1) Taking the coefficient of friction between the surfaces as being ·15, what number of threads to the inch must a screw 5in. in diam. have, so that when placed vertically it will, of its own weight, just rotate in the nut ? (2) What will be the angle of the thread of a screw which is 2·750in. diam. and has a 5in. pitch ?—J. H.

[49695.]—**Utilising Water-Tank.**—Would any reader inform me how I could utilise a water-tank to the best advantage so as to drive a hydraulic motor or engine? The tank is 18ft. above where I should require the power, and its size is 6ft. long, 4ft. deep, and 4ft. broad. Any suggestions as to above, and kind of motor or engine required, will be thankfully received. I may say the power I would wish would be about 1h.p.—DANIEL McNICOL.

[49696.]—**Micro-Photography.**—In looking over back numbers for information as to focussing, I find very contradictory advice. Thus, in one place, I find that after focussing sharply the objective is to be "pushed in 1-10in."; while in another I am directed to focus as far from the object as is consistent with sharp definition. I shall be glad of some information on this "chemical focus" from someone who has had experience. Is there any appreciable correction required for powers under ½in. ? I think not; at least, with 1in. and under. I understand correction can be made by adding a small convex lens behind the objective. Of what focus should this be for ½in. objective ?—W. G.

[49697.]—**Spiral Winding.**—If I take a bar of iron, say, 1in. diameter, and a piece of yarn, or any other material, the same length as the bar, and wind it spirally round it with a "lay" of, say, 3in., it will not reach the end of the bar. Will any reader be kind enough to give me a rule for finding the proper length of yarn for all "lays," and diameters of core ?—MANILLA.

[49698.]—**Non-Conductor of Sound.**—The committee of a co-operative society have erected extensive business premises. On the ground-floor there are large shops for grocery, drapery, boot and shoes, butchers' meat, &c. The suite of rooms on the next floor are office, board-room, warehouse, with a large reading-room, and another for recreation; these rooms being immediately over the shops. The flooring of the rooms is the ordinary wooden flooring, boarding nailed on the top of, say, 9in. joists, while the shops are ceiled with ½in. timber, so that between the flooring of the rooms and ceiling of the shops there is a vacant space of about 9in. Now it is found that the least noise in the reading-room—and there are a good number of members—is heard below, and customers being served in the shops, can also be heard speak in the reading-room, while the shuffling of feet, and noisy conversation in the recreation-room is quite annoying to customers coming into the shops below. I want to know from some of your kind readers what would be the best cure for this evil ? Could the space between the floors and ceiling be filled with something, a non-conductor of sound ?—or is there some other remedy that would be more effectual ? I should feel exceedingly obliged to anyone who could tell the committee how this very great evil may be remedied.—R. J.

[49699.]—**Lease.**—To MR. WETHERFIELD.—I am the owner of a small farm, leased for 5, 7, or 10 years, rent to be paid quarterly, usual conditions and restrictions. It is clearly stated that no hay or straw shall be removed from the premises, but all to be taken at the expiration of the term (Michaelmas next), by the lessor at consuming price. The tenant has removed and sold several lots, both hay and straw, of which I have ample proof, and he sets the lease and myself at defiance. I have lately put in an execution, and sold for 2 years' rent, but he has some stock yet left. Kindly say what I should do to protect myself.—LEASE.

[49700.]—**G. W. R. Engines.**—Would any reader kindly state (with classes) what narrow gauge tank engines run respectively into Bristol, Swansea, and Chester ? And also, who is the designer of 580, 842, 1120, 157, 1195, and 2214 ?—PROMETHEUS.

[49701.]—**Locomotive Queries.**—Is L. and Y. R. engine, 423, of Mr. Ramsbottom's design ? Are the L. and N. W. R. engines, Columbine, Herald, Inglewood, Trentham, Atalanta, Pheasant (the new one), and Una in existence ? When were the L. and N. W. engines, bloomers, 671, 672, 678, 708, 1009, 1012, &c., converted into six coupled goods (or excursion) engines ?—PROMETHEUS.

[49702.]—**To Dr. Edmunds.**—About six months ago I experienced a very curious sensation, while walking in the garden one evening—a feeling of giddiness and fulness in the head came over me, and I seemed like a steam-engine at high pressure; my heart also beat quicker than usual, and I had a sort of dread that something terrible was going to happen. I came in the house and sent for a doctor, who ordered some brandy-and-water, and gave me some medicine. I did not sleep much that night, but the next morning I seemed better. I continued his treatment some time, and by his advice went away for a change, returned, sought and acted on other advice, but cannot get quite rid of the feelings before described. I am 38 years of age, lead an active life, temperate, although not a total abstainer, never had any serious illness except gout now and then. The feelings I have been trying to describe, I notice very rarely occur in the day time when I am engaged in business, but generally in the evening, and more especially on Sunday when at church, and the only thing I find that gives relief is yawning. Would Dr. Edmunds kindly give his opinion of this case, and say if anything can be done to cure it, and oblige—SUFFERER.

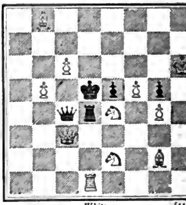
[49703.]—**Chamber Organ.**—Will "Uranium" kindly try to put me into the secret of voicing organ pipes. He truly remarks to "G. T. B." the vast difference there is in voicing and tuning: the voicing being the mysterious part to amateurs. I have made 24 wooden stopt pipes from CC with the greatest care, both to workmanship and scale as was possible for any practical pipe-maker to do, and after all, when I planted them on soundboard, I was sadly disappointed at the result of all my patience. I may tell "Uranium" that I made them from instructions given in a monthly publication. The mouths are one-third the width in height; but since I made them I have seen in answers to correspondents that the mouths should have been one-fourth of the width in height to allow for cutting a little higher. Of course this information came too late for me; but what I want to know is—When does the mouth of a pipe want cutting a little higher ? (2) When a pipe utters a note an octave above its right note before it sounds properly, I have cut off the wind from the foot, reduced the windway, &c.; but when I did I reduced the power of the pipe in comparison to others that sound very well; and there lies my difficulty. I cannot get them equalised in tone or language, and my opinion is that a very trifling thing may be the cause if amateurs only knew where it lay. All works that I have seen on organ-building are extremely quiet on this particular point, and surely there must be some established law for this as well as for other things; but these articles are written as if they were for practical men instead of amateurs, who should have the why and the wherefore explained in plain terms. For instance—How the wind should be thrown against the lip; the mechanical action of wind against the lip; why the languid should be nicked angular instead of being straight, and many other things might be better explained than they are, if it is in their power at all. I may tell "Uranium" that I have made a paper pipe from instructions in one of those monthlies. Well, when I blow through it, it may sound, and it may not. When it does sound it sounds the note very well; but one would think only when it pleased to do so. Will "Uranium" say what may be cause of this ? Also, how I could strengthen the tone of bass pipes, which seem to me very indistinct in their language ? Would angular nicking improve them ? I may mention that the stoppers are all air-tight, and the only thing that I have neglected to do is the sizing with glue inside of pipes. Would "Uranium" or "Progress" say what he thinks of the organina cabinet and the organina, both having automatic feed; but why are the music sheets for the organina cabinet about double the length of the sheets for the organina, also halfpenny dearer per foot ? They are sold by Wood and Co., London—the ones I refer to. I should like to have one of them, but being very far from London, have no chance of seeing for myself. Any information on the subject will be gratefully received.—LOVER OF MUSIC.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden W.C.

PROBLEM DCCCXXIV.—By A. BRIGGS, Rochdale.

Black.



White. [11+5

White to play and mate in two moves.

SOLUTION TO 822.

White.	*Black.*
1. B to K 6	1. Anything
2. Mates accordingly.	

NOTICES TO CORRESPONDENTS.

CORRECT Solutions to 821 by T. H. Billington and Dicky Sam; to 822 by T. H. Billington, Dicky Sam, J. B. of Boxford, H. Jacobs, E. S. Follwell, T. Basso, R. T. Adams, R. A. B.; to 823 by R. A. B.

T. BASSO, E. S. FOLLWELL.—Due notice will be given when the Tourney begins. Problems need not be sent in before May 31. Solutions must be sent before they are published, that is in less than a fortnight after the problem appears.

H. JACOBS.—Glad to hear that you intend to join. See notice above.

J. B. of Boxford.—Thanks for communication, which shall be attended to: also for enclosure.

THE following fine sui-mate in 14 moves has been sent us by the well-known composer, Mr. J. A. Miles, of Fakenham. He calls it "The Crisis." We append solution. All Black's moves are forced.

White: $\frac{\text{K}}{\text{K Kt 3}}$ $\frac{\text{Q}}{\text{Q Kt 3}}$ $\frac{\text{Rs}}{\text{K Kt sq, K R 8}}$ $\frac{\text{Bs}}{\text{Q B 3, K 8}}$

$\frac{\text{Kts}}{\text{Q 6, K 5}}$ $\frac{\text{Ps}}{\text{Q R 4, Q B 5, K 4, K B 4}}$

Black: $\frac{\text{K}}{\text{Q R sq}}$ $\frac{\text{R}}{\text{Q R 7}}$ $\frac{\text{B}}{\text{Q Kt sq}}$ $\frac{\text{Kt}}{\text{K 8}}$

$\frac{\text{Ps}}{\text{Q R 3, Q Kt 3, Q 7, K R 3 and 4}}$

SOLUTION 1. Q-Q 5 (ch); 2. P takes P (ch); 3. Q-Q 4 (ch); 4. Q-B 5 (ch); 5. Q-B 8 (ch); 6. Kt-K B 5 (ch); 7. Kt-Q 3 (dis ch); 8. P takes B (ch); 9. K-R 3 (dis ch); 10. B takes P (ch); 11. Q-B sq; 12. R takes P; 13. R-Kt 6 (ch); 14. Kt-K B 4 (ch); 14. Kt takes Kt mate.

ARRANGEMENTS have been finally made to determine correct Australian longitudes. This was to be done early this year, when the boundary between Queensland and the adjoining colony will be clearly defined.

THE boring of a tunnel 4,000ft. in length under the river Hudson at Weehawken, N.J., has been completed. Most of the tunnelling has been boring through rock from several faces, entered by five shafts, 70 air rock-drills having been employed on these faces. The tunnel is 27ft. wide and 21ft. high.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: Nos. 715, 718, 721, 724, 728, 731, 734, 741.
Bellows camera: Nos. 475, 480, 894, 897.
Bookbinding: Nos. 613, 627, 770.
Cements: Nos. 377, 729.
Coils, induction: Nos. 613, 620, 636, 640, 779, 797, 832, 885.
Coils, medical: Nos. 844, 858.
Copying processes: Nos. 750, 758, 761, 762.
Electric bells: Nos. 545, 658, 797.
Electric machines: Nos. 368, 380, 628, 759, 840, 846.
Electro-magnets: Nos. 756, 772, 783, 864, 872.
Electro-plating: No. 833.
Lacquers: Nos. 429, 475, 622, 866.
Magneto-electric machine: Nos. 376, 589, 783, 826.
Nickel-plating: No. 808, 811.
Silver-plating: Nos. 830, 868, 869, 870, 871, 874.
Varnishes: 321, 478, 619, 675, 691, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 28, and unacknowledged elsewhere:—

JAS. W. QUEEN AND CO.—W. F. Stanley.—Dr. Malley.—R. E. Quinn.—W. Watson and Sons.—Morris Cohen.—T. Taylor.—T. R. Clapham.—An Amateur.—C. Meeks.—Carbon.—E. G. B. B.—E. M. P., Bristol.—Cameron.—One Wanting to Know.—Student Civil Engineer.—Biltites.—A. Francois.—R. A. A., Sheffield.—Anxious.—M. B.—O. J. L.—Metal Planer.—Alfojoe.—Joe.

A NEW VOLUME.

THIS number is the last of Volume XXXVI. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXVI. will be published on March 23, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

T. E. J. (Without troubling our correspondent, we may say at once that you are quite correct in your supposition. Anything which cuts off even the smallest part of the available aperture, either of the object-glass or field lens of the eyepiece (always supposing that the diameter of the latter does not exceed that of the cone of rays at the point where it is situated), diminishes the light, and, *pro tanto*, the penetrating power of a telescope.)—A. HERBERT. (No chemical at all. You are mistaken as to the origin of the odour. 2. Several methods of recovering gold on p. 364, Vol. XXX.)—A READER. (See previous answer and the indices.)—GLASGOWEGIAN. (There is no book of the kind. See the papers on dynamo-electric machinery. 2. By reading technical journals. 3. Could you not attend the College of Science and Arts in your city? With that or Anderson's College, and access to the works, you seem to us to have especial advantages, if only you will utilise them.)—C. F. (Suppose you look up the back numbers? How would that on p. 241, No. 898, suit? You should have tried madder, or the artificial alizarin. 2. Sulphate of ammonia, nitrate of soda, and dissolved bones are the chief; but nurserymen use dung-water, soot-water, and various preparations supplied by merchants. There is a good deal on the subject in Vols. XV., XIV., *et seq.*)—A YOUNG SOAP-BOILER. (Works of the kind cannot be cheap, meaning low-priced; but perhaps Dr. A. Ott's work would suit you. A good deal of information on the subject in Vols. XXX., XXXII., and XXXIII. An advertisement in the "Wanted" column would, no doubt, bring an offer of a suitable book, secondhand.)—R. B. (There are several patented processes; and no doubt you will be allowed to use them on payment of royalty; but possibly you may find what you want in back numbers, as a good many suggestions have been made.)—A MECHANIC. (Do you mean a canvas boat or a wooden one? See p. 506, last volume, and the indices of recent volumes.)—KOOSO. (Hay will do for the body, but cotton wool and tow for other parts. Skull must be thoroughly cleaned out, and all parts anointed with arsenical soap. You can buy suitable eyes of the dealers.)—OTTER. (See p. 22, No. 859.)—H. C. (No. 18. Depends on what it is to do.)—MECHANIC. (We never heard of it. What is it, and where do you find any reference to it?)—ORION. (A good opera-glass would enable you to do more useful work; but you should try what you can see on Jupiter or the moon. You can buy suitable eyepieces of the opticians advertising in our columns. 2. You can buy a yard 4ft. wide for about 4s.; but why not make an oilskin? Dip the fabric in water, and swing it round, then hang up, and, whilst still moist, dip in linseed oil, or paint it over with the oil. Hang up to dry. Two coats will probably be sufficient for your purpose. 3. No book on the subject. That is why the articles and letters in these columns are so valuable.)—GRAPHO. (See p. 458, present volume, and several other replies in recent numbers. Bunsen cells are the best, but are objectionable on account of the fumes, so the bichromate battery is mostly preferred.)—VIGILANCE. (Brown-paper and tobacco-smoke are simplest; but Tyndall uses the smoke of rosin and gum mastic, and the dense fumes made by exposing hydrochloric acid and ammonia liquor to the air. Put them in a box with a hole in one side, and a flexible end, which you can tap. You will then get smoke rings; or perchloride of tin exposed to air gives very dense fumes. We should think rosin would suit.)—PHILO. (You should look through the back volumes. Perhaps those described on pp. 259, 336, Vol. XXXV., will suit. See also p. 87, same vol.)—GO AHEAD. (Dr. Edmunds replied at length about insomnia on p. 225, No. for Nov. 10 last.)—J. W. R. (Probably some firm of machinists would make the requisite apparatus. Would not something like a mortar-mill, with chilled iron rollers, crush it fine enough?)—BLACKSMITH. (Several replies in back volumes. See one on p. 338, No. 809; also pp. 18, 41, Vol. XXXI. It depends on what is meant by cast steel, as there are great differences in the metal, and some varieties will not weld.)—HYDROPATHY. (See the index of the last volume. A blanket would be best, we should think, in the absence of any details.)—W. H. T. P. S. (What portion of the process is it you wish to know? See p. 73, No. 873, for composition, and pp. 121, 143, Vol. XXXI., for methods of splitting the wood.)—V. V. (It was Chadwick's manual, no doubt. Published in Manchester, we think. Griffin, Garrick-street, was the address. 2. See paper on p. 514. The standard is a sperm candle, burning 120 grains an hour; but where accuracy is wanted, it is usual to weigh the candle and calculate accordingly.)—PRADU. (Local doctor, no doubt is correct, and you will outgrow the weakness.)—J. C. (Many causes—probably weakness; or does he suffer from epileptic fits? In any case, only a medical man can, after careful *personal* examination, help him.)—SOON PLOONER. (We think A. can stop B., but are not sure. Better consult a solicitor personally.)—MECHANIC. (Many other people have said so; but the machine is not yet made—nor will be, we fancy!)—CORFU. (Yes, it should be prepared by a solicitor.)—SAMBO. (It is *badly* boiled, that is all. If Dr. Edmunds' instructions are properly followed, lumps are impossible, the meal itself being good.)—J. HILDERSLEY. (We have sent your letter on to Mr. Vallance. We have little more space to spare for "Sizes of Flats in Newtonians," which is, to our thinking, a profitless controversy.)—A. S. L. (First letter was already in type; second shall be kept over till space offers.)—W. A. E. S. A. (See a query in last number, and look out for replies.)—BAAAS. (We cannot form an opinion from the statements made. If you have a brake which acts without air or steam, and applies directly to all the wheels, it might be worth while protecting it; but we cannot offer an opinion without knowing something of its action.)—B. N. (It is rather small, but would do if there are no bends. We should prefer inch tube, or at least three-quarter.)—G. J. H. (It entirely depends on what cell it is. In the Leclanché a zinc rod is best; in the Bunsen you require large surface of zinc.)—AN OLD SUBSCRIBER. (How old? The query was asked a short time ago; but the only answer was that it appeared to be a kind of sweet biscuit-powder.)—W. D. JONES. (Look at p. 332, Vol. XXXIII.; but you should really look through the last six or seven volumes. We do not know of one that can be used in the manner suggested without infringing the patent.)—AMATEUR. (Ask one of the large booksellers in your city. There are several books on the subject.)—HYDRAULIC. (There is no such thing. You must have a tank above the aquarium, or else force water up by means of a weight on a bellows, or some similar arrangement. See answer to "W. K." on p. 558.)—JAS. FRASER. (It cannot be disputed. A well-known lecture-room appliance is a tube from which the air is exhausted, and which contains a lead ball, a feather, pieces of paper, &c. These bodies are seen to fall in exactly the same time. Any difference which would be experienced in the open air would be due to the resistance of the atmosphere to the passage of a larger surfaced body compared to its weight.)—A SUBSCRIBER, Wantage. (If our readers knew of a method of "taking the smell off" petroleum, we suspect they would patent it. Something can be done by distillation and refining, and also by adding perfume; but one and all cost too much. 2. You should have said what you meant by steel. Wipe it over with paraffin-oil, or bury it in quicklime, or starch-powder, or plumbago, or make a paste of clean sweet fat and plumbago and smear over it.)—E. W. B. (Yes; we believe it was.)—J. W. (Look through the "Sale" column weekly.)—SOWOOD READING ROOM. (Use Boyle's chimney-caps.)—A SUBSCRIBER TO THE "ENGLISH MECHANIC" IN GLASGOW. (You have all the information in back numbers—recent ones, too.)—JOS. STEPHENSON. (Several recipes given in back numbers—we suppose it is a coat of best double-boiled oil; but you should state what you use for first coat.)—INQUIRER. (The tincture would be made by masticating the pounded freshly-roasted berries with rectified spirit for a week or longer; but we do not know of any official directions for making it. Perhaps you mean the "essence." That is a commercial product, presumably made by infusing the freshly-ground berries, straining the liquor, and evaporating it quickly, preferably in a vacuum pan. It is then thickened with syrup.)—H. W. (If you do not preserve your numbers you should not "neglect to write out" anything useful. We presume you have plenty of time. See pages 485 and 506 of the present volume.)—T. BROOKE. (The only way is to use a "frit" and burn it on in a muffle; but the best way would include trade secrets as to the composition of the "frit" and the working details. There is a good article in Ure's Dictionary of Arts, &c. (Enamels). If you will read that and put definite queries on the details, we could insert them.)—D. H. O. (Second paper received, and shall follow the first in due course. Send twenty if you like. You know every reader welcomes your contributions. Are you *quite* silent on the screw-threads controversy?)—A YOUNG ASTRONOMER. (We think not—after Sir Edmund Beckett's letter in the *Times*, it is not well to tread too heavily on the M.O.!)—OS. (Choose your own arrangement: we know from long experience your object is the benefit of all.)—J. E. WHITE. (We cannot recommend, or aid you to select, a medical man.)—J. BROWN. (He can do nothing but keep money matters in his own hands, and patiently hope for a change.)—G. E. TURNER. (There is only one way—to become apprenticed in the usual manner.)—ANXIOUS. (Heartburn, we suppose; see a medical man.)—SUBSCRIBER. (Send back the tickets; you are neither obliged to pay for them nor go. The officers of the lodge cannot touch the lodge funds to pay for teas or balls.)—T. W. (See pp. 180, 239, Vol. XXXV. It is not clear what is the matter with you, but probably a little tonic medicine is required.)—J. H. M. (Any communication addressed to the Society at Breslau, Germany, would no doubt meet with a reply.)—W. D. JONES. (You can do the bolt or latch by attaching it to the knob or handle by which you shut the door; by turning that round you can shoot a bolt or raise a latch. 2. See p. 233, this volume, and the indices; but you will be infringing the patent by such a use. 3. No one would answer such a query without details of the clock. The ball could be raised by the clock winding up a little thread (if the clock is strong enough), and then a magnet could be made to release the detent when the hour hand made contact and completed the circuit. But how do you propose to erect the staff, and would you bore the requisite holes in the marble case? See pp. 72, 165, in this volume, for general methods of working.) ST. AUBYNS. (The statement is not true. An engine might possibly run down a long bank at the rate of 90 miles an hour; but no "train" ever travelled over 118 miles in an hour and a half.)—H. G. P. (Set your weathercock "points" to the true north as near as you can get them, say 19° east of the line indicated by the compass needle.)—A. B. (How can anyone answer such a question when it depends entirely on the amount of wear they have undergone?)—FERY. (Try bathing in hot-water in which a handful of hay is steeped. Salt and water has been recommended.)—MOLEHILL. (See No. 840, p. 191. If you tan them you will make them hard. It has been frequently stated that to make them soft they must be beaten and worked about.)—EX., G. H. L. (In type.)

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The address is included as part of the advertisement, and charged for.

Advertisements must reach the office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

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PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXX., XXXI., XXXII., XXXIII., XXXIV., and XXXV., bound in cloth, 7s. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI. and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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Holloway's Pills.—These preparations may be used at all times and in all climates by persons affected by biliousness flatulency, colic, nausea, or disordered liver; for heartburn and sick headaches they are specifics; indeed, no ailment of the digestive organs can long resist their purifying and corrective powers.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Throat Irritation.—Soreness and Dryness, Tickling and Irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d.; tins, 1s. 1½d., labelled "James Epps and Co., Homœopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, Gordon Holmes, M.D., Senior Physician to the Municipal Throat and Ear Infirmary."

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

All kinds of **Scientific Apparatus** exchanged for others.—Carlavel, Science Depot and Exchange.—Chenies-street, Tattenham-court-road.

Dynamo, 6-light, value £10. Exchange Foot Lathe, or other Engineer's Tools.—E. Owen, 3, Albany-road, Leyton.

What offers for ninety-six **Metal,** 28 stopped **Wood** Organ Pipes, gilt organ front, keys, &c.?—Tanner, Rusham-road, Horsham.

Organ Pipes, Windchests, Bellows, new and secondhand, ready for performer. Harmonium Pedal Chest and Reeds. Exchange.—W. Johnson, 12, Moxley, Wednesbury.

Waltham Watch, best timekeeper in the world, only just new, jewelled lever movement, gold hands, crystal face, in massive nickel silver cases, with warranty. What offers?—Hutchinson, Millbridge, Liversedge, Yorkshire.

Telescope, astronomical and terrestrial, 1½ object-glass, three draws, two eyepieces. Also large pair of Opera-glasses, new. Will exchange for Double-barrelled Breechloading Gun. Offers wanted.—Hutchinson, Liversedge, Yorkshire.

Wanted, about 5in. iron **Lathe,** screw-cutting preferred. Will give in exchange either new Tricycle or Bicycles. State wants.—C. T. C., 65, Freehold-street, Hull.

Bicycles and Tricycles. Will give in exchange for Lathe, or any Engineer's Tools.—C. T. C., 65, Freehold-street, Hull.

54in. and 52in. **Bicycles.** Will give either in exchange for good iron Lathe, about 5in. centre. The bicycles have ball bearings.—C. T. C., 65, Freehold-street, Hull.

Organette, cost £6 10s., with 100ft. music rollers on, 48in. Bicycle; will give in exchange for any engineer's tools.—C. T. C., 65, Freehold-street, Hull.

Photographs (about 50), Abbeys, Cathedrals, and Buildings, cabinet size, 4d. each, or what offers?—Address, Photo, 182, Trongate, Glasgow.

Wanted, pieces **Brass or Zinc,** one inch wide, various thickness and length. Exchange offers. Also milling wheels, patterns, &c., to Postmaster, Rushden, Higham Ferrers.

Wanted, Ross **Ross Rapid Symmetrical Lens.** Will exchange first-rate lantern-slides to double the value.—Thomas, Hereford House, Acton, W.

Eccentric **Cutting Frame** and Drilling Spindle Buck's; wanted parallel vice about 3in. jaws, or offers.—W. H., 44, Mintern-street, St. John's-road, N.

Scenograph or Merveilleux Wanted; give in exchange gentleman's silver lever hunter, compensated balance, jewelled 13 holes, good timekeeper.—Reynolds, 39, Napier-street, Hoxton, London.

Compound Slide-Rest, 3½, for V and flat bed. Exchange for Watch.—W. H., 60, Grove-road, Holloway, London.

Wanted, 6in. gap-bed Screw-cutting **Lathe** and small Planing Machine, for two-manual Harmonium, couplers, 20 stops, cost £60.—T. East, Louth, Lincolns.

Horizontal **Engine,** ½ H.-P., heavy flywheel and grooved pulley, 4 guineas, or exchange. Also Electro-Motor, 12in. armature, wound. Offers.—Underwood, Sywell, Northampton.

30in. bed, 3in. centre back-geared Bench **Lathe,** new in December last, with separate 4 speed foot power, £3. Also Hand Fret Machine. Offers. Wanted, 4ft. bed, 4½in. centre Screw-cutting Lathe, or 1½-man Gas Engine in exchange.—F. Underwood, Sywell, Northampton.

50in. Carver **Bicycle,** balls both wheels, hollow forks, hollow spokes, cradle spring, value £10. Exchange small back-geared Lathe and cash.—50, Watlington street, Reading.

Bicycle, 48in. Special Challenge, roller bearings, horn handles, brake, lamp, &c. Exchange for Electrical Goods or Locomotive, new or second-hand, value £8.—U. S. Abrams, Eltham, Kent.

Sewing Machine (Ward's Universal Feed), cost £12, not much used, in exchange for Microscope or accessories, or Amateur Lathe, Tools, &c., or what offers? Nothing reasonable refused.—H. Dean, Westgate, Canterbury.

Clarionet Wanted, in exchange for Gentleman's Silver Stop Watch and Silver Chain and cash.—Hewson, 12, Great Crown-court, Windmill-street, Haymarket. Offers.

Exchange **Engine,** nearly finished, nearly all brass, 1¾in. by 3in., suit sewing machine, for Engineer's Tools and cash.—Particulars, Shipton, Tutbury Mills, Staffordshire.

Rose-Engine and Lathe, with oval, eccentric, straight-line, and other chucks, overhead motion, eccentric cutter, drilling spindle, and index plate. Cost £100. Offers wanted. Perfect order.—Apply to Jackson, Engineer, Bloxham, Banbury.

Offers wanted for Lockstitch **Sewing Machine,** slightly out of order; "Lathe and its Uses"; Surface Plate, 6 by 7½, perfect, new, in polished box.—Thos. Cox, Engineer, Hargrave, Kimbolton, Hunts.

Anglo-German **Concertina,** screwed steel reeds, farmyard imitations, mahogany box, &c.; also Magic Lantern, 3¼ condensers. Bicycle preferred.—T. L. McCann, Photographer, 49, Greenvale-street, Glasgow.

Magic Lantern, cost £3 10s. a short time ago. Will exchange for small Engine and Boiler, or offers.—B. Newman, Bakewell, Derbyshire.

New Cursed **Tricycle** for exchange. Would take a Lathe, Pipe Screwing Machine, or anything useful.—A. Hughes, Broad-street, Ross, Herefords.

Bicycle, 50in. nickel-plated, ball bearings to both wheels and spring, not been ridden ten miles. Cost £22.—13, Ann-street, Packington-street, Islington.

What offers for B flat **Cornet,** silver-plated, costing about £9. No rubbish.—6, Stanley-road, London, N.

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Magic-Lantern, 3½in. condensers, in case, with lamp and limelight tray; exchange for anything useful.—Howe, Newbury, Berks.

Stereo Camera, with pair of twin lenses; will exchange for anything useful.—Howe, Newbury, Berks.

I will make pair of 3½ **Lathe Heads** for Lancaster's Instantograph or portable photo. apparatus complete.—H. Chambers, 17, Charles-street, Seymour-street, N.W.

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Firework **Apparatus** and Chemicals, comprising rocket spindles, shell mortars, rocket-cases, &c., in exchange for electrical apparatus; list free.—M., 67, Fairfield-road, Bow.

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Cabinet Work for Cameras, Electric Bells, and other purposes of manufacture, good workmanship guaranteed; exchange for camera brasswork, fret-sawing, or other machines, tools, &c.—Reynolds's Cabinet Works, High-street, Haverfordwest.

Musical Box, 12 airs, cost £11, nearly new; 250 cattle fencing bolts, 9in. long, ⅝in. thick; what exchange? mutual approval.—D. Seaman, Wolverhampton.

Magnetic **Exploder,** will fire six charges at once; made by Ladd, London, cost 18 guineas; will exchange for small dynamo, lathe, or anything useful.—Also, one large Barrel Organ, plays 40 tunes; will exchange for anything useful, electric apparatus preferred.—Watson Bell, Guine Warehouse, Whitehaven.

Will exchange 48in. **Bicycle** for 50in., all-bright, splendid roadster.—W. R. Hicks, 34, Christchurch Residences, Lisson-street, Marylebone.

Hand **Sewing-Machine** (Shakspeare's); offered for old table piano in any state; give particulars.—S. Tearall, 2, Tottenham-street, London, W.

Old Table **Piano** Wanted, in any condition; state all particulars; exchange overcoat or hand sewing machine.—S. Tearall, 2, Tottenham-street, London, W.

Azimuth **Compass,** worth £2; Drawing Instruments, Pulvermacher's Battery, for Bantams (Andalusians or Hamburgs).—Burrows, 16, Endell street, Long Acre.

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THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. (List Twopence.)

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Antakos, cures Corns, Warts, and Bunions. A marvellous and unfailing remedy. Numerous testimonials, including one from the Very Rev. Dean Kiernan and Sir Henry Chamberlain. Price 1s. 1½d. per box, of all chemists, or direct from The Antakos Co., Broadclyst, Exeter.

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Peat.—Gaterell and Son's selected for orchids, ferns, greenhouse plants, &c., in large or small quantities. Prices on application.—Address, Bisterne, Ringwood.

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Perfect's "Perfect" **Sensitised Papers,** quire, 10s. 6d.; half quire, 5s. 6d.—22 Glenarm road, Clapton, London.

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Change Ringers should read the "Bell News and Ringers' Record." New Peals every week.—One Penny.

Hand-Bell Ringers will find valuable information in the "Bell News and Ringers' Record."—One Penny.

"The Bell News and Ringers' Record." Every Friday.—Allen, Ave Maria-lane, London, and all Newsagents.

Pyrotechny.—Amateurs studying in the above art can obtain formers, rocket spindles, Roman candle star moulds, charging tools, choking pegs, &c., &c., of F. M. Mayners, 26, Draper-street, Walworth-road, London, Mechanical Tool Maker to Pain, Brock and Co., Wells, &c., &c.

Blackwell's New **Bunsen Battery,** square cells and flat plates, great power at small cost, quart size, 4s. each.—Geo. G. Blackwell.

Senarmontite, beautiful octahedron crystals of Sb_2O_3, very cheap, 6d. each. Also other minerals and crystals.—Geo. G. Blackwell.

Collectors and Dealers can be supplied with Minerals in large or small quantities.—Geo. G. Blackwell, 26, Chapel-street, Liverpool.

Photograph Taken in 100-fold Camera, and particulars, 1d. Apparatus, 21s. upwards.—Pumphrey, Emily-street, Birmingham.

Pimples on the Face (how to cure), Receipt, free, 5d.—A. Rear, The Station, Thetford, Norfolk.

Polariscope Crystals.—Orthonitrophenol, Paranitrophenol, Potassium Platinocyanide, 1s. each; 3 for 2s. 6d.—Fourra, Analyst, Worcester.

10,000 Artistic **Photographs.** Popular celebrities, Actresses, Celebrated Paintings, Antique and Modern Sculpture, Classic Studies for Artists, &c. Unrivalled collection. Packets are sent for selection, post free.—Catalogue and specimens, 6d.—T. Williams and Co., Photographic Publishers (P 124), Bridgnorth. Agents wanted.

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Fretwork Patterns (new designs).—Full size patterns free for selection from "Mechanic," 2, Northbrook-street, Birmingham.

Gas Compressing Hand-lever **Pump,** 2½in. dia. Plunger compress to 300lbs.—C., 29, Oberstein-road, Wandsworth.

"The Phonographic Lecturer" now ready for March. Contains 10,000 words of shorthand for 4d.; post free, 4½d.—F. Pitman, 20, Paternoster-row, E.C.

Lathe, 4in., iron bed, slide-rest, scroll chuck, &c., £9 10s.—Clarabut, Woolston, Southampton.

Oleographs, very choice, large size, 1s. 6d. each, 2s. 6d. a pair. List sent.—R. Norton, Crockherbtown, Cardiff.

Gas Engine, half-horse (new); no water required; guarantee given. Cheap.—Hutchinson, Albion Works, Cleckheaton, Yorkshire.

4in. **Lathes,** Heads, Rest, &c., well finished, 21s. per set. Castings, 7s. 6d. Other sizes.—Walker.

5in. **Jaw Chucks,** £2. Face-plates, Drill Chucks; very good and cheap.—Walker, 6, Hamilton-street, Chester.

Engine (1-horse) **and Boiler,** £9. Slide-rest, 10in., 50s.—79, Dudley-road, West Bromwich.

Ventriloqual Figures in great variety. List on application.—Ed. Le Maar, 28, Coupland street, Manchester.

Peruvian Bitters (from Peruvian Bark).—Cures Indigestion, Debility, Neuralgia, and Biliousness.—Prepared by L. J. Cullingford, 136, Pevensey-road, Eastbourne. Price 1s. 1½d. and 2s. 9d. per bottle.

Magnesium Ribbon, equals the electric light, 6d. per yard, post free.—Mac Lucas, Llanelly.

Gelatino-Bromide Pellicles for preparing dry plates. In packets, to make 5oz. Emulsion, 1s. 6d., post free.—W. Robinson, Jun., 60, Smithdown-road, Liverpool.

Photographs beautifully copied, 2s. dozen. Enlarged and Coloured in Oils, from 2s.—Gibson Kitch, Artist, Bath.

Photographs, Drawings, Plans, &c., Copied, Enlarged or Reduced at very low prices.—Gibson Kitch, Artist, Bath.

Secret Correspondence System, suitable for any secret writings; free, 4d.—A. Rear, The Station, Thetford, Norfolk.

Strong geared Bench **Drilling Machine,** screw feed, £1.—Bencraft, Marcham-le-Fen, Boston.

Lantern Photographs, 50 sets; surplus hire lots, from 3s. per doz.—A. Pumphrey, Emily-street, Birmingham.

Lantern Manipulation for 3 stamps. Gives all requisite instruction for Oil and Lime Light.—A. Pumphrey, Birmingham.

Ethoxo Limelight, one bag only required, 10s. 6d. Sketch and particulars.—A. Pumphrey, Emily-street, Birmingham.

New Series.—Prepared Material for **Microscopic** Mounting. Injected and Stained Pathological and Anatomical Preparations, Series A Z. Six first-class sections illustrating the normal anatomy of the lung, with instructions for mounting, post free, 1s. 1d. Sample, 18 miscellaneous preparations (with instructions), 1s. 1d.—R. Mason, 30, Park-road, Clapham, S.W.

Aniline Dyes, all colours, one shilling per ounce, 2d. postage.—J. Pursson, 34, Mansell-street, E.

Strong 5in. Compound **Slide-Rest,** new, cheap.—S. W. Smith, 4, Salisbury street, Chorley, Lancs.

Photographs, Scottish Scenery, extraordinary value, 7 by 4-inch size, 4d. each.—Address "Photo," 182, Trongate, Glasgow.

Gelatines for tracing magic-lantern slides, 3¼in. size, 4½d. per doz. Sizes.—Address "Photo," 182, Trongate, Glasgow.

Meat Safes, stout perforated zinc, with varnished pine frames; all sizes cheap. Lists post free.—G. E. Newman, Rayne, Essex.

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Juvenile **Tricycle** for 1883, on new plan. Trade supplied. Send for list.—John Brown, Longford, Coventry.

Microscopical Preparations, highly finished; Histological and Pathological, including many rare specimens, 1s. each; 10s. dozen. Botanical Objects, Foraminifera, Polycystinæ, Diatoms, Insects, Zoophytes, &c., 10d. each; 9s. dozen. Boxes and postage extra. List and two samples, free, 2s.—Fairbairn Martin, Clevedon.

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